7902 SCIENTIFIC & TECHNICAL VISUALIZATION II
8007 SCIENTIFIC & TECHNICAL VISUALIZATION II

CURRICULUM GUIDE

SUMMER 2005

Trade & Industrial Education
Technology Education
Career—Technical Education

PUBLIC SCHOOLS OF NORTH CAROLINA State Board of Education | Department of Public Instruction
Career-Technical Education :: Trade & Industrial Education :: Technology Education
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This guide was developed with federal Carl Perkins Act funds.

2005
Career-Technical Education
North Carolina Department of Public Instruction

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FOREWORD

*Scientific & Technical Visualization I and II* are courses focused on the principles, concepts, and use of complex graphic and visualization tools as applied to the study of science and technology. Students use complex 2D graphics, 3D Animation, editing, and image analysis tools to better understand, illustrate, explain, and present technical, mathematical, and/or scientific concepts and principles. Emphasis is placed on the use of computer enhanced images to generate both conceptual and data-driven models, data-driven charts, and animations. Science, math, and visual design concepts are reinforced throughout each course.

This curriculum was developed to help teachers offer a focused, demanding, and exciting program of study addressing the core concepts and principles of scientific visualization. Scientific visualization involves theoretical mathematics, specialized computer programming, and the development of novel solutions to help scientists visualize and comprehend science problems of the highest order. Our goal for this course is to help high school level students gain experience using a multitude of computer graphic software, develop problem solving skills, become independent learners, and acquire the intellectual confidence required to help them be successful with their post-secondary education.

It is our goal to provide the students of our state an education of the highest quality. As this guide reflects our goals of continuous improvement, we encourage you to communicate to us ways to improve the material within the publication. Your suggestions will be welcomed and appreciated.
## TABLE OF CONTENTS
### Scientific & Technical Visualization II

### SECTION I

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>ii</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>v</td>
</tr>
<tr>
<td>Using the Curriculum Materials</td>
<td>vii</td>
</tr>
<tr>
<td>Course Blueprint</td>
<td>x</td>
</tr>
</tbody>
</table>

### SECTION II – UNITS OF INSTRUCTION

#### Unit A: Leadership Development

<table>
<thead>
<tr>
<th>V201.01</th>
<th>Explain how to deliver an extemporaneous technical presentation.</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>V201.02</td>
<td>Prepare and deliver an extemporaneous technical presentation.</td>
<td>2</td>
</tr>
<tr>
<td>V201.03</td>
<td>Complete a letter of application, a job application, and a job interview.</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Unit B: Advanced Tools of Visualization

<table>
<thead>
<tr>
<th>V202.01</th>
<th>Explain how computers store information.</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>V202.02</td>
<td>Explain how to apply pixel values to digital images.</td>
<td>13</td>
</tr>
<tr>
<td>V202.03</td>
<td>Apply pixel values to digital images.</td>
<td>18</td>
</tr>
<tr>
<td>V202.04</td>
<td>Identify trends in scientific and technical visualization tools.</td>
<td>20</td>
</tr>
</tbody>
</table>

#### Unit C: Advanced Principles of Visualization

<table>
<thead>
<tr>
<th>V203.01</th>
<th>Recognize advanced 2D design concepts.</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>V203.02</td>
<td>Describe advanced imaging techniques.</td>
<td>25</td>
</tr>
<tr>
<td>V203.03</td>
<td>Explain advanced presentation techniques.</td>
<td>28</td>
</tr>
<tr>
<td>V203.04</td>
<td>Demonstrate advanced presentation techniques.</td>
<td>31</td>
</tr>
<tr>
<td>V203.05</td>
<td>Summarize basic Web page design.</td>
<td>35</td>
</tr>
<tr>
<td>V203.06</td>
<td>Demonstrate basic Web page design.</td>
<td>39</td>
</tr>
</tbody>
</table>

#### Unit D: Advanced Static and Dynamic Visualization

<table>
<thead>
<tr>
<th>V204.01</th>
<th>Explain advanced 3D modeling.</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>V204.02</td>
<td>Explain advanced animation techniques.</td>
<td>51</td>
</tr>
<tr>
<td>V204.03</td>
<td>Explain video-editing techniques.</td>
<td>58</td>
</tr>
</tbody>
</table>

<p>| V204.04 | Demonstrate advanced video-editing techniques. | 62 |</p>
<table>
<thead>
<tr>
<th>V204.04</th>
<th>Demonstrate video-editing.</th>
<th>67</th>
</tr>
</thead>
</table>

**Unit E: Advanced Scientific Visualization** | 69 |
| V205.01 | Recognize cell and their parts. | 70 |
| V205.02 | Students will create a visualization of the cell and its parts. | 74 |
| V205.03 | Recognize plate tectonics. | 78 |
| V205.04 | Students will create a visualization of plate tectonics. | 82 |
| V205.05 | Describe DNA and gel electrophoreses | 85 |
| V205.06 | Students will create a visualization of DNA and gel electrophoreses. | 92 |
| V205.07 | Recognize different simple machines. | 96 |
| V205.08 | Students will create a visualization of simple machines. | 98 |
| V205.09 | Students will create an advanced animation. | 107 |

**Unit F: Preparation for the Future** | 109 |
| V206.01 | Identify different types of portfolios. | 110 |
| V206.02 | Synthesize an electronic portfolio. | 112 |

**SECTION III – APPENDICES**

<table>
<thead>
<tr>
<th>A. Scion Tutorial</th>
<th>113</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Adobe Premiere Video Editing Tutorial</td>
<td>156</td>
</tr>
<tr>
<td>C. Understanding Common Rendering Algorithms</td>
<td>172</td>
</tr>
<tr>
<td>D. Understanding Ray Tracing and Radiosity</td>
<td>173</td>
</tr>
<tr>
<td>E. Sample Modeling and Animation Project for the Advanced Student</td>
<td>175</td>
</tr>
<tr>
<td>F. Largest Earthquakes in Contiguous United States</td>
<td>178</td>
</tr>
<tr>
<td>G. References</td>
<td>179</td>
</tr>
<tr>
<td>H. Vendor’s Addresses</td>
<td>180</td>
</tr>
<tr>
<td>I. Equipment</td>
<td>181</td>
</tr>
<tr>
<td>J. Evaluation Form</td>
<td>183</td>
</tr>
<tr>
<td>K. Terms and Definitions</td>
<td>184</td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENTS

The Division of Instructional and Accountability Services and the Trade and Industrial Education staff wish to give special thanks to the individuals who spent many hours revising the Scientific & Technical Visualization II curriculum and test-item bank. The process included a review of national literature, the Internet, visualization software, a review of suggestions offered by NC State University professors, instructors, teachers and administrators throughout the state, a dialog with the Scientific Visualization professors at Georgia Tech University, and many hours spent in constructive debate and discussion at the NC Department of Public Instruction.

Starting with a review of the previous Scientific & Technical Visualization blueprints, curriculum guides and test-item banks, and guided by suggestions from the field and national standards, the team created a new scope and sequence for Scientific & Technical Visualization I and II. The current team developed and wrote new blueprints, curriculum guides (containing references, resources, equipment lists, and curriculum vendor names and addresses) and test-item banks.

The following individuals developed the Winter 2005 Scientific & Technical Visualization II blueprint, curriculum guide and classroom test-item bank:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gilbert Blaylock</td>
<td>Drafting/SciVis Teacher</td>
<td>North Vance High School</td>
</tr>
<tr>
<td>Kayleme Brummet</td>
<td>English Teacher</td>
<td>Page High School</td>
</tr>
<tr>
<td>Beverly Cea</td>
<td>Science/SciVis Teacher</td>
<td>Guilford Early College</td>
</tr>
<tr>
<td>Shannon Goff</td>
<td>Consultant</td>
<td>NC-DPI</td>
</tr>
<tr>
<td>Phyllis Jones</td>
<td>Science/SciVis Teacher</td>
<td>Page High School</td>
</tr>
<tr>
<td>Roy Kimmins</td>
<td>SciVis Teacher</td>
<td>Philip J. Weaver Education Center</td>
</tr>
<tr>
<td>Rick Lacek</td>
<td>SciVis Teacher</td>
<td>South Mecklenburg High School</td>
</tr>
</tbody>
</table>

Previous teams include the following people:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rebecca Bowen</td>
<td>Science Teacher</td>
<td>Guilford Early College</td>
</tr>
<tr>
<td>Beverly Cea</td>
<td>Science/SciVis Teacher</td>
<td>Broughton High School</td>
</tr>
<tr>
<td>Nancy Daughty</td>
<td>Drafting/SciVis Teacher</td>
<td>Page High School</td>
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<tr>
<td>Phyllis Jones</td>
<td>Science/SciVis Teacher</td>
<td>Eastern Guilford High School</td>
</tr>
<tr>
<td>Roy Kimmins</td>
<td>SciVis Teacher</td>
<td>SE Raleigh High School</td>
</tr>
<tr>
<td>John Geraghty</td>
<td>Drafting/SciVis Teacher</td>
<td>NW Guilford High School</td>
</tr>
<tr>
<td>Chris Griggs</td>
<td>Science/SciVis Teacher</td>
<td>Wake Tech Comm. College</td>
</tr>
<tr>
<td>Butch Grove</td>
<td>SciVis Chair</td>
<td>NCSU</td>
</tr>
<tr>
<td>Eric Wiebe</td>
<td>Assistant Professor</td>
<td>NCSU</td>
</tr>
<tr>
<td>Aaron Clark</td>
<td>Assistant Professor</td>
<td>NCSU</td>
</tr>
<tr>
<td>Eleanor Hasse</td>
<td>Research Coordinator</td>
<td>NCSU</td>
</tr>
<tr>
<td>Brian Matthews</td>
<td>Lecturer</td>
<td>NCSU</td>
</tr>
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</table>
Special thanks are given to the teachers, directors, and others such as Drs. Aaron Clark and Eric Wiebe of NC State University who have taken their time to offer continual support and guidance and Kaylene Brummett of Page High School for her editorial assistance. Our work is better for their effort.

Tom Shown  Consultant, Trade and Industrial Education, NCDPI

Rebecca Payne  Section Chief, Industrial Technology and Human Services, NCDPI

Wandra Polk  Director of Secondary Education, NCDPI
USING THE CURRICULUM MATERIALS

Purpose
The Scientific and Technical Visualization I curriculum guide has been developed as a resource for teachers to use in planning and implementing a competency-based instructional program for scientific & technical visualization in their schools. This guide was developed by a committee of North Carolina high school teachers of varying backgrounds who all have had numerous years of teaching SciVis.

Description
The Scientific and Technical Visualization I and II curriculums have been designed to be 135 to 180 instructional hours in length.

This course focuses on the principles, concepts, and use of complex graphic tools to visually explain scientific and/or technical concepts. Emphasis is placed on using computer software and hardware to enhance or generate data driven charts and graphs, 2D graphics, 3D graphics, and animations. It is the intent of this course to teach computer graphics skills and also to reinforce math, science, and visual design.

General Instruction
This course may be taught using individualized, whole class, or a combination of each strategy. Regardless of which method is used, it is essential that the activities reflect the competencies and objectives of the course.

These courses demand much from the student and the teacher in terms of its complexity of materials and the brevity of time in which the materials are to be mastered. Because of time limitations and the amount of material to be covered, one should not teach objectives as discrete units of instruction. Objectives must be taught concurrently within the larger context of an activity.

Since Scientific and Technical Visualization I and II are activity-centered curriculums with competencies and objectives to be mastered, it is important that the teacher use activities that collectively address all of the course objectives. Performance-based instruction and learning with the teacher as the facilitator of instruction rather than being the center of instruction is the intended method for teaching.

Blueprint
The blueprint (see the following pages) lists the competencies the student must attain. Competencies are mastered when a student masters the objectives, which make up the competency.

The suggested time in hours is offered as a general guide for teachers to use in planning. Course weight is the degree of importance given to each objective and is used to determine the number of test-items per objective on any test developed by the state department.
Units of Instruction

The Units of Instruction are designed to give the teacher detailed information directly correlated to the blueprint and test-item bank. It explains in detail what information the student is expected to know or do. This section also offers suggested activities and some ideas about how to evaluate them. It is important to recognize that unit sequencing does not necessarily imply sequence of instruction. Using information from a variety of competencies and objectives are used when it is pedagogically sound.

Leadership Development Unit

Objective 1.01 covers the formal procedures for making an extemporaneous and technical presentation. Objective 1.02 prepares students to make an extemporaneous and technical presentation. Objective 1.03 covers the proper methods for completing a letter of application, a job application and the protocol for job interview. All of this information in this unit was provide exclusively by the Department of Public Instruction.

Advanced Tools of Visualization

Objective 2.01 reviews how the computer stores information. Objective 2.02 teaches students the purpose for applying pixel values to digital images. Objective 2.03 provides an activity to show students how to apply pixel values to digital images. A rubric is included for performance assessment. Objective 2.04 helps students recognize trend for using scientific and technical visualization tools.

Advanced Principles of Visualization

Objective 3.01 teaches students to recognize basic advanced 2D design techniques. Objective 3.02 describes advanced imaging techniques. Objective 3.03 explains the use of advanced presentation techniques. Objective 3.04 provides a performance activity for students to demonstrate advanced presentation techniques. A rubric is included for performance assessment. Objective 3.05 summarizes the basic concepts of web page design using html code. Objective 3.06 is a performance activity used to assess the students’ ability to produce a web page design. A rubric is included for performance assessment.

Advanced Static and Dynamic Visualization

Objective 4.01 explains the advanced 3D modeling techniques and objective 4.02 explains the advanced animation techniques. After an advanced 3D modeling and animation activity, objective 4.03 will present information for the use of video-editing techniques. Objective 4.04 is the performance activity required for students to demonstrate advanced 3D modeling and animation. A rubric is included for performance assessment.

Advanced Data Visualization

The following objectives are designed to reinforce scientific concepts and the use of complex software to generate advanced concept and data driven visualizations.

Objective 5.01 evaluates students’ ability to recognize cells and their parts. Objective 5.02 is a performance activity requiring students to create an advanced visualization of the cell and its parts. Objective 5.03 shows students how to recognize the plate tectonics of the earth’s surface. Objective 5.04 will require students to create an advanced visualization of plate tectonics. Objective 5.05 will provide information for understanding the concepts of DNA and gel
electrophoresis. Objective 5.06 will require students to produce a visualization of DNA and gel electrophoresis. Objective 5.05 provides topical information on the different types of simple machines. Objective 5.08 requires students to produce an advanced visualization of simple machines. Rubrics are included for each performance assessment.

**Preparation for the Future**

Objective 6.01 will bring closure to the advanced level of Scientific and Technical Visualization. Students will recognize the different types of portfolios, and objective 6.02 will require students to synthesize and produce an electronic portfolio. A rubric is included for performance assessment.

**Scion Tutorial (Appendix A)**

**Video Editing Tutorial - Adobe Premiere (Appendix B)**

**Understanding Common Rendering Algorithms (Appendix C)**

**Understanding Ray Tracing and Radiosity (Appendix D)**

**Sample Modeling and Animation Project for the Advanced Student (Appendix E)**

**Bibliography/References (Appendix F)**

This section provides the texts’ author(s), name of the texts, and publishers of the texts listed within the Units of Instruction section.

**Vendors’ Addresses for Software (Appendix G)**

We have included a partial listing of where and who to contact for obtaining texts, literature, software, and videos.

**Equipment (Appendix H)**

The equipment list (updated as of this printing, June 2005), gives the minimum number of tools, equipment, and software necessary for the instruction of Drafting – Engineering II.

**Curriculum Products Evaluation Form (Appendix I)**

Included in this guide is an evaluation form. We sincerely want your thoughtful suggestions for improving the curriculum products. Many of the improvements within this guide and the test-item bank is the result of teachers who have taken the time to make suggestions for improvement. Please take the time to respond to us on ways to improve our work.

**Terms and Definitions (Appendix J)**

This section provides a quick reference for the majority of terms in the curriculum guide and banks.
VoCATS
Course Blueprint

Trade and Industrial Education
7902 Scientific & Technical Visualization II

Technology Education
8007 Scientific & Technical Visualization II

Special thanks to the following educators and business people who reviewed and approved this blueprint for technical content and appropriateness for the industry.

Gilbert Blaylock – North Vance High School
Beverly Cea – Guilford Early College
Phyllis Jones – Page High School
Roy Kimmins – Philip J. Weaver Education Center
Rick Lacek – South Mecklenburg High School

This blueprint has been reviewed by business and industry representatives for technical content and appropriateness for the industry. Contact tshawn@dpi.state.nc.us for more information.
VoCATS Course Blueprint

A course blueprint is a document laying out the framework of the curriculum for a given course.

Shown on the blueprint are the units of instruction, the core competencies in each unit, and the specific objectives for each competency. The blueprint illustrates the recommended sequence of units and competencies and the cognitive and performance weight of the objective within the course.

The blueprint should be used by teachers to plan the course of work for the year, prepare daily lesson plans, construct instructionally valid interim assessments. Statewide assessments are aligned directly with the course blueprint.

For additional information about this blueprint, contact program area staff. For additional information about VoCATS, contact program area staff or VoCATS, Career-Technical Education, Division of Instructional Services, North Carolina Department of Public Instruction, 301 North Wilmington Street, Raleigh, North Carolina 27601-2825, 919/807-3876, email: rwelfare@dpi.state.nc.us.

Interpretation of Columns on VoCATS Course Blueprints

<table>
<thead>
<tr>
<th>No.</th>
<th>Heading</th>
<th>Column information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Comp# Obj#</td>
<td>Comp=Competency number (two digits); Obj.=Objective number (unique course identifier plus competency number and two-digit objective number).</td>
</tr>
<tr>
<td>2</td>
<td>Unit Titles/Competency and Objective Statements</td>
<td>Statements of unit titles, competencies per unit, and specific objectives per competency. Each competency statement or specific objective begins with an action verb and makes a complete sentence when combined with the stem “The learner will be able to. . .” (The stem appears once in Column 2.) Outcome behavior in each competency/objective statement is denoted by the verb plus its object.</td>
</tr>
<tr>
<td>3</td>
<td>Time Hrs</td>
<td>Space for teachers to calculate time to be spent on each objective based on the course blueprint, their individual school schedule, and analysis of students’ previous knowledge on the topic.</td>
</tr>
<tr>
<td>4&amp;5</td>
<td>Course Weight</td>
<td>Shows the relative importance of each objective, competency, and unit. Weight is broken down into two components: cognitive and performance. Add the cognitive and performance weights shown for an objective in columns 4 and 5 to determine its total course weight. Course weight is used to help determine the percentage of total class time that is spent on each objective. The breakdown in columns 4 and 5 indicates the relative amount of class time that should be devoted to cognitive and performance activities as part of the instruction and assessment of each objective. Objectives with performance weight should include performance activities as part of instruction and/or assessment.</td>
</tr>
<tr>
<td>6</td>
<td>Type Behavior</td>
<td>Classification of outcome behavior in competency and objective statements. (C=Cognitive; P=Performance)</td>
</tr>
<tr>
<td>7</td>
<td>Integrated Skill Area</td>
<td>Shows links to other academic areas. Integrated skills codes: A=Arts; E=English Language Arts; CD=Career Development; CS=Information/Computer Skills; H=Healthful Living; M=Math; SC=Science; SS=Social Studies.</td>
</tr>
<tr>
<td>8</td>
<td>Core Supp</td>
<td>Designation of the competencies and objectives as Core or Supplemental. Competencies and objectives designated “Core” must be included in the Annual Planning Calendar and are assessed on the statewide assessments.</td>
</tr>
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</table>

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# TRADE AND INDUSTRIAL EDUCATION

## COURSE BLUEPRINT FOR 7902-Scientific and Technical Visualization II

[Recommended hours of instruction: 135-180]

<table>
<thead>
<tr>
<th>Comp #</th>
<th>Obj #</th>
<th>Unit Titles / Competency and Objective Statements</th>
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<th>Cognitive Weight</th>
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<th>Integrated Skill Area</th>
<th>Core Supp</th>
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<tr>
<td></td>
<td></td>
<td>(The learner will be able to:)</td>
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<td>100%</td>
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<td></td>
<td></td>
<td></td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### A LEADERSHIP DEVELOPMENT

**V201. Explain oral communication and job seeking skills.**

- **V201.01 Describe how to deliver an extemporaneous technical presentation.**
  - 1% Cognitive
  - 2% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V201.02 Prepare an extemporaneous technical presentation.**
  - 2% Cognitive
  - 2% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V201.03 Specify how to complete a letter of application, a job application, and a job interview.**
  - 1% Cognitive
  - 2% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

### B ADVANCED TOOLS OF VISUALIZATION

**V202. Apply advanced tools of visualization.**

- **V202.01 Describe how computers store information.**
  - 2% Cognitive
  - 2% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V202.02 Define how to apply pixel values to digital images.**
  - 2% Cognitive
  - 2% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V202.03 Apply pixel values to digital images.**
  - 6% Cognitive
  - 2% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V202.04 Identify trends in scientific & technical visualization tools.**
  - 1% Cognitive
  - 2% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

### C ADVANCED PRINCIPLES OF VISUALIZATION

**V203. Demonstrate advanced principles of visualization.**

- **V203.01 Recognize advanced 2D design concepts.**
  - 3% Cognitive
  - 3% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V203.02 Describe advanced imaging techniques.**
  - 3% Cognitive
  - 3% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V203.03 Identify advanced presentation techniques.**
  - 2% Cognitive
  - 2% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V203.04 Demonstrate advanced presentation techniques.**
  - 4% Cognitive
  - 4% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V203.05 Identify basic web page design.**
  - 4% Cognitive
  - 4% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V203.06 Demonstrate basic web page design.**
  - 4% Cognitive
  - 4% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

### D ADVANCED STATIC AND DYNAMIC VISUALIZATION

**V204. Demonstrate advanced visualization processes.**

- **V204.01 Summarize advanced 3D modeling.**
  - 12% Cognitive
  - 3% Performance
  - C2 Behavior
  - A/CS/SC
  - Core

- **V204.02 Interpret advanced animation techniques.**
  - 4% Cognitive
  - 4% Performance
  - C2 Behavior
  - A/CS/SC
  - Core

- **V204.03 Describe video-editing techniques.**
  - 5% Cognitive
  - 5% Performance
  - C1 Behavior
  - A/CS/SC
  - Core

- **V204.04 Demonstrate video-editing techniques.**
  - 3% Cognitive
  - 3% Performance
  - C1 Behavior
  - A/CS/SC
  - Core
## TRADE AND INDUSTRIAL EDUCATION
### COURSE BLUEPRINT FOR 7902-Scientific and Technical Visualization II

[Recommended hours of instruction: 135-180]

<table>
<thead>
<tr>
<th>E</th>
<th>ADVANCED SCIENTIFIC VISUALIZATION</th>
<th>8%</th>
<th>29%</th>
<th>CP3</th>
<th>A/CS/M/SC</th>
<th>Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>V205.01</td>
<td>Recognize cells and their parts.</td>
<td>2%</td>
<td>29%</td>
<td>C1</td>
<td>SC</td>
<td>Core</td>
</tr>
<tr>
<td>V205.02</td>
<td>Create a visualization of the cell and its parts.</td>
<td>4%</td>
<td>29%</td>
<td>CP3</td>
<td>A/CS/SC</td>
<td>Core</td>
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<tr>
<td>V205.03</td>
<td>Recognize plate tectonics.</td>
<td>2%</td>
<td>29%</td>
<td>C1</td>
<td>SC</td>
<td>Core</td>
</tr>
<tr>
<td>V205.04</td>
<td>Create a visualization of plate tectonics.</td>
<td>4%</td>
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<td>CP3</td>
<td>A/CS/SC</td>
<td>Core</td>
</tr>
<tr>
<td>V205.05</td>
<td>Describe DNA and gel electrophoresis.</td>
<td>2%</td>
<td>29%</td>
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<td>SC</td>
<td>Core</td>
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<tr>
<td>V205.06</td>
<td>Create a visualization of DNA and gel electrophoresis.</td>
<td>6%</td>
<td>29%</td>
<td>CP3</td>
<td>A/CS/SC</td>
<td>Core</td>
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<tr>
<td>V205.07</td>
<td>Explain different simple machines.</td>
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<td>29%</td>
<td>C2</td>
<td>M/SC</td>
<td>Core</td>
</tr>
<tr>
<td>V205.08</td>
<td>Create a visualization of simple machines.</td>
<td>7%</td>
<td>29%</td>
<td>CP3</td>
<td>A/CS/M/SC</td>
<td>Core</td>
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<tr>
<td>V205.09</td>
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<td>7%</td>
<td>29%</td>
<td>CP3</td>
<td>A/CS/M/SC</td>
<td>Core</td>
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<th>F</th>
<th>PREPERATION FOR THE FUTURE</th>
<th>2%</th>
<th>2%</th>
<th>CP3</th>
<th>A/CD/CS</th>
<th>Core</th>
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<tbody>
<tr>
<td>V206.01</td>
<td>Summarize different types of portfolios.</td>
<td>2%</td>
<td>2%</td>
<td>C2</td>
<td>CD</td>
<td>Core</td>
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<tr>
<td>V206.02</td>
<td>Synthesize an electronic portfolio.</td>
<td>2%</td>
<td>2%</td>
<td>CP3</td>
<td>A/CD/CS</td>
<td>Core</td>
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Leadership Development

V201.
Demonstrate oral communication and job seeking skills.

V201.01
Explain how to deliver an extemporaneous technical presentation.

V201.02
Deliver an extemporaneous technical presentation.

V201.03
Explain how to complete a letter of application, a job application, and a job interview.
UNIT A: Leadership Development

COMPETENCY: V201.
Demonstrate oral communication and job seeking skills.

OBJECTIVE: V201.01
Explain how to deliver an extemporaneous technical presentation.

Introduction: The purpose of this unit is to introduce students to the correct method of giving an extemporaneous technical presentation.

A. Decide quickly on your topic or ideas you will cover. Many times, other ideas may come to you after you start speaking. Use an introduction to get the speech going. Humor may be used in the introduction. Reasons for a good introduction are to:

1. Get the audience’s attention;
2. Introduce your topic;
3. Show the importance of your topic;
4. Present your facts; and
5. Forecast your main ideas.

B. Do not try and memorize what you will say - Trying to memorize will only make you nervous, and you will find yourself thinking about the words and not about the message. Use non-verbal communication. Step forward after the introduction. Take a few steps when you start a new point. Remember to use hand gestures. Do not put your hands in your pockets.

C. Start off with a strong opening idea with confidence. Then try and organize your ideas in your head. If you know you have three points or ideas to say, just start off simple by saying, "I would just like to talk about 3 points." The first point is... the second point is... and so on.

D. Decide on your transitions from one idea to the next. If you have more than one point to make, you can use a natural transition such as, "My second point is... or my next point is..."

E. Maintain eye contact with the audience. Look down at your next idea or thought and then regain eye contact with your audience.

F. Speak clearly and with good volume. Be articulate.

G. Remember the element of time is important in a speech.

H. Finally, have a good conclusion. You can summarize your basic points if needed. Reasons for a conclusion are to:

1. Inform the audience you are about to close;
2. Summarize and recap your major ideas; and
3. Leave your audience with specific ideas about your topic.

I. Remember these points.

• Do not have chewing gum.
• Stand up straight.
• Use visual aids and examples.
• Make sure the points support the goal and purpose of the speech.

J. There are six organizational forms for a speech.

1. Topical -- Most common organizational pattern, which can present more than one topic in an ordered fashion. Useful for informative and entertaining speeches.

2. Chronological -- Uses a time sequence for the framework of the speech. It can also be used for informative and persuasive speeches, both of which require background information.

3. Spatial -- Organizes material according to physical space. It can be used for informative and entertaining physical space topics.

4. Classification -- Puts items into categories in a speech.

5. Problem/Solution -- Uses the first part of the speech to present the problem and the second part to present the solution. Can also be used for persuasive speeches.

6. Cause/Effect -- Uses the first part of the speech to outline the cause and the second to describe the effect, and finally the last part to describe a possible solution.
UNIT A: Leadership Development

COMPETENCY: V201.
Demonstrate oral communication and job seeking skills.

OBJECTIVE: V201.02
Deliver an extemporaneous technical presentation.

Introduction: The purpose of this unit is to allow students to practice delivering extemporaneous technical presentations. This activity should take about 2 days.

Materials:
- Research media such as the Internet
- Materials for visuals

Requirements:
1. Students should work independently.
2. Assign different scientific topics and/or speech types to the students.
3. Have students research (no more than ½ to 1 day researching topic) or provide articles on each topic.
4. Allow students time to gather their thoughts and prepare quick visuals.
5. Have students present their topics in a 3-5 minute speech.

Assessment:
- Correct use of time: 10 points
- Introduction and conclusion: 20 points
- Eye contact and positive body language: 10 points
- Coverage/accuracy of the material: 30 points
- Voice tone and transitions: 20 points

Total: 100 points
**Rubric:**

**Correct Use of time**

<table>
<thead>
<tr>
<th>Speech was 31 or more seconds too short or two long.</th>
<th>Speech was 5-30 seconds too short or two long.</th>
<th>Speech fell into the allotted 3-5 minute time frame.</th>
<th>Total Points</th>
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<tbody>
<tr>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
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<table>
<thead>
<tr>
<th>Introduction and conclusion</th>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>The speech had no introduction and/or conclusion.</td>
<td>The speech had a weak introduction and conclusion.</td>
<td>The speech had an acceptable introduction and conclusion.</td>
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<tr>
<td>0-13 points</td>
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<tr>
<th>Eye contact and positive body language</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>The student did not maintain eye contact with the audience and read from notes. The body language was not always open or positive to the speech.</td>
<td>The student at times did not maintain eye contact with the audience and read from notes. The body language was not always open or added a positive note to the speech.</td>
<td>The student maintained eye contact with the audience and did not read from notes. The body language was open and added a positive note to the speech.</td>
<td></td>
</tr>
<tr>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
<td></td>
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<table>
<thead>
<tr>
<th>Coverage/accuracy of the material</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>The material for the speech was not complete, not organized, and did not follow a logical pattern. The information was not accurate and informative.</td>
<td>The material for the speech was somewhat complete, somewhat organized, and followed a somewhat logical pattern. The information was mostly accurate and informative.</td>
<td>The material for the speech was complete, organized, and followed a logical pattern. The information was accurate and informative.</td>
<td></td>
</tr>
<tr>
<td>0-25 points</td>
<td>26-39 points</td>
<td>40 points</td>
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</table>

<table>
<thead>
<tr>
<th>Voice tone and transitions</th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Voice used on the speech was monotone. Inflections were not used at the correct times. Transitions were not used at the correct spot in the speech.</td>
<td>Voice used on the speech was somewhat varied. Inflections were mostly used at the correct times. Transitions were use mostly at the correct spot in the speech.</td>
<td>Voice used on the speech was varied and not monotone. Inflections were used at the correct times. Transitions were used at the correct spot in the speech.</td>
<td></td>
</tr>
<tr>
<td>0-13 points</td>
<td>13-19 points</td>
<td>20 points</td>
<td></td>
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UNIT A: Leadership Development

COMPETENCY: V201.
Demonstrate oral communication and job seeking skills.

OBJECTIVE: V201.03
Explain how to complete a letter of application, a job application, and a job interview.

Introduction: The purpose of this unit is to introduce students to developing techniques used in obtaining a job.

A. Complete a letter of application for a job.
   1. The letter should be one page in length, usually 3-4 paragraphs long.
   2. The letter should be formatted using full block or modified block format. (Template can be used).
   3. The letter should readable, using 12-point type.
   4. The letter should express your interest and qualifications for the job to which you are applying. It should reflect what is in your resume.
   5. Use an introductory paragraph that indicates what job you are applying for and any special credentials you may have.
   6. In the next two paragraphs, highlight your academic degrees and work experience. Tell the employer about any special qualifications.
   7. In closing, indicate that you are interested in being contacted for an interview. Tell when and how you may be contacted. Express your enthusiasm for this opportunity.

B. Complete a job application.
   1. Be sure the application is complete and correct.
   2. Contact any references so they will be prepared to reply to any questions asked by the prospective employer.

C. Complete a job resume and electronic portfolio.
   1. The resume may be a hard copy or on a CD. If the resume is electronic, make sure the format is compatible with most computers. The electronic portfolio may be in the form of a presentation.
   2. In the resume be sure to include the following: Personal Information, Career Objective, Education, Work Experience, Honors and Activities, Special Skills, and References.

D. Complete a job interview.
   1. Research the company beforehand and memorize important facts.
   2. Arrive early but not more than 15 minutes.
   3. Make a good impression. Dress neatly, appropriately and conservatively. Do not dress trendy or outlandish. Do not wear a lot of perfume or cologne.
   4. Be enthusiastic and demonstrate a good attitude.
5. Stand up straight and use proper posture. Use eye contact.
6. Be brief and accurate with answers. Try to avoid one-word answers.
7. Do not criticize past employers.
8. Prepare a resume and work samples to give the prospective employer. Have a list of references with addresses and phone numbers.
9. Send a thank-you letter afterwards.
Advanced Tools of Visualization

V202.
Apply advanced tools of visualization.

V202.01
Describe how computers store information.

V202.02
Explain how to apply pixel values to digital images.

V202.03
Apply pixel values to digital images.

V202.04
Identify trends in scientific & technical visualization tools.

Student image in 3D StudioMax
UNIT B: Advanced Tools of Visualization

Apply advanced tools of visualization.

OBJECTIVE: V202.01  
Describe how computers store information.

Introduction: The purpose of this unit is to introduce students to the bit and byte, and how a CD can store information.

A. Bits -- Computers operate using the “base-2” number system, also known as the binary number system. We use binary numbers because it is easier to implement with current electronic technology.
   1. The word bit is short for the words “Binary digit.”
   2. Bits have only two possible values: 0 and 1. Therefore, a binary number is composed of only 0s and 1s like this: 1011.

B. Bytes
   1. Bits are rarely seen alone in computers. They are almost always bundled together into 8 bit collections called bytes. Why are there 8 bits in a byte? A similar question is, “Why are there 12 eggs in a dozen?” The eight-bit byte is something that was settled on through trial and error over the past 50 years.
   2. With 8 bits in a byte ($2^8$), you can represent 256 values ranging from 0 to 255.
   3. You need 8 bits of information to allow enough combinations just to cover the keys on the keyboard
   4. When you start talking about lots of bytes, you get into prefixes like Kilo, Mega and Giga. In decimal systems, kilo stands for 1,000, but in the binary system, a kilo is 1024 ($2^{10}$) to the 10th power. Technically, a kilobyte is 1024 bytes, but it is often used loosely as a synonym for 1000. For example, a computer that has 256K memory can store approximately 256,000 bytes.

\[
\begin{align*}
\text{Kilo} & \quad \text{K} & \quad 2^{10} = 1,024 & \quad \text{thousand} \\
\text{Mega} & \quad \text{M} & \quad 2^{20} = 1,048,576 & \quad \text{million} \\
\text{Giga} & \quad \text{G} & \quad 2^{30} = 1,073,741,824 & \quad \text{billion} \\
\text{Tera} & \quad \text{T} & \quad 2^{40} = 1,099,511,627,776 & \quad \text{trillion} \\
\text{Peta} & \quad \text{P} & \quad 2^{50} = 1,125,899,906,842,624 & \\
\text{Exa} & \quad \text{E} & \quad 2^{60} = 1,152,921,504,606,846,976 & \\
\end{align*}
\]

C. Conversions
   1. To convert bytes to kilobytes, divide the bytes by 1000.
   2. To convert kilobytes to megabytes, divide the kilobytes by 1000.
   3. To convert megabytes to kilobytes, multiply the megabytes by 1000.
D. Hard Disk Drives and data storage

1. The hard drive is where all of your programs and data are stored. The hard drive is the most important of the various locations of permanent storage. The hard drive differs from others primarily storage in three ways: size (usually larger), speed (usually faster) and permanence (usually fixed in the PC and not removable.)

2. The hard drive plays a significant role in the following important aspects of the computer system:

   a. Performance -- the speed at which the PC boots up and programs load is directly related to hard disk speed. The hard disk’s speed is also critical when multitasking or when processing large amounts of data such as graphics work, sound and video editing, or databases work.

   b. Storage Capacity -- A bigger hard drive lets you store more programs and data. The storage capacity is extremely important when doing graphics and sound work as these mediums use tremendous amounts of storage.

   c. Software Support -- Newer software needs more space and faster hard disks to load efficiently.

E. Platters

1. A platter is a round magnetic plate that constitutes part of a hard disk. Hard disks typically contain up to a dozen platters. Most platters require two read/write heads, one for each side of the platter. When the platters are not spinning, the heads rub along the surface of the platters until sufficient speed is gained for them to “lift off” and float on a cushion of air.

2. While the platters and heads are designed with the knowledge that this contact will occur, it still makes sense to avoid having this contact happen over an area of the disk where data is stored. For this reason, most disks set aside a special track that is designated to be where the heads will be placed for takeoffs and landings.

   a. Appropriately, this area is called the landing zone, and no data is placed there. The process of moving the heads to this designated area is called head parking. By having these zones, the head does not touch the disk where data is stored and thus prevents a loss of information.
b. “Crashing” -- A crash can also occur if even the smallest bit of dust makes its way onto the platter, the flight is disrupted and the head “crashes” into the platter, scratching it. The platters are stored in sealed containers to prevent dust from entering. A crash also can occur by bumping or moving the unit while it is running.

c. The platters typically spin at 3,600 to 7,200 rpm when the drive is operating. The arm that holds the read/write heads is controlled by the mechanism shown in the upper-left corner in the graphic above, which moves the heads from the hub to the edge of the drive. The arm on a typical hard-disk drive can move from hub to edge and back up to 50 times per second. The purpose of the read/write heads is to align the magnetic fields of the particles on the platters’ surfaces; the heads read data by detecting the polarities of particles that have already been aligned.

d. The number of platters and the composition of the magnetic material coating them determine the capacity of the drive. Today’s platters, typically, are coated with an alloy that is about three millionths of an inch thick.

F. Tracks are concentric circles on the surface of a disk where data can be written. A typical floppy disk has 80 (double-density) or 160 (high-density) tracks.

G. Sectors are pie-shaped wedges on a track (dark area of illustration.) A sector is the smallest unit of space on the hard disk that any software can access. A sector contains a fixed number of bytes (i.e. 512).

H. Clusters or blocks are made up of two or more sectors. Occasionally, the operating system marks a cluster as being used even though it is not assigned to any file. This is called a lost cluster.

I. Disk Defragging is a process where data is relocated so that it can be accessed more quickly thus speeding up programs. This process is timely and should be performed over night or when time allows.

J. RAM and ROM

1. RAM is an acronym for “random access memory”, a type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the
preceding bytes. RAM is the most common type of memory found in computers and other devices, such as printers.

2. RAM is volatile, meaning that it loses its contents when the power is turned off. In common usage, the term RAM is synonymous with main memory, the memory available to programs.

3. In contrast ROM ("read-only memory") refers to special memory used to store programs that boot the computer and perform diagnostics.

4. RAM is the workhorse behind the performance of your computer. It temporarily stores information from your operating system, applications, and data in current use. The amount of RAM you have determines how many programs can be executed at one time and how much data can be readily available to a program. It also determines how quickly your applications perform. The more RAM you have, the more programs you can run smoothly and simultaneously.
UNIT B: Advanced Tools of Visualization

Apply advanced tools of visualization.

OBJECTIVE: V202.02
Explain how to apply pixel values to digital images.

Introduction: The purpose of this unit is to introduce students to the use of pixel values and their function in digital images using such software as Scion Image. This unit should be taught in conjunction with the performance objective 2.03.

A. Digital images gather data by remote sensing.
   1. Remote sensing is the process of gathering information without touching it.
   2. Examples of remote sensing include:
      a. The human eye gathering light;
      b. Bats sensing their environment by emitting sound waves and listening for the reflected echo;
      c. Rattlesnakes detecting heat radiation of small animals;
      d. Sounds waves used in medical imaging (MRI); and
      e. X-rays used to detect broken bones.
   3. Satellites use a number of different sensors (IR, UV, Visible, Radio) to record information.

B. What are digital images?
   1. Digital images are composed of pixels arranged in rows and columns.
   2. Each pixel carries a numerical value or digital number (DN.)
   3. Colors or shades of gray (brightness) are assigned to each DN.
   4. A LUT (Look-Up Table) is used to show the scale relationship between each pixel’s DN and its assigned color or gray (brightness) value.
   5. Changing the LUT scale controls the appearance of the image.
   6. To digitize a photo, we superimpose a grid over the image and use the intersection of a row with a column to locate objects (similar to latitude and longitude.)
   7. The brightness value at each X and Y location can be recorded by the satellite scanner (detector.) The brightness value or DN is the Z-value associated with a picture element or pixel.
   8. By reducing the size or spacing of the grid, we can digitize at finer and finer spatial resolutions.
9. Digital data can be manipulated in numerous ways to help us manage our natural resources and protect the environment.

10. Colors can be assigned to an image using the LUT (Pseudo-color images.) This process is useful to visualize specific DN values. Use of colors include:
   a. Making clouds visible in weather maps;
   b. Coloring malignant cells a bright color to stand out in an image;
   c. Separating important data from the rest of the image; and
   d. Separating colder blue areas and warmer red areas in a weather map.

C. Multi-spectral Remote Sensing
   1. Recording energy in the red, green, blue, IR, UV, or other parts of the electromagnetic spectrum.
   2. Collected data can be qualitative or quantitative.
   3. TIR (Thermal Infrared) sensing exploits the fact that everything above absolute zero (0 K, -273°C, -459°F) emits radiation in the infrared range. For example, infrared weather satellite can sense temperature.
   4. Multi-spectral remote sensing measures the amount of energy reflected or emitted in several discrete bands that correspond to specific colors. Scientists can obtain different types of information from these different wavelengths (color.) For example, scientists can pick out the range of color for marijuana plants grown in North Carolina.

D. Contrast and Brightness levels
   1. The BRIGHTNESS is the intensity of white in an image.
   2. The CONTRAST is difference between the lightness and darkness of an image.
E. Histograms in area renderings

1. Histograms are displayed as a bar graph, with each shade of gray represented by one of the vertical lines. The height of the bar displays the number of pixels.

2. By mathematically stretching the range of pixels, features can be seen which are not apparent. Areas such as rivers, streams, and lakes are enhanced and are more easily viewable.

![Histogram Image]

F. Measuring in area renderings

1. The portion of the earth is dependent on the height of the satellite. Most weather satellites use the scale of 16 square miles equals 1 pixel. Programs like Scion Image allow you to set these scales.

2. The curve of the earth may add variations to these readings.

G. Density Slicing

1. Density slicing allows you to highlight a range of pixel values in the LUT.

2. The highlighted pixels help visualize areas of interest.

3. Density slicing is part of “particle analysis” where you let the computer locate an area of interest (a lake for example), and then the computer will analyze the slice (area, height, temperature, etc.)

![Density Slicing Image]
H. Particle Analysis
   1. Particle analysis allows one to highlight specific pixel values and take measurements (i.e. calculating the area and perimeter of a massive cloud or the size of a tumor.)
   2. Combining Set Scale, Density Slicing, and Particle Analysis is very useful to isolate and measure specific parts of a digital image.

I. Density Calibration
   1. Density calibrating an image will mathematically relate the values of one pixel to other pixels.
   2. If you know the elevation of a particular mountain, you can select those pixels and set the scale. The relative elevations of other areas can then be estimated.
   3. Density calibration is based on making predictions from a line graph (linear regression.)

J. Digital Elevation Models (DEM’s)
   1. DEM’s are images where DN (digital number) or grayscale values represent elevation.
   2. A digital image can be converted into a relief map.
   3. In Scion Image, we use Surface Plot to produce a relief map.

K. Elevation Calibration (Calibrated DEM’s)
   1. Take the data from a DEM to apply known elevations to calculate other elevations.
2. Mapping out the surface floor is an example of using this method.

L. Animation (Scion Image only)
   1. Multiple images of an area can be opened at the same time. (Images of a hurricane taken every hour.)
   2. Images are put into a “stack” which works very much like a “flip book.” Useful for showing the movement of storm patterns.
UNIT B: Advanced Tools of Visualization

Apply advanced tools of visualization.

OBJECTIVE: V202.03
Apply pixel values to digital images.

Introduction: The purpose of this unit is to allow student to practice working with remote sensing data and area renderings. Information in objective 2.02 can be taught by performing this tutorial.

Materials:
- Scion Image Software Program (free on-line and supplied on CD)
- Tutorial on Scion image located in Appendix A and on CD
- Images from a hurricane (included on CD)

Requirements:
1. Students will import an image of a hurricane. Recommend using a NOAA ECIR satellite due to a known scale. The lesson enclosed uses Hurricane Frances (image enclosed).

2. Students will perform the following activities using the Scion Image tutorial.
   a. Set scales and units.
   b. Measure the size of the hurricane (from diameter and area of the storm).
   c. Measure the perimeter and area of North Carolina.
   d. Compare the size of the hurricane to the size of North Carolina.
   e. Use a straight-line tool to measure the distance of the Hurricane’s eye from North Carolina.
   f. Using the density slice to make an image showing temperatures from 17-22°C. “Selectively” set the thickness of your density slice. In doing this, you set the upper and lower pixel values that will have color. One excellent use for this is to show areas of a particular temperature. Density Slice (colorize) all pixels between 17-22°C. Using the following equation: °C = (40/255) * P – 5. You can rearrange the equation
to solve for P (pixel value): $P = (\text{C} + 5) \times (255/40)$. The pixel value for 17°C is $P=140$, and the pixel value for 22°C is $P=172$. We can now adjust our LUT.

g. Select one other activity from the scion tutorial.

Assessment:

Students performed all of the above activities correctly - 100 pts.
UNIT B: Advanced Tools of Visualization

Apply advanced tools of visualization.

OBJECTIVE: V202.04
Identify trends in scientific & technical visualization tools.

Introduction: This unit will inform students to the areas related to visualization.

A. What is Advanced Scientific Visualization?
   1. Scientific visualization, sometimes referred to in shorthand as SciVis, is the representation of data graphically and/or visually as a means of gaining understanding and insight into the data. SciVis allows the researcher to gain insight in ways previously impossible.
   2. Examples of scientific visualization
      a. Engineering
      b. Simulations
      c. Medical Imaging
      d. Meteorology
      e. Hydrology
      f. Finance
   3. Types of scientific visualization
      a. Color coding
      b. Surface rendering
      c. Volume rendering
      d. Image analysis
      e. Vector and Scalar data analysis
      f. Parallel projections

B. What is Informational Visualization?
   1. Informational visualization is the use of interactive graphical interfaces to display, measure, and understand large amounts of data. Information visualization combines the aspects of graphics, human-computer interaction, and human-information interaction.
   2. Examples of informational visualization
      a. Molecular models
      b. CAD models
      c. Medical imagery
      d. 2D MAP GIS
e. Dynamic queries (search capabilities)

3. Informational visualization data types
   a. Linear -- (one dimensional), usually sequential lists. A typical Internet search result would be an example. This is the least complex type of visualization.
   b. Temporal -- data uses time as the one dimension (i.e. timelines, animations, project timelines, and video representations).
   c. Two dimensional -- (not to be confused with 2D representations) data is associated with geographic information systems, such as a map.
   d. Three dimensional -- is usually real world data, and is concerned with position and orientation. Visual reality is an example.

4. Organizing informational visualization
   a. Tree or hierarchical -- data has a unique parent and 1 or more siblings. Examples include classification systems, and parent child relationships.

   b. Task Gallery – a way that employs 3D space to organize data. The space is that of multiple rooms in which documents are ‘hung’ on walls until they are needed.

   c. Storytelling – storytelling is deeply rooted in human history, and technology can allow for effective storytelling. With the advent of multimedia, animation, rich text, and the Internet, many researchers believe that storytelling can aid in the visual presentation of information.
   d. Visual Data “Mining” -- is like an automatic changing data system. Example is a working mode of the stock market that changed continually as priced rise and fall.
e. SPIRE is a way to organize data in a spatial pattern. Data fits the way the human mind works. [http://www.pnl.gov/infoviz/spire/spire.html](http://www.pnl.gov/infoviz/spire/spire.html).

1. Galaxy Visualization -- the image of stars in the night sky to represent a set of documents.

![Galaxy Visualization](image1.png)

2. Theme View -- the topics or themes within a set of documents are shown as a relief map of natural terrain. The mountains in the ThemeView indicate dominant themes. The height of the peaks indicates the relative strengths of the topics in the document set.

![Theme View](image2.png)
3. Theme River -- helps users identify time-related patterns, trends, and relationships across a large collection of documents. The themes in the collection are represented by a "river" that flows left to right through time.

4. Fractal Projections -- Information is organized and viewed as fractal spaces.

5. Catch -- Computer Aided Tracking and Characterization of Homicides is a collection of tools that assist the crime analyst in the investigation process.
Advanced Principles of Visualization

V203.
Demonstrate advanced principles of visualization.

V203.01
Explain advanced 2D design concepts.

V203.02
Describe advanced imaging techniques.

V203.03
Explain advanced presentation techniques.

V203.04
Demonstrate advanced presentation techniques.

V203.05
Explain basic web page design.

V203.06
Demonstrate basic web page design.

Biomes of the World

Click on the box for more information
UNIT C: Advanced Principles of Visualization

COMPETENCY: V203.
Demonstrate advanced principles of visualization.

OBJECTIVE: V203.01
Explain advanced 2D design concepts.

Introduction: Students will learn different design concepts that can be applied to 2D vector images. CorelDraw and Adobe Illustrator are suggested programs.

A. Apply advanced fills to selected closed 2D objects.
   1. The basic fill options include uniform or solid, fountain or gradient, and pattern. The uniform fill is produced from single colors.
   2. The fountain fill is made up of gradients, formed by multiple colors. The pattern fill is made up of bitmap and vector files and can be made from any shape or texture.
   3. Pattern fills can be edited for tiling, placement, and size.

B. Use color definitions in 2D objects.
   1. Colors can be defined using CMYK definitions, RGB or HSB (V) definitions.
   2. Custom colors are predefined colors that can be created or selected from a list such as PANTONE or TRUMATCH.
   3. Colors can be fixed palettes or process color. Fixed color is referred to as color matching systems and process color is referred to as color models.

C. Draw and edit curves in 2D objects.
   1. The basic curve tools are the freehand or pencil tool and the Bezier tool.
   2. Curves can be manually closed or automatically closed.
   3. The freehand or pen tools are used to produce freeform lines without constraints.
   4. The Bezier tool is used to generate precision curves and paths. This tool is preferred for accurate tracing and path assignments (text orientation.)
   5. All curves can be edited into a variety of shapes by shape node or anchor points adjustments. Editing of the shapes can be achieved with the use of a knife tool, and the erase tool.

D. Working with shapes
   1. The basic shapes used in vector programs are the rectangle, star, spiral, ellipse, and polygon.
2. All shapes have specific properties to change the physical characteristics, stroke width, and shape. Shapes can be modified by using transformation or shaping features.

E. Paintbrush and artistic media tools
1. The paintbrush tool and the artistic media tool can be used to apply existing images to a design. Existing images can include fall leaves, bubbles, footprints, and grass.

2. These tools can also add a calligraphic effect. An angled tip produces this effect or nib, which creates a tapered line that gets thicker or thinner depending on the angle of the tip or nib.

3. Another choice for these tools is the Art Brush or brush. This brush stretches predefined art choices along a path. Some of the selections include artistic arrows, gradients, and color swatches.

F. Transform tools
1. The blend tool produce objects between two different objects in sequence. Blends can occur along paths and altered by using the blend properties.

2. Objects can be rotated, scaled, and mirrored (reflected).

3. The free transform tool will allow you to perform many transforms to an object at the same time. You can scale, rotate and skew and even distort with one motion.

G. Advanced text techniques
1. Text can be colored, reshaped, and filled in a 2D vector program.

2. Text can also follow a path, fit inside a box, be vertical, or act as a vector element.

3. Most of the options available in a word processor are available in vector programs.

H. Using object outlines
1. Different widths (points) can be applied to the outline of objects or lines in an image.

2. Using the property bar will allow the designer to change the line color, the line style, the end shapes, the line caps, and corners.

I. Layer management

1. A designer must learn to navigate among the objects in the scene if the design is complex. Layers allow for organization of type, images, backgrounds, and effects and multiple shapes.

2. Objects on a master layer will appear on every page in the design. This will include a master guide, master grid, and desktop layers used to organize the drawing window.

3. Layers can be made invisible, write protected, and non-printing by selecting the icons in the object manager window. The object manager docker window is used to locate and work with all the objects in your drawing.

J. Importing and exporting pictures.

1. One of the easiest ways of transferring images from one program to another is copying and then pasting.

2. Other techniques for moving objects in and out of applications include importing, opening files, and exporting.

3. Opening a foreign file creates a new drawing while importing brings the file into your existing drawing.

4. Files can be exported in several common formats including EPS, Tiff, GIF, BMP, JPEG, and Targa files. The exported selection will depend on how it is going to be used in the other software applications.

K. Printing and postscript in vector images

1. Printing is basically controlled by your operating system. There are several printer options to choose from to print a wide range of formats including, labels, cards, letterhead, tabloids, and other layout styles.

2. Print options include printing selected objects, selected pages, and different impositions. Imposition is the way the pages are arranged on a printed sheet for publishing.

3. Color can be printed in several ways:
   a. One color (black, red, blue etc.)
   b. Multicolor, which is more than one color (two, three, four, etc.)
   c. Full color, also called process color -- this method is used in most high quality printing magazines and publications. It is produced by using transparent inks magenta, cyan, yellow and black to print the widest range of continuous tone colors possible with modern printing equipment.
UNIT C: Advanced Principles of Visualization

COMPETENCY: V203.
*Demonstrate advanced principles of visualization.*

OBJECTIVE: V203.02
*Describe advanced imaging techniques.*

Introduction: Students will learn how to create and edit bitmap images. Suggested programs are Corel PhotoPaint, Paint, and Adobe PhotoShop.

A. Produce a bitmap image.
   1. The first thing that must be determined in developing a bitmap image is the preferred color mode (color, pixel depth.)
   2. Then choose a color background or transparency.
   3. Next, determine the correct image size and resolution: monitor resolution is set at 72 - 96 dpi; photographic quality is between 150 and 200 dpi; for simple black and white line art, the resolution should match the printer.

B. Setting Colors and Fills in bitmaps
   1. There are three color swatches used in the painting: Paint, paper, and fill.
   2. The paint color affects the Paintbrush and text tools.
   3. The fill color affects the objects such as rectangle, ellipse, polygons, or any closed shape.
   4. The paper fill only affects the paper color used in making new images.
   5. To load new colors, color pallets can be used for different types of output.

C. Painting a bitmap object
   1. The preferred method for selecting areas to paint on an image is the mask. This protects areas of your image from changes or effects when painting. Masks are made from different types of masks tools such as shapes, brushes, lasso, scissor, and magic wand tools.
   2. When a mask is selected, a marquee called marching ants surrounds the selected area. This indicates the section of the image that can be modified.
   3. Painting shapes can include an outline along with fill colors.
   4. The paint mode is called a merge mode because it allows the interaction between the shape color and the color of the pixels in the objects. Different types of merge exist to provide a variety of effects for the painted objects.
   5. Painting techniques and methods are very broad and provide many different ways of enhancing images. These include painting effects, fills, and interactive fills.

D. Object orientation
   1. Objects can be combined with other objects in the scene. Their arrangement can be changed including alignment, transformation, groups, opacity, and transparency.
2. Objects can be feathered to look like they are fading into the background or into another object.
3. Objects can be combined with each other or with the background.

E. Using paintbrushes.
1. Paintbrushes modify pixels of a bitmap image using selected colors.
2. The common paintbrush tools include: the paint tools, the effect tools, the clone tools, and the image sprayer tool.
3. An art tablet is very useful in providing greater artistic control of the image.
4. The property bar displays the options that are available with the paint tools. These include art brush styles, brush type, paint mode, nib shape and size, and transparency options.
5. The effect tool is used to produce a variety of effects by modifying the pixels in a variety of ways. Some of the effects include smear, smudge, and brightness.
6. The image sprayer provides custom spray patterns, textures and graphics that can be painted onto the image.
7. Cloning takes part of an image and repaints it onto an image. Cloning is very useful in using repetition of shapes textures and patterns.

F. Masking Techniques
1. Masks over top of images mask only currently selected objects, not the entire image.
2. Masks can be moved by selecting and dragging.
3. Masks can be edited or modified by adding to or taking away from the selection.
4. The magic wand is a great masking tool to control the tolerance of the selected areas of an image. The magic wand is useful for selecting similar colors.
   a. The mask freehand tool is useful for producing editable freehand areas by selecting different brush widths and styles.
   b. Masking effects produce unique effects such as feathering, making borders, smoothing, and clipping masks.
   c. A mask marquee can be used as a window on the object being modified. This allows for further modification of the pixels to produce unique special effects.

G. Bitmap effects
1. Different graphic effects can be achieved by using a wide range of custom and default effects. Some software programs incorporate different plug-ins to enhance graphic images. The more common effects include art strokes, blur, sharpen, texture, creative, and distortion.
2. Image properties can be modified using the image adjustment tools. Tone curves, replace color, auto equalize, and color balance are the more useful adjustment methods.
3. Different image effects can also be achieved by using layer, color channels, and color mode options. Color channels are made up of RGB and other channels such as mask channels. The color channels are mixed to add a full range of colors to the image as well as creating different color effects.

H. Advanced imaging techniques
   1. The more popular production of bitmap images are photomontages, vignettes, silhouettes, collages, and posters (2-4 tones.) Each method can incorporate a variety of photo imaging techniques and processes.
   2. A Photomontage is an old technique for creating large panoramas from standard size photos. NASA uses this technique with pictures sent back from space probes.
   3. Feathering the edges of an image to make it appear soft and not so sharp produces a vignette.
   4. Bitmap images can be generated to simulate historical patterns and styles. Some popular techniques in photography include sepia tones, art nouveau, and modern art styles.

I. Image resampling
   1. The purpose of resampling is to control the resolution and the size of the image so it will match its output.
   2. It is also used to show the amount of pixels and file size that the image is while it is being edited.
   3. Resampling can also be used to convert the image into different units of measurement such as centimeters, points, picas, pixels, and inches.
UNIT C: Advanced Principles of Visualization

COMPETENCY: V203.
Demonstrate advanced principles of visualization.

OBJECTIVE: V203.03
Explain advanced presentation techniques.

Introduction: Students will learn advanced techniques for putting together a polished presentation in Power Point. This unit can be taught in conjunction with any performance objective. Students who are familiar with Inspiration Software may use it as an organizational tool.

A. Gathering material for a presentation
   Determine the purpose of your presentation. Are you trying to entertain? Inform? Persuade?
   Research the topic. You must understand the material before you can explain it to anyone else.
   Narrow your topic (i.e. Mammals > Mammals of North America > Black Bears > Hibernation of Black Bears in North America.)
   Outline the key points.
   Know the audience to whom you have to present your topic.
   6. You may have dozens of points that you would like to make, but your audience will only remember two or three.

B. Using visual aids
   1. Visual aids help your presentation to have a lasting impact. They help organize your ideas, or point out a major point. We remember more of what we see than what we hear.
   2. Visual aids enhance peoples’ understanding of the topic.
   3. Visual aids add authenticity to your presentation; they show that you have done the research. If you are “borrowing” a graphic, give the owner credit.
   5. Visual aids should supplement your presentation; they should not become the presentation. Images by themselves cannot tell the story.
   6. Visual aids should relate to the topic. Ask yourself, “Does the graphic help me make my point?”

C. Typography
   Titles
   Titles set the tone.
   Mixing upper case and lower case letters allow you to have more characters than you would when just using upper case.
A title slide introduces the design theme (logo, colors, and fonts.)

All titles should use the same font.

Text:

a. Text is the backbone of the presentation.
b. The font should be readable. Avoid fancy fonts except as decorative elements.
c. Recommended minimum text sizes:

<table>
<thead>
<tr>
<th></th>
<th>Transparencies</th>
<th>Slides</th>
<th>Handouts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>36 pt</td>
<td>24 pt</td>
<td>18 pt</td>
</tr>
<tr>
<td>Subtitles</td>
<td>24 pt</td>
<td>18 pt</td>
<td>14 pt</td>
</tr>
<tr>
<td>Other text</td>
<td>18 pt</td>
<td>14 pt</td>
<td>12 pt</td>
</tr>
</tbody>
</table>

d. Consider using one font for the title and another font for the body text. However, avoid using more than two or three fonts on one slide.
e. Serif style fonts are often used for body text (have horizontal extensions called serfs) because they help keep the reader’s eye moving along.
f. Sans serifs (without serfs) have no contrast between strokes, which makes them easy to read when used in a heavy bold.
g. Animating text can keep people from running ahead, but they can also slow down the presentation, causing the reviewer to lose interest.
h. Avoid long sentences on PowerPoint slides. Make short, to-the-point phrases. Do not use entire paragraphs of text. Keep each bullet point to one line in length without text wrapping.

D. Working with color

1. If the background is multicolored, set the text in a solid color area or use a text box.
2. Choose one overall color scheme and use it throughout the entire presentation. Repetition of colors and graphics from slide-to-slide tie the various pages of a production together.
3. Contrast occurs when you use colors that are separated by at least one noticeably distinct color on the color wheel. Use high contrast between background color and text color.
4. Adjacent colors should have different brightness.
5. Shiny objects make colors appear lighter whereas texturized objects appear darker.
6. Warm colors seem closer while cool colors seem farther away.
7. Avoid the “Vegas” look (too many different colors.)
8. Avoid “hot” colors such as red or orange except for emphasis.
9. Avoid using a white background in a dark room; it causes a glare.
10. Rooms with lots of light require a light background and dark letters. Only use dark backgrounds and light letters where the room will be very dark.

11. Colors may look different when projected; if possible, test them prior to making the presentation.

12. When using graphics, choose one or more colors from the graphic to use.

13. Consider both color and texture for backgrounds. Sometimes pleasing textures work better than solid colors.

14. Certain colors have common associations in society, such as red with warning or green with go.

15. About 5% - 8% of men are red/green colorblind.

D. Making Oral Presentations

1. Do not memorize the material. It cuts down on spontaneity and limits your ability to interact with the audience.

2. Become very familiar with the information by rehearsing. Practice builds your confidence, which is the key to effective speaking.

3. Go through the program just before presenting it (hard copies of the slides are good for this purpose).

4. Before making an oral presentation, you should research and practice unusual word pronunciations.

5. Keep a sense of humor – do not overreact.

6. You are your best visual aid – actions, gestures, voice, facial expressions, clothes, grooming. Stand up straight and be effective!

7. Do not stand in front of the visual aids.

8. Do not display the visual aids until you are ready to use them.

9. Find out about the size of the audience and the physical layout of the room to determine visibility. Check the visibility from the back row.

10. Check out the equipment prior to the presentation.

11. Relax and take deep breaths. It is ok to be nervous. Most of the time you are the only one who knows if you make a mistake. Concentrate on your topic, not the audience.

12. Stay on time. Do not go over your allotted time.

E. Self-running presentations

1. When setting time for a self-running presentation, read aloud at a leisurely pace. Have one or two other people review your timings.

2. Never run a presentation until someone else has proofed it.

F. The amateur presentation is generally too much: too much color, too many fonts, too much animation, or too much of everything.
G. Advanced power point techniques

1. Slide transitions
   a. Try to use only one per presentation.
   b. Keep them simple so as not to distract from the presentation.

2. Importing images
   a. File formats -- make sure images are in a format that can be imported into PowerPoint.
   b. Limit yourself to no more than 2 images or media to a slide.
   c. Videos can be placed in a PowerPoint presentation.
   d. Do not use images as backgrounds on a text slide unless the images are muted. The image will distract from the words on the slides.

3. Timing constraints
   a. Looping -- Presentations can run continually until stopped. This is good for display booths.
   b. PowerPoint can be run on a dual screen display.

4. Linking pages
   a. PowerPoint slides can have links inserted to other slides as well as to Internet sites.
   b. This linking can make the presentation interactive.
   c. An example could include a map of the world showing the different biomes. Each biome can be linked to another slide explaining the biome. A home link should be included on the information slide so the reader can return to the map slide.

5. Display equipment
   a. The presenter should be aware of the projection equipment needed for the presentation.
   b. The PowerPoint presentation display parameters should be set to match the projection equipment.
   c. Projection equipment can include data projectors, large TV monitors, or overhead projectors.
UNIT C: Advanced Principles of Visualization

COMPETENCY: V203.
Demonstrate advanced principles of visualization.

OBJECTIVE: V203.04
Demonstrate advanced presentation techniques.

Introduction: The purpose of this unit is to help students demonstrate their understanding of how presentation techniques are applied to a visualization problem. All skills learned in objectives 3.01-3.03 can be applied here.

Materials:
- Map of the World image below, from webdings, or from other sources.
- Presentation software such as Power Point.
- Image editing software such as Corel Draw or Corel PhotoPaint.

Requirements:
1. Depending on time constraints, students can work independently or the work can be divided between members of a team.
2. Students will produce a PowerPoint or a web page of the world’s biomes.
3. Students should able and ready to present the finished project to the class (using techniques found in section 3.03.) They should explain how the presentation works including how to use the launch buttons and how to return to the map page.
4. The presentation should have a launch page from which other information pages can be accessed. Pages or slides can be linked using the insert hyperlink tool.
   - This page should include a map of the world showing the different biomes. A map from webdings can be used. Webdings can be copied from any draw program or copied form the image below. Map images can also be found on free clip art.
   - The biomes should be color-coded.
   - Each biome should contain a button that is linked to another slide that contains information about the biome.
5. Each biome link should have at least one information page describing the following:
   - Location of the biome;
   - General climate including rainfall amounts and seasonal temperatures;
   - Sample of plants and animals found in the biome; and
   - General characteristics.

6. All images should be original or used from a free web site. Try free images or clipart in a search engine. Also look for programs that contain free clipart. The free images can be edited in a bitmap or vector based program.

7. Each page should have a link to direct the user back to the map page. All links should work.

8. All information slides should have a similar layout.

9. No pictures as a background.

10. The student should draw one original image on every biome slide from a bitmap or vector based program.

11. All slides should demonstrate the proper use of design principles and elements such as balance, spacing, value, and color.

12. Credit should be given for all resources used in the project.
Variations: The biome ideas can be replaced with any other topic. Listed below are some examples:

- Periodic table (family)
- States in the US-Climate or population
- NC Counties-information
- Human body-systems

Assessment:

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch page</td>
<td>20</td>
</tr>
<tr>
<td>Other slides</td>
<td>40</td>
</tr>
<tr>
<td>Use of design elements</td>
<td>15</td>
</tr>
<tr>
<td>Scientific accuracy</td>
<td>10</td>
</tr>
<tr>
<td>Functioning</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 Points</strong></td>
</tr>
</tbody>
</table>

Rubric:

**Launch Page**

<table>
<thead>
<tr>
<th>Components</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 or more items are missing:</td>
<td></td>
</tr>
<tr>
<td>The world map is original and displays all of the biomes. Buttons are present for each biome. The biomes are color coded and labeled.</td>
<td></td>
</tr>
<tr>
<td>1-2 items are missing:</td>
<td></td>
</tr>
<tr>
<td>The world map is original and displays all of the biomes. Buttons are present for each biome. The biomes are color coded and labeled.</td>
<td></td>
</tr>
<tr>
<td>The world map is original and displays all of the biomes. Buttons are present for each biome. The biomes are color coded and labeled.</td>
<td></td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td></td>
</tr>
<tr>
<td>0-10 points</td>
<td>11-19 points</td>
</tr>
</tbody>
</table>

**Other biome slides**

<table>
<thead>
<tr>
<th>Components</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some biomes do not have an informational slide. Many of the information listed in the procedure is not present. Images are not present and original or free.</td>
<td></td>
</tr>
<tr>
<td>All biomes have an informational slide. Some information listed in the procedure is not present. Images are not present and original or free.</td>
<td></td>
</tr>
<tr>
<td>All biomes have an informational slide. All information listed in the procedure is present. Images are present and original or free.</td>
<td></td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td></td>
</tr>
<tr>
<td>0-21 points</td>
<td>22-39 points</td>
</tr>
</tbody>
</table>
## Use of design elements

<table>
<thead>
<tr>
<th>Description</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>The color harmonies are incorrect. The typefaces conflict with the design and theme. More than two typefaces are used. The design is cluttered and white space is not used affectively.</td>
<td>0-8 points</td>
</tr>
<tr>
<td>The color harmonies are somewhat incorrect. The typefaces somewhat conflict with the design and theme. More than two typefaces are used. The design is acceptable and the white space is somewhat effective.</td>
<td>8-14 points</td>
</tr>
<tr>
<td>The uses of color harmonies are correct. The typefaces compliment the design and theme. One to two typefaces are used. The design is clean and white space is used effectively.</td>
<td>15 points</td>
</tr>
</tbody>
</table>

## Scientific Accuracy

<table>
<thead>
<tr>
<th>Description</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>The project contains some correct scientific information. All the biomes are not included.</td>
<td>0-4 points</td>
</tr>
<tr>
<td>The project contains mostly correct scientific information. All the biomes are included.</td>
<td>5-9 points</td>
</tr>
<tr>
<td>The project contains correct scientific information. All the biomes are included.</td>
<td>10 points</td>
</tr>
</tbody>
</table>

## Function

<table>
<thead>
<tr>
<th>Description</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some of the buttons on the presentation work. The project does not run on its own and is not user friendly. Instructions are not available.</td>
<td>0-8 points</td>
</tr>
<tr>
<td>Most of the buttons on the presentation work. The project runs on its own and is mostly user friendly. Instructions are available.</td>
<td>8-14 points</td>
</tr>
<tr>
<td>All of the buttons on the presentation work. The project runs on its own and is user friendly. Instructions are clear and easy to understand.</td>
<td>15 points</td>
</tr>
</tbody>
</table>
UNIT C: Advanced Principles of Visualization

COMPETENCY: V203.
Demonstrate advanced principles of visualization.

OBJECTIVE: V203.05
Explain basic web page design.

Introduction: Students will learn basic Internet terminology and HTML tags (including tables.) This unit is intended to be taught in conjunction with the performance objective 3.06.

A. The Internet

1. The Internet is made up of thousands of networks spread all over the world. Colleges, companies, governmental agencies, and individuals all develop and maintain their own networks.

2. Transfer protocols are rules or formats that have been agreed-upon for transmitting data.

3. Protocols have been established to make sure that all of the varying networks can exchange information over the Internet.

4. Computers called servers that are accessible to the World Wide Web are used to store web pages. There are several types of computer servers, for example a file server would be dedicated to storing files, a network server would manage network traffic, and a print server manages one or more printers.

5. A web page has a unique address called a Uniform Resource Locator (URL). If you have access to the Internet and know the URL, you can find and display a specific web page. The pathname specifies the location of the Web page.

   web server name

   Example: http://www.webopedia.com/Term/w/web_page.html

   scheme path

   a. The scheme is the language or protocol used to access the web. Web pages generally use the http (HyperText Transfer Protocol) scheme.

   b. The path specifies the location of the web page on the web server.

2. Web pages are documents that are formatted in a markup language called HTML (HyperText Markup Language) that supports links to other documents as well as graphics, audio, and video files.

3. Links or hyperlinks are text or images on a Web page that connect to other pages on the Web.
4. A browser or web browser, is a software application used to locate and display web pages. Currently two of the more popular browsers are Internet Explorer and Netscape Navigator.

a. Different web browsers interpret and display web pages differently. How a web page looks will vary from computer to computer. View your web page on several browsers and several computers if possible to look for possible errors. There are web sites that will help you look for problems.

b. Although you can create and view an HTML document on your computer if you have a browser, others will not be able to access it. The document must be uploaded to an Internet server.

9. The type of Internet connection that you have determines how quickly information from the Internet is transferred to and displayed on your computer. Common types of connections include:

a. Modem -- connects over a telephone line, the slowest connection method, cheapest connection, usual transfer rate of 28 Kbps to 56 Kbps.

b. ISDN -- uses a digital telephone line, transfers at 64 Kbps to 128 Kbps.

c. Cable Modem -- transfers information using a television cable, speeds up to 3,000 Kbps.

d. DSL -- uses sophisticated modulation schemes to pack data onto copper wires which offer transfer rates from 1,000 Kbps to 9,000 Kbps.

10. Kbps = Kilobytes per second is the measurement of the speed at which information is transferred.

B. HTML (HyperText Markup Language)

1. HTML is a universal language used to create web pages. It is made up of text and HTML tags which allows you to display your page on any computer that has a software browser installed.

2. The HTML source code for any Web page can be accessed by using the “view, source” feature of the browser software. Looking at other peoples’ code is a good way to get ideas about how you should format HTML documents. (Other peoples’ code should never be copied directly.)

3. HTML code is typically created using a standard text-editing program. The more basic the text editor, the fewer complication are encountered.

a. If you are using a MS Windows operating system, it is recommended that you use the Notepad. Macintosh users will probably use Simple Text. When working in Notepad, be aware that the .txt is the default and “all files” should be selected.

b. If you save the document using a .txt or other word-editor format, it will not be saved as an HTML document and cannot be displayed. HTML files must be saved with an .htm or a .html extension to be “seen” by a browser.

4. HTML editors are available that will create web pages without actually having to use the HTML coding. As you type, the editor will create the code in the background.
Microsoft’s *FrontPage* and Macromedia’s *Dreamweaver* are two popular programs that do that type of editing. This unit will not cover editors.

5. Common methods of creating web page layouts are tables, frames, and cascading style sheets. Only tables are addressed in this basic HTML outline.

6. Web page structure consists of two basic parts: it starts with `<HTML><HEAD>` and ends with `</BODY></HTML>`. All the information you want to include in your Web page fits in between the `<BODY>` and `</BODY>` tags.

7. White space around the text on the HTML document does not matter. It does not affect how words or images are aligned or arranged on the Web page. Tags control how the final document will look.

C. HTML Tags and Attributes

1. A *tag* is a command inserted into a document that specifies how the document, or a portion of the document, should be formatted.
   a. Tags are enclosed within `< >` brackets.
   b. Some tags (container tags) include beginnings and endings. Ending tags are preceded by a “/” (slash) (example, `</font>`).
   c. Some tags (empty tags) stand alone and do not have an ending (i.e. `<br>`.)
   d. Text within the tags can be upper or lower case, but are not typically mixed.

2. An *attribute* is used to add additional information to a tag. For example, when describing a horizontal rule `<hr>`, the “width” attribute will specify the width of that line either as a percentage of the page or as the number of pixels `<hr width = “50%”>`.

3. Commonly used tags.

<table>
<thead>
<tr>
<th>TAG</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;html&gt;&lt;/html&gt;</code></td>
<td>Starts and ends an HTML document.</td>
</tr>
<tr>
<td><code>&lt;head&gt;&lt;/head&gt;</code></td>
<td>Contains information about the web page.</td>
</tr>
<tr>
<td><code>&lt;title&gt;&lt;/title&gt;</code></td>
<td>Creates the web title that is printed on the web page title bar.</td>
</tr>
<tr>
<td><code>&lt;body&gt;&lt;/body&gt;</code></td>
<td>Begins and ends the body of the document.</td>
</tr>
<tr>
<td><code>&lt;br&gt;</code></td>
<td>Break – Stops text (or other element) and begins a new line.</td>
</tr>
<tr>
<td><code>&lt;p&gt;&lt;/p&gt;</code></td>
<td>Paragraph - Adds a line of space before and after the information between the tags.</td>
</tr>
<tr>
<td><code>&lt;h1&gt;</code> to <code>&lt;h6&gt;</code></td>
<td>Headings – Specifies the size and boldness of headers, levels are 1 (most important) to 6 (least important.)</td>
</tr>
<tr>
<td><code>align</code></td>
<td>Changes the alignment when used with a heading (left, right, center.)</td>
</tr>
<tr>
<td><code>&lt;ol&gt;&lt;/ol&gt;</code></td>
<td>Ordered list – Used for a list. Adds a number or letter in front of each list item (depending upon attributes assigned.)</td>
</tr>
<tr>
<td>Tag</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><code>&lt;ul&gt;</code></td>
<td>Unordered list – Adds a bullet (or image) to the front of listed items.</td>
</tr>
<tr>
<td><code>&lt;li&gt;</code></td>
<td>List item – used for each item in a list.</td>
</tr>
<tr>
<td><code>&amp;nbsp</code></td>
<td>Inserts a blank space, repeat for each space required.</td>
</tr>
<tr>
<td><code>&lt;b&gt;</code></td>
<td>Bold – create bold text.</td>
</tr>
<tr>
<td><code>&lt;i&gt;</code></td>
<td>Italicize – creates italicized text.</td>
</tr>
<tr>
<td><code>&lt;u&gt;</code></td>
<td>Underline – underlines text.</td>
</tr>
<tr>
<td><code>&lt;center&gt;</code></td>
<td>Centers the element which is placed between the tags.</td>
</tr>
<tr>
<td><code>&lt;bgcolor=&quot;hex code&quot;&gt;</code></td>
<td>Background color – adds a background color when combined with a hexadecimal value for the color.</td>
</tr>
<tr>
<td><code>&lt;img src=&quot;xxxx.xxx&quot;&gt;</code></td>
<td>Image – adds an image when the file name (or path) is specified.</td>
</tr>
<tr>
<td><code>align</code></td>
<td>Aligns an image with text or wraps text around an image (left, right, top, middle, bottom.)</td>
</tr>
<tr>
<td><code>alt</code></td>
<td>Displays a text message when the image does not appear.</td>
</tr>
<tr>
<td><code>border</code></td>
<td>Creates a border around an image.</td>
</tr>
<tr>
<td><code>height, width</code></td>
<td>Specifies a height and width for an image.  Speeds loading of image</td>
</tr>
<tr>
<td><code>hspace, vspace</code></td>
<td>Creates a space around the image, distance is measured in pixel.</td>
</tr>
<tr>
<td><code>&lt;font&gt;</code></td>
<td>Changes the characteristics of the text when attributes are used.</td>
</tr>
<tr>
<td><code>color</code></td>
<td>Specifies the color of the text when the hexadecimal code is specified.</td>
</tr>
<tr>
<td><code>face</code></td>
<td>Specifies the font to be used.</td>
</tr>
<tr>
<td><code>size</code></td>
<td>Specifies the size of the font when a number size is specified. 1 (8pt) to 7 (36pt).</td>
</tr>
<tr>
<td><code>&lt;hr&gt;</code></td>
<td>Horizontal rule - Creates a horizontal line.</td>
</tr>
<tr>
<td><code>align</code></td>
<td>Changes the alignment of the horizontal rule (left, right, center.)</td>
</tr>
<tr>
<td><code>size</code></td>
<td>Changes the thickness of a horizontal rule.</td>
</tr>
<tr>
<td><code>width</code></td>
<td>Changes the width of a horizontal rule (specify % of page or distance in pixels.)</td>
</tr>
<tr>
<td><code>noshade</code></td>
<td>Removes the three-dimensional shadow effect from a horizontal rule.</td>
</tr>
<tr>
<td><code>&lt;a href=&quot;xxx&quot;&gt;text&lt;/a&gt;</code></td>
<td>Creates a hyperlink to another page when the address is specified and provides a written link on the page as specified.</td>
</tr>
<tr>
<td><code>&lt;table&gt;</code></td>
<td>The ending table tag must be used or Netscape will not display the table.</td>
</tr>
</tbody>
</table>
4. Hexadecimal codes
   a. Hexadecimal codes are six digit codes used to specify “web safe” colors.
   b. Names for simple colors such as red, blue, green can be given in place of using the code.
   c. Examples of color codes:
      1. aqua = #00FFFF
      2. blue = #0000FF
      3. lime = #00ff00
      4. bright blue = #000090
      5. bright green = #009000
   d. Check the Internet or books on HTML for a complete list of color codes.

5. Tables are used to control placement and layout of text and objects in a predictable manner.
   a. Before you attempt to create a complex web page, it’s a really good idea to design the page on a sheet of paper.
   b. The standard width for a table is 600 pixels, which will allow it to be viewed on almost all monitor resolution settings.
   c. Figure out how many rows and columns you need. Identify any rows or columns that will span more than one space.
   d. The table may be created with or without visible division lines and borders.
      1. A border “n” attribute can be added to the <table> tag (“n” = number of pixels).
      2. A cellspacing “n” attribute will create space between the cells.
      3. A cellpadding “n” attribute will create space between the contents and the walls of the cell.
   e. Contents of the cells may be aligned vertically or horizontally using the align and valign attributes.
   f. Many other cell and table attributes are available for advanced users. Consult any good book on HTML such as Elizabeth Castro’s HTML for the World Wide Web.
UNIT C: Advanced Principles of Visualization

COMPETENCY: V203.
Demonstrate advanced principles of visualization.

OBJECTIVE: V203.06
Demonstrate basic web page design.

Introduction: Students will create the web page shown using HTML. It is the intention of this exercise to use table layouts. Teachers should assess the experiences of their students and vary the basic assignment to meet the needs of individual students. For HTML experienced students, consider alternative exercises in Flash, JavaScript, DHTML, DreamWeaver, etc.

Materials:
- Web editor such as Notepad
- List of hexadecimal codes from Internet or other reference
- List of common tag and attributes (See objective 3.05)
- Examples of completed Web page coding
- Images needed for page completion (See CD)

Requirements:
1. Students should create an independent document, but be allowed to consult with other students.
2. Use a simple word editor to type the HTML code needed to create the web pages shown below.
3. Students could substitute the images shown with images that they have created.
4. The code should be saved as an .htm or .html file so that a browser can display the page.
5. Hyperlinks are created between the two pages.
6. Grammar and spelling are correct.
7. The student should include the following basic tags:
   - Header
   - Horizontal rule
   - Image
   - Align
   - Ordered list
   - Anchor
   - Font
   - Background color
   - Break
   - Paragraph
   - Table
Variations:
A topic may be substituted. This unit may also be combined with any other objective in the curriculum.

Assessment:
Tags are present so that the Web page to correctly display the text, headings, list, and lines 30 points
Hyperlinks are present and work 25 points
Images appear on Web page correctly sized and positioned 25 points
Web pages will display correctly on various computers 10 points
Grammar and spelling are correct 10 points
Total 100 Points

Rubric:
Tags are present that cause the Web page to correctly display the text, etc.

<table>
<thead>
<tr>
<th>Text not italicized, bolded, sized, or underlined as shown on the example page. Horizontal rule not present or not correctly sized. List is not present or is not ordered. White spaces are not shown as in the example.</th>
<th>One or two errors related to font, italicizing, bolding, or underlining. Horizontal rule present, but not sized or positioned as shown. List is bulleted instead of numbered. One or two errors related to white spaces.</th>
<th>Size and style of text match the example page. Horizontal rule is present and sized correctly. Ordered list is present. White spaces are present as shown in the example.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-14 points</td>
<td>15-29 points</td>
<td>30 points</td>
<td></td>
</tr>
</tbody>
</table>

Hyperlinks are present and work

<table>
<thead>
<tr>
<th>Hyperlinks do not look like example. Hyperlinks not positioned as shown. Hyperlinks do not work.</th>
<th>No more than one error related to hyperlink positioning, italicizing, or script. One hyperlink does not work.</th>
<th>Hyperlinks appear as shown in the example problem. Hyperlinks work.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10 points</td>
<td>11-24 points</td>
<td>25 points</td>
<td></td>
</tr>
</tbody>
</table>

Images appear on Web page correctly sized and positioned

<table>
<thead>
<tr>
<th>Images do not appear on web page or images are not sized correctly. Some small problems with sizing. One or two images do not show on web page. Images are sized and positioned as shown</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Create the pages shown below:

Page 1

**Using Heat to Do Work:**

The internal combustion engine.

---

Heat engines are devices that convert thermal energy into mechanical energy by burning fuel in a process called combustion.

Each movement of the piston is called a *stroke*:

1. Intake stroke
2. Compression stroke
3. Power stroke
4. Exhaust stroke

[Click here to understand more about the four strokes](#)
Power Stroke: When the piston is almost at the top, a spark plug produces a spark and ignites the fuel. The fuel and air mixture explodes, pushing the piston back down. Energy is transferred by the downward motion of the piston to the wheels by the crankshaft.

Exhaust Stroke: As the crankshaft turns, the piston is pushed upward again. As it moves upward it compresses the waste products. The exhaust valve opens to let the waste out.

Click here to return to the home page.
A possible code solution for the page 1:

<html>
<head>
<title>A web page on the Internal combustion engine</title>
</head>
<body bgcolor= #EEE9BF>
<center><h1><font face="arial" color="red"><u>Using Heat to Do Work: The internal combustion engine.</u></font></h1><hr color="red" width="60%" size="5">
<br>
<table align="center" border="0" width="600" cellspacing="0">
<tr>
<td width="370" height="400"><font face="arial" color="blue" size="3">Heat engines are devices that convert thermal energy into mechanical energy by burning fuel in a process called combustion</font>
<br>
<font color="black">Each movement of the piston is called a <i><b>stroke</b></i>:</font>
<br>
<ol>
<li>Intake stroke</li>
<li>Compression stroke</li>
<li>Power stroke</li>
<li>Exhaust stroke</li>
</ol></td>
<td width="230" height="400"><img src="internal engine pix.jpg" width="224" height="339"></td>
</tr>
</center>
<a href="Internal Combustion page 2.htm"><i><font size="2">Click here to understand more about the four strokes</font></i></a></body>
</html>
A possible code solution for the page 2:

<html>
<head>
<title>page 2 Internal Combustion Engine</title>
</head>
<body bgcolor=#EEE9BF>
<center><h1><font face="arial" color="red">Understanding the four strokes</font></center>
<hr color="red" width="60%" size="5">
<table align="center" border="0" width="600" cellspacing="3">
<tr>
<td width="260" height="175"><img src="intake.gif" width="260" height="175" border="1"></td>
<td width="340" height="175"><font face="arial" size="2" color="blue"><b><i>Intake Stroke:</i>
In the carburetor gasoline is broken into small droplets and mixed with air. In the cylinder, the intake
valve opens and the piston moves downward, drawing the air - gasoline mixture into the
cylinder.</font></td>
</tr>
<tr>
<td width="260" height="175"><img src="Compression.gif" width="260" height="175" border="1"></td>
<td width="340" height="175"><font face="arial" size="2" color="blue"><b><i>Compression Stroke:</i>
The intake valve closes and the piston moves upward. The fuel and air mixture is
compressed into the ever smaller space.</font></td>
</tr>
<tr>
<td width="260" height="175"><img src="Power.gif" width="260" height="175" border="1"></td>
<td width="340" height="175"><font face="arial" size="2" color="blue"><b><i>Power Stroke:</i>
When the piston is almost at the top, a spark plug produces a spark and ignites the fuel. The fuel and air
mixture explodes, pushing the piston back down. Energy is transferred by the downward motion of the
piston to the wheels by the crankshaft.</font></td>
</tr>
<tr>
<td width="260" height="175"><img src="exhaust.gif" width="260" height="175" border="1"></td>
<td width="340" height="175"><font face="arial" size="2" color="blue"><b><i>Exhaust Stroke:</i>
As the crankshaft turns, the piston is pushed upward again. As it moves upward it
compresses the waste products. The exhaust valve opens to let the waste out.</font></td>
</tr>
</table></center>
<a href="Internal Combustion index.htm"><i><font size="2">Click here to return to the home
page.</font></i></a></body>
</html>
Advanced Static and Dynamic Visualization

V204.
Demonstrate advanced visualization processes.

V204.01
Summarize advanced 3D modeling.

V204.02
Interpret advanced animation techniques.

V204.03
Describe video-editing techniques

V204.04
Demonstrate video editing techniques.
UNIT D: Advanced Static and Dynamic Visualization

COMPETENCY: V204.
Demonstrate advanced visualization processes.

OBJECTIVE: V204.01
Summarize advanced 3D modeling.

Introduction: Students will learn how to model a scene in 3D space.

A. Lights and Shadows in a 3D scene.

Most 3D programs have some type of default lighting that can be changed to create a more realistic appearance of objects in a scene. The standard or default lighting does not represent real world lighting, but it is simple and fast. Numerous controls exist to modify the default settings and produce realistic images.

CG (computer graphics) lighting typically includes four elements.

a. Where in the scene the light is located (usually specified by X, Y, Z coordinates from the keyboard or by mouse operations)

b. Intensity of the light or how bright it is (usually specified with a range where the higher the number, the brighter the light)

c. Color (commonly specified using RGB values, i.e. black=0,0,0, white=255,255,255, pure red=255,0,0)

   RGB of 0, 0, 0 = black; 255, 255, 255 = white; 255, 0, 0 = pure red, etc.

d. Angle of incidence specifies that the more a surface is angled away from a light, the darker it appears. When the angle is 90˚ to the surface, the surface is lighter.

There are several basic types of CG (computer graphics) lights.

a. Point lights, also known as omni lights or local lights, simulate a single light bulb. They radiate light equally in all directions.

b. Spotlights throw light rays in a certain direction radiating from a single point in space.

   1. Spotlights produce a circular pattern of light known as the hotspot that grows elliptical in shape as the angle of the light’s centerline decreases.

   2. The intensity of the light fades with an increase in its distance from the centerline of the cone to its edge. This fading is known as dropoff.

   3. The width or spread of the cone can be controlled in most programs.

   4. Ambient light simulates the overall amount of light in the world around you.

      1. Ambient light does not come from any one point, nor does it extend in any one direction.

      2. Ambient light does not cast shadows; it lights all objects evenly and uniformly throughout the scene.
d. *Infinite* or *directional* light simulates the great distance of the sun by producing light rays that are parallel to each other, but that shine only in one direction.

1. All objects in the scene receive the same amount of light.
2. It is easy to get a decent rendering with only a single infinite light.

e. Lights do not have size or shape. Although represented by icons, lights do not appear in the rendered scene, only their effects.

Colored light

a. Colored lights can be used to create special effects.

b. Colored lights typically are not used as general lighting within a scene, but can be used to emphasis time. For example, use a yellow cast in a late afternoon scene, a pinkish tint to represent mornings, and white to represent noon. Longer shadows occur in the afternoon. Morning light is softer. Mid-afternoon light is hard and sharp.

c. Colored lights can be used to emphasis mood. For examples, red, orange, and yellow imply passion or anger, green implies peacefulness, and blue implies sadness or depression.

d. Color is a visual indicator of temperature. For example, use red to represent warmth and blues to represent coolness.

e. Objects in the real world derive their color, in part, from the reflections of objects around them. In computer graphics, color is pure. Blue light shining on a yellow object will cause the object to turn green.

f. Before starting your lighting, write down how you want the scene to look when it is finished.

g. The more lights you use, the longer the render times and the more RAM you will need.

The classic lighting layout (suggested as a starting point for lighting) consists of three lights.

a. Remove all default lighting from the scene, the scene is now black.

b. *Key light* – the primary light source in the scene. It is usually placed off to the side of the main feature in the scene. It is the strongest, brightest light. Typically it is the only light in the scene set to cast shadows. Local lights and spotlights are often used as key lights.

c. *Fill light* – the real world contains a certain amount of ambient light that is always present. In the computer scene the only light that appears is that which is inserted. The fill light is usually 25% – 50% the strength of the key light and is used to add enough light to soften the light provided by the key and to reduce or eliminate unwanted shadows. Place the fill light opposite the key.

d. *Backlight* – adds depth to the scene by separating the objects from the background, giving them more of a defined shape. As the name implies the light is placed behind the objects in the scene and is about 50% – 100% the intensity of the key.
Lighting moods

a. **High key lighting** places the key light in front of and above the items in the scene to create interior, daylight scene. A 50% intensity fill light is placed in front of the items and off to the side. Place the back light at ground level at 1.5 times the key.

b. **Low key lighting** is a key light placed higher in the scene than in the High Key setup. The key is often placed to the side. Low key settings are used for nighttime scenes.

c. **Frontal lighting** does what the name implies; it places the key in front of the scene, but it also places the key high above the scene to produce an effect similar to an overhead light would produce.

d. **Side lighting** places the key light at eye level and in front of the scene to produce light that simulates sunlight.

**Attenuation** simulates the diminishing (fading) of a light’s intensity over a distance. Most computer graphics programs do not include attenuation as a default; it must be set if you want your scene to emulate natural lighting.

a. *Decay* measures the amount of fade or lessening of intensity. For example, a decay value of zero means that there is no decay or loss of intensity.

b. *Falloff* describes how the light energy is dispersed. For example, a *linear falloff* setting will cause the light to dim in direct proportion to how far the light is away from its source while a *squared falloff* has the light dim in proportion to the square of the distance from the light source. *Squared falloff* most closely simulates light in the real world.

c. Objects close to a light source appear brighter; the farther they are away from the source, the darker they should appear.

Shadows play an important role in lighting.

Shadows add depth and realism to a scene.

The angle of your light source determines the length and size of the shadows.

B. Using cameras in a 3D scene

1. There are four main elements effecting camera usage.

   a. Where you are standing as you view the scene is the camera location or the eye location.

   b. Where you are looking is the center of interest or camera interest.

      The tilt of the camera

      The camera’s zoom

2. Free and Target cameras

   a. A free camera can point anywhere in a scene. It is more useful when panning a scene.

   b. A target camera points to an object and is used for tracking animation. Both the camera and the target can be animated separately.
3. Camera parameters
   a. Lens – the length of the lens can be changed (i.e. for close ups.)
   b. Orbit -- the camera can be rotated around an object.
   c. The field of view is an angle that defines the objects that you can see as you look in a particular direction. Objects to the left or right of your field of view will not be seen. Camera zoom and lens settings effect you field of view. A wide angle takes in more of the scene while a narrow angle produces a tight shot.
   d. The depth of field is a measurement of focus accuracy for a given distance. For example, when you look at a scene the main subject may be in focus while the background and foreground would appear blurred.
   e. Zoom – Moves the camera closer or farther away from an object.

4. Camera placement- Camera placement will affect the mood, the perception, and the interest of a viewer. Framing camera shots can help the viewer understand the story.
   a. Long shots display the environment and are used to define the general area before the character is displayed or action begins.
   b. Medium distance shots might be from a character’s waist or chest to their head and would be used to make gestures or movements clear.
   c. Close-ups might show the individual parts of a cell, the rim of a test tube, or the opening of a book.
   d. An example of how framing might be used would be a scene where a truck is traveling down a highway: you first see it as a small object that is a part of its environment (long shot); it grows larger and the environment around it is reduced (medium shot); as it passes, only the individual elements of the vehicle are shown (close-up.) The shots are reversed as the truck moves away from you.

5. Storyboards are an important element in defining and preparing for camera locations and other decisions.

C. Mapping
   1. Texture Mapping
      a. Surfaces may have single colors or they may have multiple color patterns, which are commonly referred to as textures. For example, wood has a characteristic appearance because of its varying color patterns. Even materials like metals which seem to be one color, when closely examined, reveals varying shades and colors mixed in random patterns.
      b. The term texture in 3D computer graphics refers to image patterns rather than the “feel” of materials.
      c. The most basic type of texture is a 2D picture (often saved as a .jpg, .bmp or .tga files) which is then applied to an object.
      d. Surfacing (applying textures to surfaces) is an extremely important part of making objects look realistic.
Textures may be acquired in different ways.

Most 3D programs come with libraries of materials where you can select various materials and patterns.

Typically, 3D programs allow materials to be added to the library

1. New materials can be made by combining existing library selections using “mixing formulas” provided by other 3D artists.
2. There are graphics programs designed for creating 2D textures that can be found on the Internet or through software suppliers.
3. Digital cameras can be used to capture textures (1024 x 768 resolution or higher is best.)
4. Photography can be used for acquiring textures but the pictures will need to be saved in a digital format or they will need to be scanned.
5. “Paper” images, patterns, and textures can be scanned to create extended texture libraries.
6. Software plug-ins are available with complex textures.
7. Textures may be purchased as part of software packages or downloaded from Internet sites.

Textures need to be **seamless** so that they can be repeated over a mesh without showing where the individual **tiled** patterns join together.

*Projection mapping* is a commonly used technique that works sort of like a film projector by projecting the texture patterns onto the surface of the objects.

Textures may be projected from several directions at one time.

UVW space is how the map is applied to an object. The U applies to the X-axis, the V to the Y-axis, and the W to the Z-axis.

UV mapping is a way of trying to solve the distortion problems that occur when applying image maps (textures) to complex surfaces.

Many 3D graphics programs allow texture image scaling and placement controls.

1. Texture images are composed of 2D pixels.
2. When applying the image map, the 3D surface is divided up into the same number of rectangular polygons as there are pixels on the image to be applied. This process assigns the grid pattern to the 3D surface to coincide with the XY dimensions of the 2D texture.
3. Because the 3D surface may be curved, it is necessary for the surface geometry polygons to assume different dimensions than the image pixels. The change in geometry polygon width and height dimensions causes a distortion of the image pixels.

By applying UV scaling and placement restraints the most appropriate fit of the image can be obtained.
1. **Scale commands** – Allows you to change the size of the material rectangle in relation to the object’s surface. If the scale is 1.0, the 2D image covers 100% of the 3D surface, if the scale is 0.5 it would only cover 50% of the surface in both the U and the V directions (or ¼ of the total surface).

2. **Placement commands** – Alters the UV position of the material rectangle in relation to the object’s surface. Typically the user specifies the beginning point of the map, usually at UV = 0,0. It is possible for an image to be wrapped if the image is scaled to 1.0 and the beginning point is set at more than UV = 0, 0.

3. **Repetition commands** – Controls tiling by specifying the number of times the pattern repeats over the surface.

By manipulating UV controls, it is also possible to apply textures to parts of surface as well as the entire surface.

2. **Bump Mapping (bump texture mapping)**
   a. Bump maps simulate the roughness of surfaces even though the surfaces are perfectly flat. Bump maps make an object appear to have a bumpy or irregular surface or to create embossed looks. It can do this because higher areas are light and lower areas are dark.
   b. Surface roughness might include the unevenness of a brick surface, the weave of a fabric, the bumpiness of an orange, or the craters of a planet.
   c. The illusion of roughness can be created because an irregular surface would have light and dark areas caused by the surface normals pointing in different directions. The artificial tipping of the surface normals fools the software into displaying the surface as rough.
   d. The process of creating artificial roughness takes less computing power than actually dividing the surface into large numbers of polygons and moving the vertices of those polygons up or down to create a real roughness.
   e. *Aptitude or intensity* settings allow the user to determine the height and depth of bumps.
   f. Bump maps can be produced by photographing surfaces, scanning images and actual materials, or by using software programs to draw patterns in grayscale.

3. **Reflection and Refraction**
   a. A reflection map creates the illusion of shiny metals and glass by reflecting rays off the object’s surface.
   b. Reflections look more realistic if specular (color, size and shape of highlights) levels and glossiness (shininess) are varied according to the material being described.
   c. Some non-metallic materials may need a polished look.
   d. Refraction mapping provides realism when looking through a surface such as water in a glass.
   e. The index of refraction controls how much the light is bent as it passes through the object.
f. Various materials have a different index of refraction based upon the density of the materials.

C. Environmental Mapping

1. One of the effects that can add realism to a scene is to define the environment. Is it foggy? Is it the dusty blackness of space? The use of environmental effects can be used to add color, texture, or atmospheric conditions to the entire scene instead of to a single object.

2. Environmental mapping allows the reflection of an image onto the surfaces of the objects within the scene. For example using clouds, as an environmental map would not only place clouds in the background, it would also cause the clouds to be reflected on shiny objects within the scene.

You can change the background color so that the color appears everywhere object geometry is not present.

Pictures saved as jpegs can be used to add a background scene much like backdrops are used in stage productions.

In the real world, the colors change depending upon the distance that you are from the object. The color of a distance object is less vibrant than that of similar objects that are located closer to you. Most computer graphics programs do not automatically create this effect, but they give you the opportunity to generate atmospheric effects such as fog, haze, fire, and smoke.

Wall with texture map of bricks
UNIT D: Advanced Static and Dynamic Visualization

COMPETENCY: V204.
Demonstrate advanced visualization processes.

OBJECTIVE: V204.02
Interpret advanced animation techniques.

Introduction: The purpose of this unit is to introduce advanced animation and rendering techniques. Students are expected to have previous knowledge on 3D modeling basics. Note: Different 3D animation software packages have similarities but also have specific differences in achieving the same results in 3D modeling and animation.

A. Animation is the process of giving life or movement to drawings or objects.

   Student generated animation
   a. Students can manually transform, move, and/or modify 3D objects.
   b. Students can manually set animation parameters.
   c. Manual animation changes will create key frames. Key frames are frames that demonstrate major action. A computer will fill in the frames between each key frame. These filled in frames are called tweens. This process sped up the animation industry greatly since all of the frames did not have to be hand drawn.

   Example: Frame one is a key frame set by the student (teapot on a table.) Frame 100 is a key frame set by the student (teapot on the floor.) Frames 2-99 are filled in by the computer and are called tweens.
   d. Students can insert and delete key frames in appropriate locations.
   e. Students can move and copy key frames to appropriate locations.
   f. Movements into and out of key frames can be controlled. Imagine a ball bouncing on the floor. The movement of the ball is not smooth since the ball slows as it nears the top of its path and speeds up as it bounces. This effect can be achieved by editing these movements in and out of the key frames.
   g. Pivot points (axis origin) can be adjusted.

   Example: A door hinge has a pivot point on the side of the door. The door’s pivot point needs to be moved from the default (center) to the edge.

Computer generated animation
   a. Students can apply computer-generated transformations, movements, and/or modifications of 3D objects.
   b. Students can apply computer-generated settings of animation parameters.
   c. Morphing is changing an object’s geometry from one shape to another.
      1. Used for facial animation
      2. Blends from one object into another object
3. Materials can also be morphed.

d. Controllers can add animation. An object can be made to follow a path in a path controller.

e. Animation can simulate environmental effects such as detonation, gravity, water movement and flag waving.

f. Particles can be rendered. Particles can include sprays, rain, or snow. Other objects can be instanced on the particle system so it can really rain cats and dogs. There are different types of particle systems available with different parameters that can simulate physical forces of nature. Particle systems add lots of rendering time to your animations.

B. Timeline for 3D animation

1. Frame rate is the number of frames used in an animation and how fast they will run.
   a. Students can lengthen or shorten an animation by adding or subtracting frames.
   b. Students can make adjustments to key frame for editing purposes.
   c. Students can set the frame rate and number of frames.
      1. 24 frames per second is used for editing motion-picture film.
      2. 25 frames per second is used for editing PAL (European standard.)
      3. 30 (29.97) frames per second is used for editing NTSC (North American standard) video (television.)
   d. Students will be able to calculate the number of frames and play rate in an animation.
      1. Using NTSC, a 120-frame animation will play for about 4 seconds.
         \[
         \frac{120\text{frames}}{30\text{frames per second}} = 4 \text{ seconds}
         \]
      2. If a NSTC animation plays for 10 seconds, then there are 300 frames.
         \[
         10\text{ seconds} = \frac{300\text{ frames}}{30\text{ frames per second}}
         \]

2. Loop animation -- animations can be looped many times. This is useful in repeating a needed movement such as a bouncing ball.

C. Animating Cameras

1. Camera movement can add to your animations by allowing your audience to know more about the environment. The rate of movement helps the viewer understand distances within your scene.
   a. Architects use walkthroughs to show clients what the proposed structure will look like. The camera follows a defined path, which is a line of motion the viewer takes as they walk around or through the building.

   b. Look At tools automatically point a camera’s Z axis at a selected object’s axis origin and keeps the camera pointed at the object regardless of the path. In some programs, the Look At tool can be used to control not only cameras but also other tools such as a light.
c. Attaching a camera to an object is a simple way of getting the camera into the action. An example would be a roller coaster ride where the camera is glued to a passenger car and set to look ahead as the objects in the scene pass.

d. Motion blur tools blur everything in the scene, which can add realism to the scene.

D. Hierarchy and Linking

1. To achieve realistic action, you must study movement. Professional cinematographers expend significant resources mapping the motion of humans, animals, insects, and objects when trying to create realistic computer graphic scenes.

2. The motion of a bouncing ball is simple when compared to the multiple movements involved as the human leg is lifted, moved forward, and replanted on the walking surface. Complex objects may be created from several parts (each with its own origins) that require individual movement or movement of all parts together as one unit.

3. A part of the solution to complex structures with different origins and X, Y, Z-axes is to organize the parts into a hierarchical structure. Hierarchies allow the user to move the entire object and/or select and move individual components. An example is the model of a truck, which consists of wheels and a body. The wheels need to rotate around their axes while moving forward with the body in a defined direction.

4. Hierarchical structures allow the individual parts to be moved, rotated, scaled, colored, or textured independently. A complex object formed by parts that are unioned will only assume a single color or texture and allow only a single transformation of the entire structure.

5. Computer graphics programs allow the parts to be linked using different hierarchies, the most common being the Parent-Child and the Sibling.

   a. The highest element within the hierarchy is the parent or in our example, the entire truck.

   b. The lower levels would be the children or in our truck example, the individual wheels.

   c. The child(ren) will follow the parent wherever the parent goes in a Parent-Child relationship.

   d. Children may have sub-parts, which would be children of the children.

   e. Where the individual links are equal and do not contain a “highest level,” you have a sibling relationship.

E. Render and Output

1. Rendering will allow an animation or scene to be used in other applications. Also, files can be rendered using different file formats and different compressions.

2. A scene can be rendered from any view including a camera.

3. Output can include a single frame, an active time segment, and a range of frames.

4. Common output sizes include 320x240 through 800x600. The larger the output size, the longer the rendering time.
5. Common single frame output formats include bitmap, JPEG, TARGA, and TIFF.
6. Common multi-image formats include AVI and MOV.
7. Rendered images can be compressed. Compression will reduce the size of the file. A CODEC is used to compress the file.
8. A common CODEC is Cinepak. Using different CODECs will depend on your subject matter and desired output.
9. Basic post-production editing are effects that are added to a scene after the scene has been rendered.
   a. Lens Flare -- adds a sense of reality by recreating the effects that occur in real camera lenses such as streaks of light and secondary flares. Glows, rings, and streaks are some common effects that can be added to a lens flare.
   b. Depth of field can be controlled. Objects inside of the focal range can become blurred while the main subject stays in focus. Depth of field is determined by the focal point and focal parameters.
   c. Environmental mapping will add a map to the environment. This is useful for adding clouds to a sky or stars to a background.
   d. Blurs can be added to scenes or images to give the illusion of movement.
10. Atmospheric effects can also be added when rendering. Examples include fog, volume fog, combustion, and volume light. Adding fog to a scene can add realism.
11. Once files are created, they can be converted from one format to another depending on the software application.
   a. AVI
   b. QuickTime
   c. Real Player
UNIT D: Advanced Static and Dynamic Visualization

COMPETENCY: V204.
Demonstrate advanced visualization processes.

OBJECTIVE: V204.03
Describe video-editing techniques.

Introduction: In this unit students will learn about video editing techniques. This unit can be taught in conjunction with the performance objective 4.04.

A. Video post-production.
   1. Creating an animation using a program such as 3D Studio Max or trueSpace is often just a part of a total video production process.
   2. Video editing software (such as Adobe Premiere) offers the opportunity to enhance animation productions with sound, still images, and scene transitions.
   3. The addition of sound can add realism and interest to a video production.
   4. Titles and single images (static or scrolling) provide additional information.

B. Digital versus analog
   1. Analog (linear) devices record light and sound as continuously changing electrical signals described by a continuous change of voltage. Digital recordings are composed of a series of specific, discrete values which are recorded and manipulated as bits of information, which can be accessed or modified one bit at the time or in selected groups of bits.
   2. Digital media is stored in a format that a computer can read and process directly.
      a. Digital cameras, scanners, and digital audio recorders can be used to save images and sound in a format that can be recognized by computer programs.
      b. Digital media may come from images created or sound recorded directly by computer programs.
   3. Analog media must be digitized or converted to a digital format before a computer can work with the material.
      a. Analog images may be obtained from such sources as older video cameras working with VHS or SVHS. Analog sounds may come from sources such as audiotapes and recordings.
      b. Hardware devices such as a video capture card must be attached to the computer to bring analog materials into computer video editing programs.
   4. Sufficient computer resources are needed for digital video editing.
      a. Fast processors are needed to process the video.
      b. Additional RAM beyond customary requirements is needed. The number of frames that you can watch and work with depends upon how much RAM you have.
c. Very large hard drives are needed. A few minutes of DV footage will require a vast amount of storage.

d. Video cards should be capable of working with 24-bit color depth displays.

e. Large monitors are better to work with due to the need to work with numerous software displays.

C. Specifying project settings

1. Selecting settings can be a complex task requiring an understanding of input resources and output goals. The ability to make good decisions regarding capture, edit, and output settings require an understanding of topics such as frame rates, compression, and audio. Numerous books (such as Antony Bolante’s *Premiere*) address these topics and are a needed resource for the person working with video production. *Experience* is still a really good teacher.

2. General settings
   a. Timebase specifies time divisions used to calculate the time position of each edit, expressed in frames per second (fps).
      1. 24 is used for editing motion-picture film
      2. 25 for editing PAL (European standard)
      3. 29.97 for editing NTSC (North American standard) video (television)
   b. Frame *rate* indicates to the number of frames per second contained in the source or the exported video. Whenever possible, the timebase and frame rate agree. The frame rate does not affect the speed of the video, only how smoothly it displays.
   c. *Timecode* is a way of specifying time. Timecode is displayed in hours, minutes, second and frames (00:00;00:00). The timecode number gives each frame a unique address.

3. Video setting
   a. Frame *size* specifies the dimensions (in pixels) for frames. Choose the frame size that matches your source video. Common frames sizes include:
      1. 640 x 480 – standard for low-end video cards;
      2. 720 x 486 – standard-resolution professional video;
      3. 720 x 480 – DV standard; and
      4. 720 x 576 – PAL video standard (Used in Europe.)
   b. *Aspect ratio* is the ratio of width to height of the video display.
      1. *Pixel aspect ratio* is the ratio for a pixel while the *frame aspect ratio* is the width to height relationship for an image.
      2. 4:3 is the standard for conventional television and analog video.
      3. 16:9 is the motion picture standard.
4. Distortion can occur when a source image has a different pixel aspect ratio from
the one used by your display monitor. Some software may correct for the
distortion.

c. CODECs (compressor/decompressor) specify the compression system used for
reducing the size of digital files. Digital video and audio files are very large and must
be reduced for use on anything other than powerful computer systems. Some
common CODECS include systems for QuickTime or Windows.

1. *QuickTime* (movie-playing format for both the Mac and Windows platform) -
Cinepak, DV-NTSC, Motion JPEG A and B, Video

2. *Video for Windows* (movie-playing format available only for the Windows
platform) – Cinepak, Intel Indeo, Microsoft DV, Microsoft Video1

d. *Color bit depth* is the number of colors to be included. The more colors that you
choose to work with, the larger the file size and in turn, the more computer resources
required.

1. 8-bit color (256 colors) might be used for displays on the Web.
2. 24-bit color (millions of colors) produces the best image quality.
3. 32-bit color (millions of colors) allows the use of an alpha channel.

4. Audio settings

a. Audio *bit depth* is the number of bits used to describe the audio sample.

1. 8-bit mono is similar to FM radio
2. 16-bit is similar to CD audio

b. Audio *interleave* specifies how often audio information is inserted among the video
frames.

c. *Audio compression* reduces file size and is needed when you plan to export very large
audio files to CD-ROMs or the Internet.

d. Audio formats include WAV, MP3, and MIDI files. MIDI files do not include vocals.
MPEG files can also include audio.

D. The editing process

1. Visual and audio source media are referred to as *clips*, which is a film industry metaphor
referring to short segments of a film project.

a. Clips may be either computer-generated or live-action images or sounds that may last
from a few frames to several minutes.

b. Bins are used store and organize clips in a small screen space. Bin is another film
industry metaphor, which is where editors hung strips of film until added to the total
production. Bins are sometimes referred to as folders.

2. Editing tools

a. Opening and viewing clips
1. Images must be in a format that the video editing software can recognize such as an avi (for animation), wav (for sound), or jpg (for still image) before it can be imported.

2. Many software programs provide both a “source” window and a separate “program” window where the entire production can be monitored.

3. Sound clips may be displayed as a waveform where sounds are shown as spikes in a graph.

4. Playback controls are a part of most viewing windows. Play, Stop, Frame back, frame forward are typical of window commands.

5. The Timeline helps cue the user as to the relative position and duration of a particular clip (or frame) within the program by graphically showing the clips as colored bars whose length is an indication of the duration. As clip positions are moved along the timeline, their position within the program is changed.

6. Typically the timeline will include rows or individual tracks for images, audio, and scene transition clips. The tracks often include a time ruler for measurement of the clips duration.

7. Some programs allow the duration of a clip to be changed by altering the length of the bar representing the clip. Scenes within the program may be slowed or the speed increased using this stretch method.

b. Cutting and joining clips

1. Software tools are typically available for selecting a clip on the timeline and then cutting the bar that represents the clip. Using this process, segments of “film” may be separated, deleted, moved, or joined with other clips.

2. Cutting and joining may be used on audio or video.

c. Transitions allow you to make a gradual or interesting change from one clip to another by using special effects.

1. Transitions might include dissolve, page peels, slides, and stretches.

2. The number and types of transitions available depend upon the software you are using.

d. Audio mixing is the process of making adjustments to sound clips.

e. Title clips that include text and/or graphics can be created and inserted into the program using title windows.

1. Use of an alpha channel allows you to superimpose the title over other clips.

2. Title rolls allow text to move from the bottom of the screen to beyond the top and are often used for credits.

3. A title crawl moves the text (and/or graphics) horizontally across the screen. News bulletins along the bottom of the television are an example of this type of effect.
4. Text and graphics may be created in other programs and inserted as title clips. Video editing programs are usually limited in their ability to create and manipulate text and graphics.

f. By using layering techniques, adjusting opacity, and creating transparency, composite clips can be created.
   1. Bluescreen (greenscreen) and track hierarchy allow background scenes to be overlaid and image editing to occur.
   2. *Keying* makes only certain parts of a clip transparent which can then be filled with other images (clips on the lower tracks of the timeline.)

E. Creating Output

1. Output may be to videotape for display on a television or to a digital file for display through a computer output device.

2. Output may be put into other presentation programs such as PowerPoint.

3. Export goals will determine the output settings that you choose.
   a. Does the production need to operate on Windows and/or Mac platforms?
   b. What software will be used to play your production?
   c. What image quality is required?
   d. How big can the file size be?
   e. Will the production need to be displayed on the Web?

4. Common digital outputs
   a. Audio Video Interleave (avi) – for use on Windows only computers, good for short digital movies.
   b. QuickTime – a cross platform Apple format that is popular for Web video.
   c. RealVideo – RealNetworks streaming video is an extremely popular format.

5. Video editing programs may be exported to other multimedia programs (such as *Macromedia Director* or *Authorware*) for addition editing or integration with other materials such as *Flash* programs.
UNIT D: Advanced Static and Dynamic Visualization

COMPETENCY: V204.
Demonstrate advanced visualization processes.

OBJECTIVE: V204.04
Demonstrate video editing techniques.

Introduction: This tutorial will help students understand how to edit video clips and add sound to create a finished movie. The tutorial was written for Adobe Premiere and should be adapted for other video editing software as needed.

Materials:

- Bowling alley images (on CD)
- Sounds (on CD)
- Tutorial (in appendix B and on CD)
- Video editing program

Requirements:

1. Working independently, students should draw a storyboard of the project using the video clips and sounds provided.
2. Using Adobe Premiere students will import supplied video and audio files into the bin library.
3. From the bins, students will place video and audio files into the time line. Student can fine tune positions of the video and audio files. This is video-editing.
4. Add transitions between the videos.
5. Add title slides and credits.
6. Export movie to correct file format.

Assessment:

The movie plays with all provided clips and has sound 20 points
Transitions are present and work 20 points
Credits and titles are included 20 points
The movie is seamless 20 points
The sound matches the video 20 points

Total 100 points
**Rubric:**

**The movie plays and has sound**

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<th>Points</th>
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<td>Plays correctly</td>
<td>20 points</td>
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**Transitions are present and work**

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<th>Points</th>
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<tr>
<td>Not display correctly</td>
<td>12-19 points</td>
</tr>
<tr>
<td>Present and display correctly</td>
<td>20 points</td>
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**Credits and titles are included**

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<td>Not correct</td>
<td>12-19 points</td>
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<tr>
<td>Correct and display correctly</td>
<td>20 points</td>
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**The movie is seamless**

<table>
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<th>Video, transitions, credits, sound clips</th>
<th>Points</th>
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<td>0-11 points</td>
</tr>
<tr>
<td>Most connect without overlap</td>
<td>12-19 points</td>
</tr>
<tr>
<td>All connect without overlap</td>
<td>20 points</td>
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**The sound matches the video**

<table>
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<th>Sound</th>
<th>Points</th>
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<tr>
<td>Few match the video</td>
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Advanced Scientific Visualization

V205.
Demonstrate advanced scientific visualization.

V205.01
Explain cells and their parts.

V205.02
Create a visualization of the cell and its parts.

V205.03
Explain plate tectonics.

V205.04
Create a visualization of plate tectonics.

V205.05
Describe DNA and gel electrophoresis.

V205.06
Create a visualization of DNA and gel electrophoresis.

V205.07
Explain different simple machines.

V205.08
Create a visualization of simple machines.

V205.09
Create an advanced visualization.

Note: This unit will allow the students to practice their multimedia skills. The activities may be adapted to different multimedia packages as long as the information in the cognitive objective is covered. Examples could include web pages and video-editing software.
UNIT E: Advanced Scientific Visualization

COMPETENCY: V205.
Demonstrate advanced scientific visualization

OBJECTIVE: V205.01
Explain cells and their parts.

Introduction: The purpose of this unit to familiarize students with plant and animal cells and their parts. The information can then be used in objective 4.02

Cells are the fundamental units of living material. They contain special structures called organelles, which have specific functions for maintaining the life and health of the cell.

A. Animal Cells -- The bodies of all living organisms are made of cells; without cells there would be no life.

1. Cell membrane
   a. The membrane is a double layer of lipids along with numerous proteins that are important to cell activity. These proteins include receptors, pores, and enzymes. The contents of the membrane float together in a “Fluid Mosaic” manner.
   b. The lipid layer (called phospholipids) is a water-fearing molecule.
   c. The membrane is responsible for the controlled entry and exit of substances.

2. Nucleus
   a. The nucleus is like the brain of the cell. It controls every part of the cell and its functions. It is a membrane-bound organelle surrounded by a double membrane. It communicates with the surrounding cell through numerous nuclear pores.
   b. Within the nucleus is the DNA. When a cell is dividing, the DNA and surrounding protein condense into chromosomes that are visible by microscopy.
   c. The prominent structure in the nucleus is the nucleolus. The nucleolus produces ribosome and RNA.

3. Mitochondria
   a. Mitochondria provide the energy needed by the cell. This process is call respiration. They are the power centers of the cell and have different shapes depending on the cell type.
   b. Mitochondria are double membrane-bound organelles. The outer membrane is fairly smooth, unlike the inner membrane, which is highly convoluted, forming folds called cristae. The cristae increase the inner membrane's surface area. It is on these folds that food (sugar) is combined with oxygen to produce ATP - the primary energy source for the cell.

4. Golgi bodies
a. The Golgi apparatus is a single membrane-bound structure. It is actually a stack of membrane-bound vesicles that are important in packaging large molecules for transport throughout the cell.
b. It is the packaging and shipping center of the cell.
c. The packages that are formed are called vesicles.

5. Ribosome
   a. Ribosomes look like tiny dots in the cytoplasm of the cell. Sometimes they float free and sometimes they are attached to the endoplasmic reticulum.
b. Ribosomes are the site of protein synthesis.
c. They read the code found in RNA, and assemble proteins needed by the cell for growth and internal functions.

6. Endoplasmic reticulum
   Throughout the cell is a vast amount of membrane called the endoplasmic reticulum, or ER for short. The ER connects with the outer nuclear membrane and the cell membrane.
   These membranes function as channels in the cell.
   c. Some areas of the endoplasmic reticulum look "smooth" (smooth ER) and some appear "rough" (rough ER.) The rough ER appears rough because ribosomes are on the membrane surface. Smooth and Rough ER have different functions. Smooth ER is important in the production of fats and membrane proteins. Rough ER is important in the synthesis of other proteins.

7. Vacuole
   a. Membrane bound organelles that store substances for the cell.
b. Vacuoles export or import substances in the cell by fusing with the cell membrane.

B. Plant Cells- Plant cells have two more organelles than the animal cell: the cell wall and the chloroplast. The vacuole is also much larger in a plant cell.

1. Cell Wall
   a. The cell wall is used for support of the plant. It is made up of a fiber called Cellulose to help perform this job.
b. Cellulose cannot be digested by living organisms.
c. The cell wall is connected to a cell membrane. The membrane is responsible for the controlled entry and exit of substances.

2. Nucleus
   a. The nucleus is like the brain of the cell. It controls every part of the cell and its functions. It is a membrane-bound organelle and is surrounded by a double membrane. It communicates with the surrounding cell through numerous nuclear pores.
b. The DNA is within the nucleus. When a cell is dividing, the DNA and surrounding protein condense into chromosomes that are visible through microscopy.

c. The prominent structure in the nucleus is the nucleolus. The nucleolus produces ribosome and RNA.

3. Mitochondria
   a. Mitochondria provide the energy needed by the cell through a process called respiration. They are the power centers of the cell and have different shapes depending on the cell type.
   
   b. Mitochondria are double membrane-bound organelles. The outer membrane is fairly smooth, unlike the inner membrane, which is highly convoluted forming folds called cristae. The cristae increase the inner membrane's surface area. It is on these folds that food (sugar) is combined with oxygen to produce ATP - the primary energy source for the cell.

4. Golgi bodies
   a. The Golgi apparatus is a single membrane-bound structure. It is actually a stack of membrane-bound vesicles that is important in packaging large molecules for transport throughout the cell.
   
   b. It is the packaging and shipping center of the cell of the vesicles.

5. Ribosome
   a. Ribosomes look like tiny dots in the cytoplasm of the cell. Sometimes they float free and sometimes they are attached to the endoplasmic reticulum.
   
   b. Ribosomes are the site of protein synthesis.
   
   c. They read the code found in RNA and assemble proteins needed by the cell for growth and internal functions.

6. Endoplasmic reticulum
   a. Throughout the cell is a vast amount of membrane called the endoplasmic reticulum, or ER for short. The ER connects with the outer nuclear membrane and the cell membrane.
   
   b. These membranes function as channels in the cell.
   
   c. Some areas of the endoplasmic reticulum look "smooth" (smooth ER) and some appear "rough" (rough ER.) The rough ER appears rough because ribosomes are on the membrane surface. Smooth and Rough ER have different functions. Smooth ER is important in the production of fats and membrane proteins. Rough ER is important in the synthesis of other proteins.

6. Chloroplast
   a. The chloroplast is the site for photosynthesis where the cell takes sunlight, water, and carbon dioxide to make glucose for the plant and oxygen for the world.
   
   b. Chlorophyll is the green pigment found in the chloroplast. The chlorophyll collects the sun’s energy.
c. Structure includes an outer membrane with stacks of grana inside. These grana, or “stacks of coins,” are made up of membrane-bound chambers called thylakoids.

7. Vacuole
Membrane-bound organelles that store substances for the cell.
Vacuoles export or import substances in the cell by fusing with the cell membrane.

**Plant Cell (student work in CorelDraw)**

**Animal Cell (student work in CorelDraw)**
UNIT E: ADVANCED SCIENTIFIC VISUALIZATION

COMPETENCY: V205.
Demonstrate advanced scientific visualization.

OBJECTIVE: V205.02
Create a visualization of the cell and its parts.

Introduction: The purpose of this unit to allow students to apply what they have learned in class to a new science topic. Multimedia concepts such as 2D, 3D, and video may be used.

Materials:
- Presentation software such as PowerPoint
- Research medium such as the Internet
- Drawing software such as CorelDraw
- 3D animation software such as 3D StudioMax or trueSpace

Requirements:
1. Students should work in groups of 2.
2. Each group should explain the parts of an animal or plant cell in multimedia presentation software such as PowerPoint. Power Points should be timed.
3. Students should research the topic and develop a storyboard for their presentation.
4. The presentation needs to have a 2D or 3D visualization of an animal or plant cell with all of the internal parts labeled and placed near the front of the presentation (see examples p. 73.)
5. Each internal organelle of the cell should be placed on additional slides or in a later part of the presentation.
6. Graphics to explain each cell organelle need to be original.
7. The cell wall or membrane and its functions should be visualized with a 3D video package such as 3D Max or trueSpace.
8. Other type of original work may be included. Data and images may NOT be copied off of the Internet.
9. Organelles to include are the nucleus, mitochondria, cell wall (plant), cell membrane (animal), endoplasmic reticulum (rough and smooth), Golgi body, vacuole (plant), chloroplast (plant), and ribosome.

Variations:
Projects can be done as a web page.
Projects can be done and animated completely in a 3D modeling program (advanced.)
Cell mitosis can be animated in a vector-based program.
**Assessment:** The graphs should be evaluated based on the following:

- Visualization of cell and labeled parts: 15 points
- Presentation uses color, safe and ideal design: 10 points
- Visualization of organelles: 40 points
- Information is correct and adequate: 10 points
- Power Point works and is correctly assembled: 10 points
- Cell wall/membrane animation works, is accurate, and explains the process: 15 points

**Total:** 100 points
**Rubric:**

Visualization of cell and labeled parts

<table>
<thead>
<tr>
<th>3 or more of the organelles are missing or labeled incorrectly.</th>
<th>1-2 of the organelles is (are) missing or labeled incorrectly.</th>
<th>All cell organelles are represented and labeled correctly.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0-9 points</strong></td>
<td><strong>10-14 points</strong></td>
<td><strong>15 points</strong></td>
<td></td>
</tr>
</tbody>
</table>

Presentation uses color, safe and ideal design

<table>
<thead>
<tr>
<th>More than 5 of the following are missing.</th>
<th>3-4 of the following are missing.</th>
<th>1-2 of the following are missing.</th>
<th>Colors are complementary and 10 or less per presentation. Slide background and text are contrasting. The Safe and ideal design method was used correctly. Spacing and use of white space are correct on each slide. Text is at a minimum. No more than 2 images per slide. No more than 6 bullets per slide.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colors are complementary and 10 or less per presentation. Slide background and text are contrasting. The Safe and ideal design method was used correctly. Spacing and use of white space are correct on each slide. Text is at a minimum. No more than 2 images per slide. No more than 6 bullets per slide.</td>
<td>Colors are complementary and 10 or less per presentation. Slide background and text are contrasting. The Safe and ideal design method was used correctly. Spacing and use of white space are correct on each slide. Text is at a minimum. No more than 2 images per slide. No more than 6 bullets per slide.</td>
<td>Colors are complementary and 10 or less per presentation. Slide background and text are contrasting. The Safe and ideal design method was used correctly. Spacing and use of white space are correct on each slide. Text is at a minimum. No more than 2 images per slide. No more than 6 bullets per slide.</td>
<td><strong>6 0-00g</strong></td>
<td><strong>0-3 points</strong></td>
</tr>
</tbody>
</table>

Visualization of organelles

<table>
<thead>
<tr>
<th>5 or more of the organelles are missing, labeled incorrectly, explained incorrectly, or not on separate slides.</th>
<th>3-4 of the organelles are missing, labeled incorrectly, explained incorrectly, or not on separate slides.</th>
<th>1-2 of the organelles are missing, labeled incorrectly, explained incorrectly, or not on separate slides.</th>
<th>All organelles are represented correctly, labeled correctly, explained, and on separate slides.</th>
<th><strong>Total Points</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6 0-00g</strong></td>
<td><strong>0-7 points</strong></td>
<td><strong>8-26 points</strong></td>
<td><strong>27-39 points</strong></td>
<td><strong>40 points</strong></td>
</tr>
</tbody>
</table>
Information is correct and adequate

<table>
<thead>
<tr>
<th>Some of the information about each cell and organelle is not correct. It is copied from the Internet. There is not adequate information to explain each organelle.</th>
<th>Some of the information about each cell and organelle is not correct. It is not copied from the Internet. There is not adequate information to explain each organelle.</th>
<th>All information about each cell and organelle is correct. It is not copied from the Internet. There is adequate information to explain each organelle.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-00g</td>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
</tr>
</tbody>
</table>

Power Point works and is correctly assembled.

<table>
<thead>
<tr>
<th>Less than 70% of the slides work. Less than 70% are timed so it can be read and understood. Movies do not play when necessary. Images cannot be seen.</th>
<th>Most slides work. Most slides are timed so it can be read and understood. All movies play when necessary. Images can be seen.</th>
<th>All slides work. Each slide is timed so it can be read and understood. All movies play when necessary. Images can be seen.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-00g</td>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
</tr>
</tbody>
</table>

Cell wall/membrane animation works, is accurate, and explains the processes.

<table>
<thead>
<tr>
<th>The animation of the cell wall/membrane does not work, is not accurate, realistic, or detailed enough to explain the process.</th>
<th>The animation of the cell wall/membrane does not work correctly, is not completely accurate, realistic, or detailed enough to explain the process.</th>
<th>The animation of the cell wall/membrane works, is accurate, realistic, and detailed enough to explain the process</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9 points</td>
<td>10-14 points</td>
<td>15 points</td>
<td></td>
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</tbody>
</table>
UNIT E: Advanced Scientific Visualization

COMPETENCY: V205.
Demonstrate advanced scientific visualization.

OBJECTIVE: V205.03
Explain plate tectonics.

Introduction: The purpose of this unit is to familiarize students with the theory of plate tectonics including plate movement and boundary types. Students can then use the information for objective 5.04.

A. Theory of plate tectonics

1. According to the theory, the surface of the Earth is broken into large pieces of earth called plates. These plates float over an inner molten layer. The size and position of these plates change over time. An example of such movement is the idea of a super continent called Pangaea that existed millions of years ago. Evidence suggests that the separate continents we know today migrated from this one large land mass.

2. The edges of these plates are sites of intense geologic activity. Earthquakes, volcanoes, and mountain building can occur when they move against each other.

3. Plate tectonics are a combination of two earlier ideas, continental drift and sea-floor spreading.
   a. Continental drift is the movement of continents over the Earth's surface and their change in position relative to each other.
   b. Sea-floor spreading is the creation of new oceanic crust at mid-ocean ridges and movement of the crust away from the mid-ocean ridges.

B. Plate Boundaries

1. Many changes and movements in the earth’s crust originate along Lithospheric plate boundaries. These boundaries are not always easy to identify. The familiar outlines of the continents and oceans depicted on maps may not resemble the outlines made by the plate boundaries.

2. Plate boundaries can be in the middle of the ocean floor, around the edges of continents, or within continents. There are several types of plate boundaries, each of which is associated with a characteristic type of geologic activity.
   a. Divergent boundaries are two plates moving apart from each other. Also known as spreading boundary, a divergent boundary occurs where two plates move apart, allowing magma, or molten rock, to rise from the Earth's interior to fill in the gap. The two plates move away from each other like two conveyor belts moving in opposite directions.
      1. The process by which the plates move apart can also be referred to as sea floor spreading. At this type of boundary, new oceanic crust is formed in the gap between two diverging plates. Plate area is increased as the plates move apart.
2. Plate movement takes place laterally away from the plate boundary, which is normally marked by a rise or a ridge. The ridge or rise may be offset by a transform fault.

3. Presently, most divergent margins occur along the central zone of the world’s major ocean basins. The Mid-Atlantic Ridge and East Pacific Rise provide good examples of this type of plate margin.

b. **Convergent boundaries** are the direct collision of one plate with another. As seafloor spreading pulls plates apart at one boundary, those plates push into neighboring plates at other boundaries. The direct collision of one plate with another type of plate is called a convergent boundary. Three types of collisions can occur at convergent boundaries.

1. *Oceanic-continental convergence* -- One type occurs when a plate with oceanic crust at its leading edge collides with a plate with continental crust at its edge. Because oceanic crust is denser, it is subducted, or forced under the less dense continental crust. Scientists refer to the region along a plate boundary where one plate moves under another plate as a subduction zone. A deep oceanic trench generally forms along a subduction zone. As the oceanic plate moves down into a subduction zone, it melts and becomes part of the mantle material. Some of the magma formed rises to the surface through the continental crust and produces volcanic mountains.
2. **Continent-continent convergence** -- A second type of collision occurs when two plates with continental crust at their leading edges come together. During this type of collision, neither plate is conducted because they both have the same density. Instead, the colliding edges are crumpled and uplifted, producing large mountain ranges. Scientists are convinced that the Himalayas were formed by this type of collision.

3. **Oceanic-oceanic convergent** -- The third type of collision along convergent boundaries occurs between oceanic crust and oceanic crust. A deep ocean trench also forms when one of these plates is subducted. Part of the subducted plate melts, and the resulting molten rock rise to the surface along the trench to form a chain of volcanic islands called an island arc.

c. **Transform fault boundaries** occur where two plates are grinding past each other. Transform boundaries neither create nor consume crust. Rather, two plates move against each other building up tension and then releasing the tension in a sudden and often violent jerk. This sudden jerk creates an earthquake.

   **Example:** The San Andreas Fault is undoubtedly the most famous transform boundary in the world. To the west of the fault is the Pacific plate, which is moving northwest. To the east is the North American Plate, which is moving southeast. Los Angeles, located on the Pacific plate, is now 340 miles south of San Francisco, located on the North American plate. In 16 million years, the plates will have moved so much that Los Angeles will be north of San Francisco!

C. Measuring plate movement
1. Global Positioning System (GPS) is a constellation of 24 satellites which are used for navigation and precise geodetic position measurements. They can also be used to plot global velocities. Data can be obtained from web pages such as the following link.


2. Satellite Laser Ranging (SLR) determines round-trip time of light from ground-based lasers at widely separated points on the earth to mirrors on satellites. Information can be obtained from the following web page.

http://cddisa.gsfc.nasa.gov/slr_brochure/belmont_rpt.html

3. Very Long Baseline Interferometry (VLBI) uses the difference in time at widely separated places of received quasar-emitted radio signals and can also be used to obtain plate movement.

http://geowords.com/histbooknetscape/g11.htm

4. Volcanic and earthquake activity can also be measured to help determine plate movement. The “Ring of Fire” (area of volcanic activity) in the Pacific Ocean helped map out certain oceanic plates.

UNIT E: Advanced Scientific Visualization

COMPETENCY: V205.
Demonstrate advanced scientific visualization.

OBJECTIVE: V205.04
Create a visualization of plate tectonics.

Introduction: The purpose of this unit is to allow students to apply what they have learned in class to a new science topic.

Materials:
Presentation software such as Power Point
Research medium such as the Internet
Drawing software such as CorelDraw
3D animation software such as 3D StudioMax or trueSpace

Requirements:
1. Students can work in groups of two.
2. Students should research the topic and develop a storyboard for their presentation.
3. Each group should explain the process and theory of plate tectonics with a presentation package such as Power Point.
4. Students should include an easy demonstration of how the super continent Pangea changed into modern day plate locations. This can be accomplished by animating 2D images. The web site listed shows an example of a similar activity. Student examples are also included on the CD.
   http://www2.ncsu.edu:8010/scivis/lessons/cell2/cell2.html
5. Students need to include a visualization of earthquake data. The data should include size, location, and dates of the 15 largest earthquakes in the contiguous United States. The USGS web site will contain this information (see Appendix F for example data.) The students should not copy a chart from the Internet. Examples of ways to visualize the data include the following:
   • An original map of the US showing all of the information. The information can use a 3D effect showing the magnitude of each quake. The US Today Newspaper has many examples of this type of visualization. (See included student examples on CD.)
   • One or more graphs in excel can be used.
6. The presentation should have 2D or 3D visualizations explaining the different types of boundaries that occur between plates. Boundaries to include are convergent, divergent, and transform fault.
   • Include the resulting formations and effects of the moving plates at each boundary. Label all parts.
• The presentation should include at least one 3D animation depicting how the plates might move.

7. Data and images may NOT be copied off the Internet.

8. All graphics need to be original.

Variations:

1. Project can be constructed with a web page design. The drawing of the plates can be the launch page with links to each type of boundary between the plates. The links can direct the viewer to another page. The new page can display an image of the landform and boundary with a brief description.

2. The project can be done in Power Point with the same idea as explained in number one above. The first slide can contain the drawing of the plates. Links to other slides can be attached at each boundary. The links can direct the viewer to another slide. The new slide can display an image of the landform and boundary with a brief description. Be sure to include a home button on each boundary page.

Assessment:

| Description of theory and process/plate drawing | 10 points |
| Presentation uses color, safe and ideal design | 10 points |
| Visualization of boundaries | 40 points |
| Data for seismic activity in included and graphed | 10 points |
| Power Point works and is correctly assembled | 10 points |
| Plate animation works is accurate and explains the processes | 20 points |
| **Total** | **100 points** |
Rubric:

Description of theory and process

<table>
<thead>
<tr>
<th>The process is not explained thoroughly or correctly. Drawing and labeling of current plates have 3 or more errors.</th>
<th>The process is explained. Drawings of current plates are mostly correct. Plates are labeled.</th>
<th>The process is accurately and completely explained. A drawing of current plates in correct. Plates are labeled correctly.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
<td></td>
</tr>
</tbody>
</table>

Presentation uses color, safe and ideal design

<table>
<thead>
<tr>
<th>Background color does not contrast with the graphics. More than 10 colors are used. The presentation does not follow two or more of the safe design elements.</th>
<th>Background color does not contrast with the graphics. More than 10 colors. The presentation is simple, appropriate, functional and economical.</th>
<th>Background color contrasts with the graphics. 10 or less colors are used. The presentation is simple, appropriate, functional and economical.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
<td></td>
</tr>
</tbody>
</table>

Visualization of boundaries

| Some information on the boundaries may be omitted or not accurate. More than 5 errors. More than one boundary per slide. | Some information on the boundaries slides may be omitted or not accurate. No more than 5 errors. | Some information on the boundaries may be omitted or not accurate. Nor more than 3 errors. | All of the graphics for the boundaries are correct. Information is accurate. One boundary per slide. | Total Points |
|---|---|---|---|
| 6 0-00g 0-30 points | 30-43 points | 44-49 points | 40 points |

Power Point works and is correctly assembled

<table>
<thead>
<tr>
<th>Three or more of the following does not work. The program plays correctly, videos play, graphics show up, and proper spacing and font size is evident.</th>
<th>One or two of the following does not work. The program plays correctly, videos play, graphics show up, and proper spacing and font size is evident.</th>
<th>The program plays correctly, videos play, graphics show up, and proper spacing and font size is evident.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
<td></td>
</tr>
</tbody>
</table>

Plate animation works is accurate and explains the processes

<table>
<thead>
<tr>
<th>The video does not work or explain the type of boundary and/or plate movement. Information is not accurate.</th>
<th>The video works and explains the type of boundary and/or plate movement. Some information is missing or not accurate.</th>
<th>The video works and accurately and completely explains the type of boundary and/or plate movement.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-13 points</td>
<td>13-19 points</td>
<td>20 points</td>
<td></td>
</tr>
</tbody>
</table>
UNIT E: Advanced Scientific Visualization

COMPETENCY: V205.
*Demonstrate advanced scientific visualization.*

OBJECTIVE: V205.05
*Describe DNA and gel electrophoresis.*

Introduction: The purpose of this unit is to introduce student to DNA structure and gel electrophoresis.

A. The structure of DNA

1. DNA, or deoxyribonucleic acid, is a very large molecule called a polymer. Polymer means molecule with many units. The units or monomers of DNA are called nucleotides.
   a. Nucleotides are made up of a 5-carbon sugar (deoxyribose) a phosphate group and one of four nitrogen bases. The bases use letters to shorten their names.
      1. A is for adenine
      2. G is for guanine
      3. C is for cytosine
      4. T is for thymine
   b. Purine Bases -- Adenine and guanine are purines. Purines are the larger of the two types of bases found in DNA. They have a double ring structure.
   c. Pyrimidine Bases -- Cytosine and thymine are pyrimidines. They have a single ring structure.

2. Deoxyribose Sugar -- The deoxyribose sugar of the DNA backbone has 3 oxygen and 5 carbon atoms. The hydroxyl groups carbons link to the phosphate groups to form a DNA backbone.

3. DNA is composed of twisting strands of nucleotides. Each strand is a Helix or spiral staircase. The two strands bound together make DNA a double helix.
4. In the structural configuration of DNA, A and T always join together and form two hydrogen bonds while C and G always join together and form three hydrogen bonds. Because of the specificity of base pairing, the two strands of DNA are said to be complementary. This characteristic makes DNA unique and capable of transmitting genetic information.

B. DNA Fingerprinting

1. DNA Fingerprinting is a method of identification that compares fragments of DNA. DNA is the genetic material found within the cell nucleus. An individual's DNA is as distinctive as a fingerprint. With the exception of identical twins, the complete DNA of each individual is unique.

2. A DNA fingerprint is constructed by first obtaining a DNA sample from body tissue or fluid. The sample is then cut into pieces using enzymes and the segments are arranged by size using a process called gel electrophoresis.

3. Gel electrophoresis is a method that separates macromolecules like DNA on the basis of size, electric charge, and other physical properties.
   a. A gel is similar to Jell-O in consistency. The term electrophoresis describes the migration of charged DNA particles under the influence of an electric field. Electro refers to the energy of electricity. Phoresis, from the Greek verb phoros, means "to
carry across." Thus, gel electrophoresis refers to the technique in which molecules are forced across a span of gel motivated by an electrical current.
b. Holes are created in the gel that serves as a reservoir to hold the DNA solution.

c. DNA solutions (mixtures of different sizes of DNA fragments) are loaded into a well in the gel.

d. The gel matrix acts as a sieve for DNA molecules. Large molecules have difficulty getting through the holes in the matrix. Small molecules move easily through the holes because of this, large fragments will lag behind small fragments as DNA migrates through the gel.
e. Results are usually photographed in order to save the findings. Wells are then compared together for similarities. If two fingerprints match they are probably from the same DNA source (i.e. Crime scene blood and suspect blood.)
4. DNA fingerprinting technology has helped scientists to discover the genetic causes of many disease processes. Mapping the entire Human Genome (all of our DNA) has been one of the most massive scientific endeavors of all time. The complete human genome was completed in 2003.

![DNA fingerprinting diagram](image)

5. DNA fingerprinting helped advance forensic science and paternity testing. Which 2 DNA samples match?

![DNA fingerprinting diagram](image)
UNIT E: ADVANCED SCIENTIFIC VISUALIZATION

COMPETENCY: V205.
Demonstrate advanced scientific visualization.

OBJECTIVE: V205.06
Create a visualization of DNA and gel electrophoresis.

Introduction: Students will create a multimedia presentation of DNA and gel electrophoresis.

Materials:
3D animation software such as 3D StudioMax or trueSpace
Research medium such as the Internet

Requirements:
1. Students are to work independently.
2. Using 3D animation software, students need to animate the process of gel electrophoresis.
3. Students should research the topic and develop a storyboard for their presentation.
4. The student should have the following modeled in their animation:
   - Gel box
   - power supply
   - power electrodes
   - identification of the negative and positive sides of the gel box
   - identification of the sources of the DNA
   - (i.e. suspect, mother, father, evidence)
5. The student needs to have the following animated in their project:
   • the DNA being deposited into the gel box at the proper location
   • movement of the DNA fragments through the gel
   • A close up from a camera placed in the scene of the results
   • Proper lighting instead of default lighting (see unit on lighting)
   • Text that appears after the DNA has stopped moving, explaining the results

Variations: Advanced students can add PCR to their presentation.

Assessment:

All models are drawn correctly 30 points
Animation works correctly 30 points
Text is used to label the animation 15 points
Results are shown and explained 10 points
Correct color, size, lights and view of animation 15 points

Total 100 points
**Rubric:**

All models are drawn correctly

<table>
<thead>
<tr>
<th>3 or more of the following are not correct.</th>
<th>1-2 of the following are not correct.</th>
<th>The Gel box, gel, power supply, power electrodes, negative and positive ends, and sources of the DNA are drawn correctly and to scale.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Gel box, gel, power supply, power electrodes, negative and positive ends, and sources of the DNA are drawn correctly and to scale.</td>
<td>The Gel box, gel, power supply, power electrodes, negative and positive ends, and sources of the DNA are drawn correctly and to scale.</td>
<td>The Gel box, gel, power supply, power electrodes, negative and positive ends, and sources of the DNA are drawn correctly and to scale.</td>
<td>0-19 points</td>
</tr>
</tbody>
</table>

Animation works correctly

<table>
<thead>
<tr>
<th>2 or more of the following do not work correctly.</th>
<th>1 of the following does not work correctly.</th>
<th>The DNA is loaded in the gel, the DNA moves down the gel towards the positive end, and the results are animated correctly.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>The DNA is loaded in the gel, the DNA moves down the gel towards the positive end, and the results are animated correctly.</td>
<td>The DNA is loaded in the gel, the DNA moves down the gel towards the positive end, and the results are animated correctly.</td>
<td>The DNA is loaded in the gel, the DNA moves down the gel towards the positive end, and the results are animated correctly.</td>
<td>0-19 points</td>
</tr>
</tbody>
</table>

Text is used to label the animation

<table>
<thead>
<tr>
<th>3 or more of the following labels are missing and not visible at the correct time.</th>
<th>1-2 of the following labels are missing and not visible at the correct time.</th>
<th>3D text is used to label each well with the source of the DNA. 3D text is used to label the results. Text becomes visible at the correct time.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D text is used to label each well with the source of the DNA. 3D text is used to label the results. Text becomes visible at the correct time.</td>
<td>3D text is used to label each well with the source of the DNA. 3D text is used to label the results. Text becomes visible at the correct time.</td>
<td>3D text is used to label each well with the source of the DNA. 3D text is used to label the results. Text becomes visible at the correct time.</td>
<td>0-9 points</td>
</tr>
</tbody>
</table>

Results are shown and explained

<table>
<thead>
<tr>
<th>The gel does not show a match between two of the DNA samples and the matching wells are not labeled to explain the results (i.e. blood at crime scene matches the victim’s DNA.)</th>
<th>The gel does not show a match between two of the DNA samples or the matching wells are not labeled to explain the results (i.e. blood at crime scene matches the victim’s DNA.)</th>
<th>The gel shows a match between two of the DNA samples. The matching wells are somehow labeled to explain the results (i.e. blood at crime scene matches the victim’s DNA.)</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>The gel shows a match between two of the DNA samples. The matching wells are somehow labeled to explain the results (i.e. blood at crime scene matches the victim’s DNA.)</td>
<td>The gel shows a match between two of the DNA samples. The matching wells are somehow labeled to explain the results (i.e. blood at crime scene matches the victim’s DNA.)</td>
<td>The gel shows a match between two of the DNA samples. The matching wells are somehow labeled to explain the results (i.e. blood at crime scene matches the victim’s DNA.)</td>
<td>0-5 points</td>
</tr>
</tbody>
</table>
Correct color, size, and view of animation

<table>
<thead>
<tr>
<th>2 or more of the following are incorrect. The animation uses correct color (see unit on color.) The models fill most of the scene. The camera is used correctly to zoom in on the results. Lights are placed properly to correctly light the scene.</th>
<th>1 of the following is incorrect. The animation uses correct color (see unit on color.) The models fill most of the scene. The camera is used correctly to zoom in on the results. Lights are placed properly to correctly light the scene.</th>
<th>The animation uses correct color (see unit on color.) The models fill most of the scene. The camera is used correctly to zoom in on the results. Lights are placed properly to correctly light the scene.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9 points</td>
<td>10-14 points</td>
<td>15 points</td>
<td></td>
</tr>
</tbody>
</table>
UNIT E: ADVANCED SCIENTIFIC VISUALIZATION

COMPETENCY: V205.
Demonstrate advanced scientific visualization.

OBJECTIVE: V205.07
Explain different simple machines.

Introduction: Students will learn the six simple machines and how they function.

A. Simple machines are devices such as levers, ramps, and pulleys that make our work easier. They allow us to apply effort at one place to do work at another point and/or to change the direction of a force.

1. How simple machines change the work done.
   a. One way is to magnify an effort force so that a smaller effort can be applied over a longer distance thus moving a large load a small distance. Examples of this include a crowbar being used to dislodge a boulder, a nutcracker being used to crack a nut, or a block and tackle pulley system being used to lift a large weight.
   
   b. The mechanical advantage of a machine is the ratio of the load force to the effort force. The crowbar, nutcracker, and block and tackle pulley system have a mechanical advantage greater than one. Other machines have a mechanical advantage less than one allowing magnification of the distance and speed of a movement. An example of this might be a fishing rod or baseball bat.

2. The six types of simple machines are listed below with some examples.
   a. Inclined plane -- a sloping surface, such as a ramp. An inclined plane can be used to alter the effort and distance involved in doing work, such as lifting loads. The trade-off is that an object must be moved a longer distance than if it was lifted straight up, but less force is needed.
      Examples: staircase, ramp, and bottom of a bath tub
   
   b. Wedge -- two inclined planes joined back to back. Wedges are used to split things.
      Examples: axe, zipper, and knife
   
   c. Screw -- an inclined plane wrapped around a shaft or cylinder. This inclined plane allows the screw to move itself or to move an object or material surrounding it when rotated.
      Examples: bolt, spiral staircase, wood screw, corkscrew, and screws on light bulbs
   
   d. Wheel and axle -- a wheel and axle has a larger wheel (or wheels) connected by a smaller cylinder (axle) and is fastened to the wheel so that they turn together. When the axle is turned, the wheel moves a greater distance than the axle, but less force is needed to move it. The axle moves a shorter distance, but it takes greater force to move it.
      Examples: door knob, wagon, toy car, bicycle gears, and screw driver
e. Pulley -- a wheel that usually has a groove around the outside edge. This groove is for a rope or belt to move around the pulley. Pulling down on the rope can lift an object attached to the rope. Work is made easier since pulling down is assisted by gravity.

Examples: flag pole, crane, elevators, and window blinds

f. Lever -- a straight rod or board that pivots on a point known as a fulcrum. The fulcrum can be moved depending on the weight of the object to be lifted or the force you wish to exert. Pushing down on one end of a lever results in the upward motion of the opposite end of the fulcrum.

Examples: door on hinges, seesaw, hammer, and bottle opener

The class of a lever is based on the relative position of the load, effort, and fulcrum. Levers are classified into 1st class, 2nd class and 3rd class levers.

1. 1st class: crowbar, scissors

![First-class Lever Diagram]

2. 2nd class: nutcracker, wheelbarrow, and doors

![Second-class Lever Diagram]

3. 3rd class: tennis racket and tweezers

![Third-class Lever Diagram]
UNIT E: Advanced Scientific Visualization

COMPETENCY: V205.
Demonstrate advanced scientific visualization.

OBJECTIVE: V205.08
Create a visualization of simple machines.

Introduction: Student will use what they learned to create animations of simple machines.

Materials:
- Presentation software such as Power Point or Premiere
- Research medium such as the Internet
- 3D animation package such as 3D Studio Max or trueSpace
- Digital Camera
- Science materials for Lab experiment (2 pulleys, string, support, various weights, centimeter ruler)
- Spreadsheet software such as Excel

Requirements:
1. Students can work in groups or 3-4.
2. Each group will need to animate all 6 simple machines. The work can be divided up among the students.
3. Students should research the topic and develop a storyboard for their presentation.
4. The animations need to be placed in a Power Point or Premiere. The final product should explain the following:
   - What is a simple machine?
   - What are the 6 simple machines?
   - How does each simple machine work?
   - How does each machine make work easier?
   - What are the classes of levers and how do they work?
   - What is mechanical advantage?
   - Results of experiment (graph, table, and/or chart)
   5. Digital pictures of every day examples of each machine need to be placed in the final product using a digital camera.
   6. Students should design an experiment to calculate the mechanical advantage and efficiency for at least one type of machine. (High school physical science texts show a variety of experimental designs.) A sample experiment is included.
• Mechanical advantage is the ratio of the load or resistance force to the effort force.

• Students can use spring balances and known weights to measure these forces. The ideal mechanical advantage is what could be obtained if friction were not a factor. It is the ratio of the effort distance to the load distance. By dividing the mechanical advantage by the ideal mechanical advantage the efficiency is obtained.

• The students should use their machine on a number of different loads. Then their data will consist of the effort force required to move each load as measured on a spring balance or by using the known weights. Alternatively they might use the same load with different configurations of their machine (for example different lever lengths or numbers of moveable pulleys) and show how the changing ratio of the distance the load moves to the distance to the effort force moves changes the effort needed. See following experiment example.
Sample experiment: Measuring the mechanical advantage of a pulley

Part A: Set up the pulley system as shown below.

1. Place a 50-gram mass for M1 and M2. With a ruler measure the distance mass M1 moves when you pull mass M2 down 15 centimeters.
2. You should notice M1 moves the same distance.
3. This pulley system has a mechanical advantage of one.
4. Repeat the experiment with 4 different weights. Record the data in the chart below.

<table>
<thead>
<tr>
<th>Weight</th>
<th>Movement of M1</th>
<th>Movement of M2</th>
</tr>
</thead>
</table>

5. Graph the data and include in your project.
Part B: Set up the pulley system as shown below.

1. Let M1 equal 100 grams and M2 equal 50 grams. Notice the system almost balances itself.
2. You need only add a little more force to M2 to move M1 upward. Now, again measure the distance M1 moves when you pull M2 down 20 centimeters.
3. You should see that M1 only goes up 10 centimeters when you pull M2 down 20 centimeters.
4. This pulley system has a mechanical advantage of two. You can lift 100 grams with only 50 grams plus a whisker.
5. Also note 50 grams times 20 centimeters equals 100 grams times 10 centimeters. Force times distance or energy is conserved.
6. Repeat the experiment with 4 different weights. Record the data in the chart below.

<table>
<thead>
<tr>
<th>Weight</th>
<th>Movement of M1</th>
<th>Movement of M2</th>
</tr>
</thead>
</table>

7. Graph the data and include in your project.
Assessment:

Project planning, storyboard, and group coordination 10 points

All simple machines are included and animated (5 pts each)
  levers (3), ramp, wedge, screw, wheel and axle, and pulley 40 points

Graphics are clear and labeled - easy to see and understand 10 points

Good choice of colors and appropriate backgrounds. Experimental data presented in table and graphical format 10 points

Digital pictures labeled and included and contribute to understanding of machines. 10 points

Concepts of work, efficiency and mechanical advantages are correctly explained. 10 points

Overall project (fits together, holds viewers attention, conveys science concepts) 10 points

Total 100 points

Variations and Extensions:

Possible extensions include actually presenting this to physical science classes, producing a CD ROM for Physical Science classes to use, developing a web site on machines, or producing an animation of a more complex machine.
**Rubric:**

**Project planning, storyboard, and group coordination**

<table>
<thead>
<tr>
<th>There is no evidence of planning and group coordination. Story board is not complete.</th>
<th>There is little evidence of planning and group coordination. Story board is not complete.</th>
<th>There is evidence of planning and group coordination. Story board is complete</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 0-00g</td>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
</tr>
</tbody>
</table>

**All simple machines are included and animated (5 pts each.)**

| 7 or more of the simple machines are missing or not animated including the three types of levers. All animations work correctly. | 4-6 of the simple machines are missing or not animated including the three types of levers. All animations work correctly. | 1-3 of the simple machines are missing or not animated including the three types of levers. All animations work correctly. | All simple machines are included and animated including the three types of levers. All animations work correctly. | Total Points |
|---|---|---|---|
| 6 0-00g | 0-10 points | 10-25 points | 25-35 points | 40 points |

**Graphics clear, labeled, good choice of colors, appropriate backgrounds**

<table>
<thead>
<tr>
<th>3 or more of the following are missing: Graphics are clear, labeled on the correct space, are easy to understand. Correct use of colors, appropriate backgrounds, and slide layouts are present.</th>
<th>1-2 of the following are missing: Graphics are clear, labeled on the correct space, are easy to understand. Correct use of colors, appropriate backgrounds, and slide layouts are present.</th>
<th>Graphics are clear, labeled on the correct space, are easy to understand. Correct use of colors, appropriate backgrounds, and slide layouts are present.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 0-00g</td>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
</tr>
</tbody>
</table>

**Experimental data presented in table and graphical format**

<table>
<thead>
<tr>
<th>The data collected from the experiment is not displayed in a table and in correct graph. The graph is not correctly labeled. The results are not completely explained.</th>
<th>The data collected from the experiment is displayed in a table and correct graph. The graph is not correctly labeled. The results are not completely explained.</th>
<th>The data collected from the experiment is displayed in a table and correct graph. The graph is correctly labeled. The results are explained.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 0-00g</td>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
</tr>
</tbody>
</table>
Digital pictures labeled and included and contribute to understanding of machines

<table>
<thead>
<tr>
<th>5 or more images are missing out of the 8 needed.</th>
<th>2-4 images are missing out of the 8 needed.</th>
<th>Correct digital examples of each machine are included and labeled. (8 total-6 simple machines with 3 lever types)</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6 0-00g</strong></td>
<td><strong>0-5 points</strong></td>
<td><strong>6-9 points</strong></td>
<td><strong>10 points</strong></td>
</tr>
</tbody>
</table>

Concepts of work, efficiency, and mechanical advantage are correctly explained.

<table>
<thead>
<tr>
<th>The concepts of work, efficiency, and mechanical advantage are not explained.</th>
<th>The concepts of work, efficiency, and mechanical advantage are not correctly explained.</th>
<th>The concepts of work, efficiency, and mechanical advantage are correctly explained.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6 0-00g</strong></td>
<td><strong>0-5 points</strong></td>
<td><strong>6-9 points</strong></td>
<td><strong>10 points</strong></td>
</tr>
</tbody>
</table>

Overall project (fits together, holds viewers attention, conveys science concepts)

<table>
<thead>
<tr>
<th>3 or more of the following are missing: The overall project fits together, holds viewers attention, conveys science concepts, and is organized, neat, and polished.</th>
<th>1-2 of the following are missing: The overall project fits together, holds viewers attention, conveys science concepts, and is organized, neat, and polished.</th>
<th>The overall project fits together, holds viewers attention, conveys science concepts, and is organized, neat, and polished.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6 0-00g</strong></td>
<td><strong>0-5 points</strong></td>
<td><strong>6-9 points</strong></td>
<td><strong>10 points</strong></td>
</tr>
</tbody>
</table>
Sample graph and data from Excel (Part A):

<table>
<thead>
<tr>
<th>Weight</th>
<th>Movement in M1</th>
<th>Movement in M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 g</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>50 g</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>75 g</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>100 g</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>125 g</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>
UNIT E: Advanced Scientific Visualization

COMPETENCY: V205.
Demstrate advanced scientific visualization.

OBJECTIVE: V205.09
Create an advanced visualization.

Introduction: Students will create a multimedia presentation using all the techniques they have learned in SciVis I and II. This presentation will be in an area they select.

Materials:
Presentation software such as Power Point or Premiere
Research medium such as the Internet
2D software such as CorelDraw or Corel PhotoPaint
3D animation software such as 3D StudioMax or trueSpace
Any other program of interest to the students

Requirements:
1. Students will research and select an idea that interests them. The idea must be approved by the teacher. See list of suggestions at the end of this objective. There is also an advanced tutorial in Appendix E.
2. Students can work alone or in groups.
3. Students should research their topic and develop a storyboard for their presentation.
4. The final presentation should include but not limited to the following.
   • Several rendered movie clips
   • Several 2D original images (can be used as materials on a 3D object)
   • Demonstration of advanced 2D image skills
   • Sound (original or other legal and usable clips)
   • Demonstration of advanced 3D modeling and animation skills
   • A finished movie in Premiere or other video-editing program
Sample ideas:

Any cycle (water)  Any world event (911)  Birth and Life of Stars
Car Engines  Carnival Rides  Electric motors
Houses (design)  How something works  Instruments (guitar)
Kitchen and all appliances  Lab experiment  Medieval weapons
PCR or other process  Photosynthesis/Respiration  Scientific Theories
Sharks (other animals)  Ships  Skateboards
Submarine (Hunley)  Types of insulations  Types of motorcycles
Weather systems

Assessment:

Aesthetics and design  30 points
Functionality with Sound  20 points
Accurate models and animations  20 points
Demonstration of advanced techniques  30 points

Total  100 points

(No rubric enclosed due to variety of the finished products)
Preparation for the Future

V206.
Demonstrate preparedness for the future.

V206.01
Summarize different types of portfolios.

V206.02
Synthesize an electronic portfolio.
UNIT F: Preparation for the Future

COMPETENCY: V206.
Demonstrate preparedness for the future.

OBJECTIVE: V206.01
Summarize different types of portfolios.

Introduction: Students will learn about different types of portfolios, what to include in a portfolio, and how to create an electronic portfolio.

A. A portfolio is designed to showcase a student’s work that meets a prescribed set of standards and is deemed by the student to be his/her own work.
   1. Electronic portfolio
      a. With an electronic portfolio, information can be stored digitally on a computer hard drive or some sort of removable media (pen drive, Zip disk, CD, etc.) This electronic information takes up very little physical space and is easily accessed.
      b. You can easily add sound, pictures, graphics, and even video to an electronic portfolio.
      c. The portfolio can be easily edited for content as well as updated.
   2. Traditional portfolio.
      a. With traditional portfolios, folders, boxes, or 3-ring binders hold papers, pictures, cassette tapes, and more.
      b. Traditional portfolios should contain a wide variety of examples of your work. There is usually a concentration of a particular style or technique or medium.
   3. How to create an electronic portfolio
      a. Decide on the format you will use (examples include CD ROM, DVD, or web page.) Also decide on the programs you will use to display your work. Power Point, Premiere, and Flash are some suggestions.
      b. Plan your portfolio. Create a storyboard or flowchart on paper to plan what to put in your portfolio. Think about what work you need to include. Determine how a viewer will navigate through the portfolio.
      c. Set up a template. You can add graphics, models, and animations to the template.
      d. Start entering information into the template. Information can include text, sounds, scanned images, pictures, video, or other projects you have done.
         1. All included work must be original.
         2. Include samples of your best work.
         3. Include samples to illustrate your growth in the class.
         4. Students should reflect on each piece they include. These reflections can focus on what they have learned on a particular assignment, academic progress in general,
and on the actual production of the electronic portfolios. The reflections can be attached as a printed document or included as text in the electronic portfolio.

4. Types of portfolio
   a. Collections of work -- The simplest form of electronic portfolio is a collection of work saved on a pen drive, Zip-type disk, writeable CD, or hard drive. For this, you can use almost any word-processing or layout application you already have. While simply saving collections of work is the quickest and easiest option, it is also the least accessible to others. Accessing the work requires the viewer to have the same software that was used to create the student work.

   b. Linear -- As the term implies, these electronic portfolios are sequential. Viewers start with an opening page and progress through a series of pages or slides. Applications for producing linear portfolios include such programs as ClarisWorks, Slideshow, and PowerPoint. As with electronic collections of work, accessibility can be a problem because it requires the viewer to have the same software in order to look at the portfolio. Although, with newer versions of some of these software applications, options are available that allow you to convert the files to Web page format.

   c. Interconnected -- this is the most flexible format. Students can create links to jump to and from pages, sections, and subjects. If you plan to make student portfolios available as web pages, you might consider using web page design software. Web page portfolios can be accessible via the Internet to audiences worldwide.

5. Feedback -- As with traditional portfolios, viewers of electronic portfolios are encouraged to share their impressions and suggestions regarding student work. Because electronic portfolios can be made available to wider audiences on the Internet, feedback can come not only from peers and teachers, but also via email from parents and the community.
UNIT F: Preparation for the Future

COMPETENCY: V206.
Demonstrate preparedness for the future.

OBJECTIVE: V206.02
Synthesize an electronic portfolio.

Introduction: Students will prepare a portfolio of their work done in SciVis I and II.

Materials:
Portfolio software such as Premiere, Power Point, Flash, and FrontPage
Collection of past work including rendered files, single images, and projects

Requirements:
1. Students will create one of the portfolio types covered in section 6.01.
2. Students should include 5-9 examples of their best work.
3. Selections should demonstrate mastery of the major areas covered in the class.
4. Include reflections on each selected piece.

Electronic Portfolio Scoring Rubric:

<table>
<thead>
<tr>
<th>Template:</th>
<th>Design is inappropriate.</th>
<th>Design could be neater or is slightly inappropriate.</th>
<th>Design is attractive and colorful.</th>
<th>Design is attractive, colorful, and shows creativity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanics:</td>
<td>Spelling and punctuation errors are distracting.</td>
<td>Spelling and punctuation errors are evident.</td>
<td>Errors in spelling and punctuation are minor and few.</td>
<td>There are NO errors in spelling or punctuation.</td>
</tr>
<tr>
<td>Content of project reflections:</td>
<td>Few reflections include: the program used and the main skills learned.</td>
<td>Some reflections include: the program used and the main skills learned.</td>
<td>All reflections include: the program used and the main skills learned.</td>
<td>All reflections include: the program used and a detailed account of all skills learned.</td>
</tr>
<tr>
<td>Areas covered in SciVis class:</td>
<td>Three or more areas were not covered with examples and reflections.</td>
<td>The works selected cover all of the major areas in class except for 2 areas.</td>
<td>The works selected cover all of the major areas in class except for one area.</td>
<td>The works selected cover all of the major areas in class.</td>
</tr>
<tr>
<td>Total points</td>
<td>0-69 pts.</td>
<td>70-79 pts.</td>
<td>80-90 pts.</td>
<td>90-100 pts.</td>
</tr>
</tbody>
</table>
APPENDIX A: Scion Tutorial

A. Basic information:

1. Using Scion Image: All of the images below were obtained from www.noaa.gov by right clicking on top of the EGIR (East Coast Infrared) satellite image and saving. The images were opened in a photo editing software package (Adobe Photoshop, Corel Photo Paint, or MS Paint) and converted (exported) in the TIF format. TIF images are not compressed. Scion Image will only open TIF files. The following are only the steps to follow for the teacher and are not intended as student activities.

2. Measuring: Each pixel in the NOAA satellite images corresponds to 16 square miles (4 miles x 4 miles) on earth. Effective measuring in Scion depends on learning how to set the scale and applying the settings to your measurements.

B. Scion Tutorial: Part 1

Step 1: Open the TIF image in Scion.

![Image of Scion interface and satellite image]
Step 2: Select the Straight Line Tool from the toolbar.

Step 3: Click on the analyze menu

Step 4: Choose Set Scale:
Step 5: Change the units to Miles in the pop-up menu that appears. **Units must be set first.**

![Image of pop-up menu with units set to Miles]

Step 6: Enter the Known Distance and the Measured Distance. If you are using NOAA ECIR satellite images, the actual scale is 1 pixel covers 16 square miles (4 miles x 4 miles) on earth. The measured distance should be 1.00 pixels and your known distance should be 4.00 and the units should be in miles. Select OK to set.

Step 7: Once you have set the scale to MILES, you can always come back to the Set Scale command and change your UNITS. **DO NOT** change the measured distance or the known distance! Only change to the desired units and the other amounts will automatically be adjusted.

![Image of pop-up menu with scale set to MILES]
Step 8: With the Straight Line Tool selected, click and drag out a straight line. The image below has a line from piedmont NC to the eye of Hurricane Frances.

![Image of hurricane with line](image)

Step 9: Click on Analyze and then Measure.

![Image of Analyze menu](image)
Step 10: Next click on Analyze and then Show Results.

Step 11: The Results box will pop-up and the distance covered by the line will be displayed.

Step 12: You can also measure the distance around an area. Select the Zoom
Step 13: Click on top of the state of NC until you can easily see the lines around the state.

Step 14: Select the Polygon Tool.

Step 15: Click around the state and then double-click to close the spline. You should see the “dancing ants” marching around the state.
Step 16: Choose Analyze and Measure.

Step 17: Choose Analyze and Show Results.

Step 18: The length will also appear in the Info Box on the desktop.
C. Scion Tutorial: Part 2: Pseudo-color Images:

Step 1: Pseudo-color (False Color) images reassign “new” colors to images. This process is helpful in making certain objects or processes standout or easier to follow. Open the image in Scion Image.

Step 2: Choose Options – Color Tables. Select from the different pre-set color options. I use Ice to show temperature.
Step 3: The new Pseudo-color palette has now been applied. This process is referred to as “False Color” because the colors are not the actual colors of the earth as seen by the satellite, but artificially produced by the computer.

Step 4: If you place the Density Slice Tool on top of the LUT, reposition the tool over the LUT range (DO NOT CLICK – just reposition) and you see the pixel value and the color assigned in the Info Box.
Step 5: If you Click – Hold – Drag the Density Slice Tool on the LUT, you can reposition the colors over the LUT range. This is helpful to “Fine Tune” your colors over the image.

![Image of the density slice tool on a map with a message: The density slice tool can be used to slide the LUT scale up or down to adjust the positions of each pseudo-color.]

Step 6: To reset the image back to grayscale, choose Options – Grayscale. You could also reopen the image.

![Image of the menu with Grayscale highlighted and other options listed below.]
D. Scion Tutorial: Part 3: Histogram:

Step 1: A histogram of an image is a statistical graph showing the number of gray (DN/pixel value) and the frequency at which they occur in the image. **Open the NOAA weather ECIR image, close the “Red” image and leave the ‘Indexed Color” image open.**

![Scion Image GUI](image)

Step 2: Click on Analyze and Show Histogram.

![Scion Analyze Menu](image)
Step 3: The Histogram will appear as a separate window.

Step 4: Using the Cross Hair tool, place your mouse over several different bars of the histogram. The pixel value and the pixel count appear in the Info Box.
E. Scion Tutorial: Part 4: Density Slicing:
Step 1: Open the ECIR weather satellite image from NOAA. Choose Options and then Density Slice.

Step 2: A colored bar appears in the LUT (Color Look Up Table) spanning a range of pixel values. The color of the slice may vary from computer to computer.
Step 3: You can use the mouse to slide the “slice” up and down through the range of the LUT. The corresponding pixels in the image will change color.

Step 4: If you move the LUT tool up, the lighter pixels turn red.

Step 5: If you move the LUT tool down, the darker pixels will change color.
Step 6: Double-click on top of the slice with the eyedropper tool to change the color of the slice.

Step 7: After double-clicking, a color palette will appear. Select the color you want and click OK.
Step 8: The pixels corresponding to the density slice will now be a different color.

Step 9: You can expand the slice by dragging up on the slice using the slice tool. This will include more pixel values in the slice. The density slice can also be pulled down from the bottom of the slice using the slice tool.
Step 10: Another important option is to “Selectively” set the thickness of your density slice. In doing this you set the upper and lower pixel values that will have color. One excellent use for this is to show areas of a particular temperature.

1. Density Slice (colorize) all pixels between 17-22 degrees C: Degrees $C = (40/255) \times P - 5$. You can rearrange the equation to solve for $P$ (pixel value) $P = C + 5 \times (255/40)$. The pixel value for 17 degrees is $P=140$ and the pixel value for 22 degrees is $P=172$. We can now adjust our LUT.

2. Click ON TOP and in the MIDDLE of the density slice. Drag the entire slice up and down until the correct pixel value appears in the Info Box for the lower pixel value (140).

Step 11: Place your density slice tool on the LOWER EDGE of the slice, Click, Hold and Drag until the higher pixel value appears in the Info Box.
Step 12: You density slice is now set to colorize all pixels that temperature corresponds to the temperature range between 17-22 degrees C. For more advance students, you could have them convert from C – F before during this process. Use the following equation: \( F = \dfrac{9}{5}C + 32 \)
F. Scion Tutorial: Part 5: Particle Analysis: Particle analysis allows you to use the computer to select specific areas of your image and then process the area. This can be used instead of “clicking around” to select an area. It is helpful if you have several locations that need to be selected (As an example: you want to find the area of a group of islands instead of just one item).

Step 1: First: Crop your image (in Corel or Adobe) to remove unnecessary information. Below you will find I have cropped out all by Hurricane Frances.

Step 2: Choose Analyze – Reset to remove any past numerical data from the software. If you have just opened Scion Image, this step will be unnecessary.
Step 3: Choose Analyze – Options. This will bring up the Measurement Options Window. Be sure only Area and Perimeter/Length are checked. Click OK.

Step 4: Choose Analyze – Set Scale

Step 5: Enter the correct units (Miles).
Step 6: Enter the correct Measured Distance and Known Distance.

Step 7: Choose Options – Density Slice.
Step 8: Expand or reduce your slice (with the Density Slice Tool) until the image area in question is filled with color.

Step 9: Choose Analyze – Measure
Step 10: The Area of Hurricane Frances appears in the Info Box.
G. Scion Tutorial: Part 6: Density Calibration:  Density calibration is a very useful tool to teach about Linear Regression. Density calibration lets us select at least two, small pixel areas of known values and have Scion Image calculate and plot a linear regression for the entire range of values. The Cross-Hair Tool can then be placed anywhere on the image and the pixel value and calculated value will appear in the Info Box.

Step 1: Open your image in Scion Image and Choose Analyze – Measure – Reset to remove any numerical data already stored in the program. This may not be necessary if you have just opened Scion Image.

Step 2: Choose Analyze – Options.
Step 3: In the Measurement Options Window, be sure only Area and Mean Density are checked. Click OK.

Step 4: Select the Rectangle Tool and select a SMALL area of pixels where you know the actual temperature in the area.
Step 5: Choose Analyze – Measure to find the average pixel value in the box.

Step 6: Choose Analyze – Calibrate. A calculation window will appear. An **average pixel value** is in the Measured Column. Enter the KNOWN temperature in the column (I entered 61 degrees C). Put a check in the Straight Line radio button (Radio buttons, unlike checkboxes, will only let you make one selection) to calculate a linear regression. Type in **Degrees C** in your Units Measured box. Click OK.
Step 7: You will receive a warning box that reads “You need at least 2 standards to do straight line fitting”. Click OK – you are going to enter another value in the next step.

Step 8: Using the Rectangle Tool, Click and Drag around another small area of pixels of known temperature.

Step 9: Choose Analyze – Measure to find the average pixel value in the second box.
Step 10: Choose Analyze Calibrate.

Step 11: You will see the second average pixel value in the Measured Column. Enter the known temperature in the Known Column. Put a check in the Straight Line radio button. Enter the correct units.
Step 12: The calculated Linear Regression will appear in a new window. This window can be printed out if you desire. (All plot windows may be printed.) Notice the formula $y=a+bx$. This is the formula to find the Slope of the line.

Step 13: Close out of the linear regression window. Use you Cross Hair Tool and place the tool anywhere (DO NOT click – just place OVER) over your image. The corresponding temperature (64.91 Degrees C) and Pixel value (69) will appear in the Info Box.
H. Scion Tutorial: Part 7: Digital Elevation Model (DEM): A Digital Elevation Model is a special type of digital image where each pixel contains Elevation or Topographic data. NOAA satellite images are NOT DEM’s. For this instruction I am using Mobile.tif from the Hurricane Opal Activity.

Step 1: Open your image.

Step 2: Choose the Density Profile Tool.
Step 3: Choose Options – Profile Plot Options

Step 4: DO NOT change any settings, but press OK.
Step 5: Use the Cross Hair tool to Click and Drag out a line across the area of interest.

Step 6: Choose Analyze – Plot Profile.
Step 7: The Plot Profile Window will appear. This profile have a line curve representing the elevation of each pixel that the line travels across. You have NOT set scale for this DEM.

Step 8: Now select your Rectangle Tool. Click and Drag to select an area of the image.
Step 9: Choose Analyze – Surface Plot.

Step 10: Put a check in the Wireframe checkbox. Click OK.
Step 11: Now repeat the procedure and select Grayscale instead of Wireframe.
I. Scion Tutorial: Part 8: Making a Weather Movie (Corel Photo Paint): Scion Image will allow the user to create an ANIMATION that plays within Scion Image. If you need to place the movie out of Scion Image, you will need to use another program. I use Corel Photo Paint, but other high-end graphic programs will also work. The instructions below are for Corel Photo Paint only. Refer to the instructions of your own graphic software package for specific instructions concerning that program.

Step 1: Open the first sequential image in Corel.

Step 2: Here I am selecting the first in a series of ECIR satellite image taken during Hurricane Frances.
Step 3: Click on Movie – Create from Document. This image will be frame 1.

Step 4: Choose Movie – Insert from File. Select the next sequential image to be frame 2.
Step 5: You will get the following Insert File box to verify where the new frame is to be inserted in the movie. Unless you will to place the image out of sequence, just press OK.

Step 6: Insert the next frame into your movie.
Step 7: You will have to specify where each image is to be placed in the movie.

Step 8: Continue to add your images. Here I am added image 21 after frame 20.

Step 9: To view your movie in Corel, choose Move – Play Movie.
Step 10: To stop the movie in Corel, choose Movie – Stop Movie.

**Note:** In Corel Paint your two options for creating movie file are AVI and an Animated GIF file. These files are for totally different uses. AVI files can be placed into PowerPoint, Flash Movies, or even added to 3D Max during video post operations. Animated GIF files are must smaller and run inside a web page and are usually set to “loop.”

Step 11: To create an AVI file: Choose “Save As” and give the movie a name.
Step 12: Instead of “Saving the movie” as an AVI file, you can also EXPORT the movie as an ANIMATED GIF file. GIF movies are suitable to be placed into a web page.
Step 13: When you choose to create an animated GIF movie, you will be given an opportunity to preview the movie.
Step 14: This is a web page with the animated GIF file inserted.

![Hurricane Frances Animated GIF Movie](image)

Step 15: Below you will find the correct HTML tag to use if you desire to place your animated GIF movie inside a web page.

```
<html>
<body bgcolor="NAVY" text="white">
<br/>
<center><h1>Hurricane Frances Animated GIF Movie</h1></center>
<center><img src="Hurricane Frances 01.gif"></center>
</body>
</html>
```

This is the correct way to insert a GIF animation into a webpage. `Width=""` and `Height=""` can be inserted inside the tag to control movie size.
APPENDIX B: Adobe Premiere Video Editing Tutorial

Step 1: Open Adobe Premiere.

Step 2: Select NTSC 720x480 video for Windows – OK.

Step 3: The bin is where you import video & audio files.
Step 4: The Timeline is where you will place video & audio files to be included in the project.

Step 5: The monitor is where you can preview your project.

Step 7: Import the following video (avi) files.

Step 8: Import the sound (wav) files. The project window should be like the following:
Step 9: Grab the bowling alley survey video and place into video 1A track.

Step 10: The bowling alley survey video is 23:10 seconds long.
Step 11: Bring ball roll.avi into track video 1B.

Step 12: Adjust the timeline so that ball roll.avi begins at 23:00 seconds.

Step 13: Insert ball return.avi into the timeline at 33:00 seconds in track 1A.
Step 14: The length of the timeline should be 36:11 seconds.

Step 15: Bring bowling alley ambiance.wav into audio track 1A.
Step 16: The length of bowling alley ambiance.wav is longer than the total timeline. Clip the audio file so that it matches the video length.
Step 17: Bring in ball down the alley.wav into audio track 2. Bring in bowling down the lane.wav into audio track 3. Click on the small arrow to open audio track 2.

Step 18: Move the “rubber band” up (at both ends) to increase the volume of the ball rolling down the alley.

Step 19: Advance the video in the monitor to locate the place where the ball strikes the pins.
Step 20: Adjust the location of ball down the alley.wav until the “crash” happens as the pins begin to fall.

Step 21: Open up audio track 3 and increase the volume of the ball rolling down the lane. Adjust the position of the audio to match the video.
Step 22: Right-click on top of the gray area of one of the audio tracks. Select “add audio track.” add audio track 4.

Step 23: Bring in return feed of bowling ball.wav into audio track 4. Clip the end of the audio track to match the end of the video track.

Step 24: Add a transition between the first two video tracks in the “transition layer” located between the video tracks.
Step 25: Add a transition between the last two video tracks in the “transition layer.”

Step 26: Add the credits. go to file, new, title.
Step 27: Right-click on top of the title area and adjust font, size and style.

Step 28: Right-click on top of the title area and select title window options.

Step 29: Click in the background color area at change background color of credits.
Step 30: Click to change the color of the text.

Step 31: Click the rolling title tool.

Step 32: Use the mouse to “drag out” a text box. enter the credit information.

Step 33: Drag across the text to select it. right-click on the text to justify.
Step 34: Right-click on the title area to open the title window options.

Step 35: Select rolling title options. Select desired rolling direction. You may enable special timings to add seconds to the beginning or the end of the credits.

Step 36: Save the credits as a *ptl file.
Step 37: Import the credit file into the project bin.

Step 38: Place the credit frame into the video tract.

Step 39: Save your Premiere project file.
Step 40: Export the timeline as a movie (avi) file.
APPENDIX C: Understanding Common Rendering Algorithms
(Additional information not tested in the test bank)

A. Faceted shading
1. Treats every point on the surface (facet) as being the same color.
2. Uniform coloring of curved surfaces makes the object look faceted.
3. Faceted shading produces a fast rendering, but makes things look 2D.

B. Gouraud shading
1. Is an algorithm that is used to make triangulated curved surfaces look smooth.
2. It calculates the averages of the surface normals that occur where the polygons (facets) intersect. A single average of the normals where the surfaces intersect is used to produce variations in color that make the polygons look smooth.
3. Seams can appear where very bright lights are applied to the surface.
4. Gouraud is very fast and is often used as a real-time rendering process when building objects in a 3D scene.

C. Phong shading
1. Because Gouraud shading uses an average of the intersecting polygons’ normals, the seams where the surfaces intersect may show as hard edges.
2. The Phong algorithm works like the Gouraud shader but takes additional steps to produce a more accurate calculation of the colors at the seams, which makes the seams not visible when rendered.
3. Phong shading takes more computing power and more time than Gouraud.
APPENDIX D: Understanding Ray-tracing and Radiosity
(Additional information not tested in the test bank)

A. Surface Normals
1. *Surface normals* are vectors that are perpendicular to a surface. Normals are used to calculate the angle of the surface to the light and to define which way the face is pointing.

2. Surfaces exposed directly to the light are the lightest. Surfaces whose normals form a greater angle to the light are shown as darker shades.

3. It takes only one normal to describe a flat surface, but it takes numerous normals to describe curved surfaces because each point on the curved surface projects a normal off of the surface in a different direction.

4. To reduce the number of normals to be calculated, many programs convert curved surfaces into numerous flat, triangular polygons before rendering (called *triangulation*). Triangles are used because they must be flat. The polygons can cause the curved surfaces to appear faceted unless additional “shading” algorithms are used to make the surfaces appear curved.

B. Ray Tracing
1. Ray tracing is the process of tracing the path of a light ray from your eye backward to the objects in your scene.

2. Ray Tracing calculates for light obtained from the light source, but does not make calculations for the *ambient light* arriving from surfaces within the scene. (Ambient light can be thought of as the overall amount of daylight in the scene. Unlike sunlight, spotlights, etc.; it does not come from a definite location or direction but rather is uniform throughout the scene.) The lack of calculations for ambient light leaves ray-traced scenes sometimes looking flat.

3. Surfaces are not only affected by direct light projecting onto the surface but also by the light being reflected from other surfaces.

4. To get an accurate representation of surface color, you need to calculate all of the light falling onto it. Accurate surface color can be determined by tracing each individual light ray back to its source. Does it pass through any transparent or translucent objects? Are nearby surfaces reflective or flat? How does the shape of nearby objects affect the angle at which the light is reflected? What colors are the nearby objects? All of these factors affect Ray Trace rendering.

5. A ray could bounce around in a scene forever, causing the calculations to also continue without end. The depth of the ray tracing is the maximum number of bounces that is allowed.

6. All of the calculations needed to completely trace a ray from its source to its final surface require time and processing power. Use of Ray Tracing can greatly slow down the rendering process.

7. Increasing or decreasing the number of lights in a scene affects the rendering time.
8. Ray Tracing is used to accurately simulate shadows, reflections, *refraction* (amount of bending that occurs when light bends as it passes through a transparent object), direct lighting, and transparency.

9. Ray Tracing does not handle specular lighting, and the interreflections of light that occurs between surfaces in a complex scene.

C. Radiosity

1. Radiosity is a way of figuring how much light is bouncing around off of surfaces in a scene. In other words, it calculates the indirect illumination or the lighting interreflections between surfaces.

2. In his book Inside trueSpace 4, Frank Rivera explains radiosity in the following manner:” *it overlays a mesh on the scene as a way to pinpoint the location of light changes.*  ... *Next, it evaluates the light shot from the grid into the environment.*  ... *This shooting of the energy from the lights into the environment is akin to asking each light the questions, “How much energy are you giving out? In what color and direction are you sending it? Are there any other surfaces obstructing your view?” The surfaces are then asked: “How much light have you received and are any surfaces obstructing your view of the lights?”*

3. Breaking surfaces down into smaller surfaces (sub-surfaces), allows for the varying colors that occur on a surface in a realistic scene.

4. Once surfaces are broken down into smaller sub-surfaces, calculations are performed to determine how the smaller sub-surfaces affect other nearby sub-surfaces.

5. If two surfaces are a long distance apart, are at extreme angles to each other, are directly opposite each other, or have other positional relationships, different color calculations must be performed.

6. Radiosity is not as a good system as Ray Tracing for calculating transparency, *specularity* (color, size and shape of highlights), and reflections.

7. Unlike highlights and reflections, which change as you move, the calculations for scenes must be done only if a surface moves. Therefore, the calculations can be stored and “reused” for each change in an animated scene.

8. Hybrid radiosity combines the advantages of Ray Tracing and radiosity by rendering the scene in two passes.
APPENDIX E: Sample Modeling and Animation Project for the Advanced Student

Requirements:

1. Students should work independently.

2. Using 3D animation software, students need to create an animation of a solar-powered moon roving vehicle designed to travel on the surface of the moon.

3. Students should research the topic and develop an engineering design brief. Keep in mind the environment of the moon and the pressure suit of the driver when designing your rover. (ie. no air, rough terrain, low lighting, and low gravity.)

4. Students should provide a storyboard that describes the action, camera usage, and materials.

5. The student should have the following elements in their animation:
   - Moon Rover
   - Rocks, terrain, and or soil conditions that involve the use of bump maps.
   - Vehicle materials that involve the use of texture mapping.
   - At least one reflective, shiny, or transparent material.
   - Environmental mapping that defines the scene location as the surface of the moon with space in the background.
   - Movement of the vehicle along a path.
   - Lights and shadows that relate to the time and the vehicle’s changing location.
   - Multiple camera views that either look ahead as the vehicle moves, follows a path around the vehicle, and/or describes vehicle motion using such elements as zooming.
   - Wheels, tracks, or legs (or other means of propulsion) that move independently of the body of the vehicle to demonstrate that they understand and can control hierarchy and linking.

Assessment:

The moon rover is designed according to the environment 15 points
Bump and texture maps are used and are realistic 30 points
Environmental maps are used and are realistic 15 points
Hierarchical vehicle movement and motion along a path is used and is realistic 10 points
Lights, shadows, and various camera angles are used, are not default settings, and are reasonable for the setting 30 points

Total 100 points
Rubric:

Moon rover is designed according to the environment and occupants.

<table>
<thead>
<tr>
<th>Student used very little thought when creating the design. Examples: used a hover fan or an internal combustion engine (no air), low ground clearance (will not go over rocks), sharp edges (tear the space suit), rocket powered (too fast for surface exploration), narrow tires (will sink into dust).</th>
<th>The majority of the design elements seem to be reasonable for the rover’s assigned task and environment.</th>
<th>Student considered and designed the rover to work in the moon’s environment. Example: high ground clearance (rocky terrain), lights, no sharp edges, no internal combustion engines, etc.), wide tires (distribute loads over a wider area).</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-7 points</td>
<td>8-14 points</td>
<td>15 points</td>
<td></td>
</tr>
</tbody>
</table>

Bump maps and textures are used and they are realistic.

<table>
<thead>
<tr>
<th>Most or all of the rocks and vehicle materials are smooth.</th>
<th>Most of the objects in the scene demonstrate the use of bump and texture mapping, but some there are some elements that are not realistically represented or there is too much repetition of one or two maps.</th>
<th>Rocks have realistic surfacing and coloring. Various vehicle materials are used and demonstrate texture maps (i.e., gold foil wrapping) and not just color.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-19 points</td>
<td>20-29 points</td>
<td>30 points</td>
<td></td>
</tr>
</tbody>
</table>

Realistic environmental maps are used.

<table>
<thead>
<tr>
<th>Backgrounds are not used or don’t accurately represent the environment. Colors of objects in the distance are as bright and clear as those in the foreground.</th>
<th>Environmental maps are used but do not do a good job or creating realism.</th>
<th>The blackness of space and the stars and/or earth is portrayed in the background. Colors of objects in the distance fade.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9 points</td>
<td>10-14 points</td>
<td>15 points</td>
<td></td>
</tr>
</tbody>
</table>
Hierarchical vehicle movement and motion along a path is used and is realistic.

<table>
<thead>
<tr>
<th>Vehicle does not remain upright and move along a path. Propulsion devices do not move independently of the vehicle body. Motion is jerky and/or unrealistic (i.e., wheels turn in wrong direction or don’t move together). Parts get left behind or move off in an undesired direction.</th>
<th>Both of the required elements of motion are present, but one is poorly done. <strong>OR</strong> motion is less realistic than the best projects in the class.</th>
<th>Vehicle moves along a path. Propulsion devices move independently of the vehicle body. Motion is smooth and realistic. All of the parts remain together as the vehicle moves.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 points</td>
<td>6-9 points</td>
<td>10 points</td>
<td></td>
</tr>
</tbody>
</table>

Lights, shadows, and various camera angles are used, are not default settings, and are reasonable.

<table>
<thead>
<tr>
<th>The default lighting was used and/or no shadows are present. <strong>OR</strong> The computer crashes when the animation is run. <strong>OR</strong> Lights and light colors cause the scene to be unrealistic.</th>
<th>One of the following is true: Shadows are present but poorly done. The student created lighting, but it causes the scene to be unrealistic. Attenuation is not present.</th>
<th>Shadows are realistic and follow the vehicle. Lights clearly define the object while still producing an image that seems to be in a moon-like setting. Lights add interest to the scene. Attenuation is present. The scene can be run without crashing.</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9 points</td>
<td>10-14 points</td>
<td>30 points</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX F: Largest Earthquakes in the Contiguous United States
(USGS Web site)

<table>
<thead>
<tr>
<th>Location</th>
<th>Date/Time UTC</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. New Madrid, Missouri</td>
<td>1811 12 16 08:15 UTC</td>
<td>8.1</td>
</tr>
<tr>
<td>2. New Madrid, Missouri</td>
<td>1812 02 07 09:45 UTC</td>
<td>8.0</td>
</tr>
<tr>
<td>3. Fort Tejon, California</td>
<td>1857 01 09 16:24 UTC</td>
<td>7.9</td>
</tr>
<tr>
<td>4. New Madrid, Missouri</td>
<td>1812 01 23 15:00 UTC</td>
<td>7.8</td>
</tr>
<tr>
<td>5. Imperial Valley, California</td>
<td>1892 02 24 07:20 UTC</td>
<td>7.8</td>
</tr>
<tr>
<td>6. San Francisco, California</td>
<td>1906 04 18 13:12 UTC</td>
<td>7.8</td>
</tr>
<tr>
<td>7. Owens Valley, California</td>
<td>1872 03 26 10:30 UTC</td>
<td>7.6</td>
</tr>
<tr>
<td>8. Gorda Plate, California</td>
<td>1980 11 08 10:27 UTC</td>
<td>7.4</td>
</tr>
<tr>
<td>10. California - Oregon Coast</td>
<td>1873 11 23 05:00 UTC</td>
<td>7.3</td>
</tr>
<tr>
<td>11. Charleston, South Carolina</td>
<td>1886 09 01 02:51 UTC</td>
<td>7.3</td>
</tr>
<tr>
<td>12. West of Eureka, California</td>
<td>1922 01 31 13:17 UTC</td>
<td>7.3</td>
</tr>
<tr>
<td>13. Kern County, California</td>
<td>1952 07 21 11:52 UTC</td>
<td>7.3</td>
</tr>
<tr>
<td>14. Hebgen Lake, Montana</td>
<td>1959 08 18 06:37 UTC</td>
<td>7.3</td>
</tr>
<tr>
<td>15. Landers, California</td>
<td>1992 06 28 11:57 UTC</td>
<td>7.3</td>
</tr>
</tbody>
</table>
APPENDIX G: References

Suggested References:

North Carolina State Adopted Science Textbooks such as:
APPENDIX H: Vendors’ Addresses

For 3D Studio Max software:

Kris A. Dell
NC Educational Account Manager
ACADemic/Applied Software
3200 Northline Ave, Suite 130
Greensboro, NC 27403
Direct: 704-491-2285
800-948-1952 x898
FAX: 704-573-9981
kris@asti.com
www.asti.com

For trueSpace software:

Caligari Corporation
1959 Landings Drive
Mountain View, CA 94043
800-351-7620
FAX: 650-390-9755
sales@caligari.com
www.caligari.com

Numerous third-party vendors exist for miscellaneous software (Microsoft products are available through State Contract), a couple to get you started are:

Journey Education Marketing, Inc.
13755 Hutton Drive
Suite 500
Dallas, TX 75234
800-874-9001
FAX: 972-481-2150
schoolsales@journeyed.com
www.journeyed.com

Software Express, Inc.
PO Box 11010
Charlotte, NC 28220-1010
800-527-7638
FAX: 704-529-1010
nicepeople@swexpress.com
www.swexpress.com/website/newpages5.nsf
APPENDIX I: Equipment

Hardware requirements (per student)

- ThinkCentre A50p; Intel® Pentium® 4 2.60GHz with Hyper-Threading technology/512K L2 Cache, 800 MHz FSB I $1800.00
- 40 GB hard drive, 512 MB RAM or more
- Video Card to match animation software
- 17” monitor
- 10 MB/sec network card
- Windows 2000 or XP
- Network card
- USB serial and parallel ports
- CD-ROM Drive
- 3 button mouse (optical)
- Sound card
- Headphone / microphone
- Surge protector for computers
- Internet connection

Hardware requirements (per lab)

- Scanner-flatbed $229.00
- Digital camera 300.00
- Color printer capable of graphics output 400.00
- 2 FLASH drive pens: 256 MB minimum 70.00
- Video input device Varies
- Data projector (1000 or better lumens) 1000.00
- Replacement bulb for projector 250.00
- Projector screen 120.00
- Cabling for computers and printer 100.00
- Network cabling 400.00

Software requirements (per student)

- Animation: 3D StudioMax*, trueSpace*, etc.
- Presentation and spreadsheet: Microsoft Office (Excel, PowerPoint, Word)
- 2D graphics: CorelDraw*, Adobe Illustrator Suite
- ScionImage (free download)
- Video editor: Adobe Premiere*, MediaDirector Pro, etc.
  (Minimum 1 copy for every student)
- Web editor: Dreamweaver, Notepad, FrontPage

* Currently preferred for class and are taught at SciVis workshop
### Supplemental software
- FLASH
- Adobe PhotoShop
- WinZip
- GIS Software
- NetOp
- SnagIt
- SlideShow

### Supplies
- Blank CD-R disks
- Ink cartridges

### Additional requirements and recommendations
- Class size 24 maximum (1 computer / student)
- One additional computer for rendering (80 GB hard drive, 1 GB RAM, Video port, DVD burner)
- One teacher computer with DVD
- One computer server
- LAN network
APPENDIX J: Evaluation Form

7902 Scientific & Technical Visualization II

Your suggestions and insights are needed to improve our curriculum products including the curriculum guide, recommended activities, performance assessments, blueprint, test-item bank, and reference media. Please review all the SciVis II curriculum materials carefully. After teaching one full course cycle, please take the time to fill out and return this evaluation form. Note that the more specific and clear your suggestions are, the more useful and influential they will be. You may wish to have an industry representative evaluate the products. Thank you for helping us serve you and your students better.

Rate the following statements from 1-5, with 1 being poor and 5 being excellent. When responding to specific curriculum content found within the curriculum guide or blueprint, please give competency and objective numbers.

**Teacher's Name:** ____________________________

**School Name:** ____________________________

<table>
<thead>
<tr>
<th>Statement</th>
<th>Don’t Know</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blueprint is well structured and focuses on essential concepts and skills. It does not contain superfluous content.</td>
<td>Unsure</td>
<td>1</td>
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Return To:    Tom Shown  
Instructional Technology & Human Services  
6360 Mail Service Center  
Raleigh, N.C. 27699-6360  
Phone: 919-807-3880  
Fax: 919-807-3899  
tshown@dpi.state.nc.us
APPENDIX K: Terms and Definitions

Student image in Corel draw
Additive Color Model -- When you combine all the colors (RGB) of light and the result is white light (i.e. TV and computer monitors)

Algorithm -- (pronounced AL-go-rith-um) is a procedure or formula for solving a problem. In SciVis, we study Compression Algorithms.

Alignment -- When two or more objects share one or more positions on common axes.

Ambient light -- Ambient light is the general light that illuminates the entire scene.

Anchor -- In HTML an anchor is a tag that links text or object to another web site (a href www.website.edu)

Angle of incidence -- The angle between a ray of light and the face "normal" of the surface. As the angle of incidence increases, the intensity of the face illumination decreases.

Area Chart -- Area charts are a special kind of line chart where the “area” under the line is shaded in to better visualize the data.

Array -- the cloning and precisely transforming and positioning groups of objects in one or more spatial dimensions.
**Attenuation** -- is the effect of light diminishing over distance.

**AVI** -- AVI stands for Audio Video Interleave. It is a special case of the RIFF (Resource Interchange File Format). AVI was defined by *Microsoft*. AVI is the most common format for audio/video data on the PC.

**Axis origin** -- an arbitrary point in space where each axis is set to zero.

**Bar Chart** -- useful for comparing a number of discontinuous events (or values) against the same scale. Bar charts allow you to see the **differences** between events, rather than trends.

**Bezier** -- the precision drawing tool used in all graphic software programs to form curves that can be accurately controlled.

**Bias (Ray Traced Shadow)** -- moves the shadow toward or away from the shadow-casting object (or objects). If the bias value is too low, shadows can "leak" through places they shouldn't, producing moiré patterns or making out-of-place dark areas on meshes. If bias is too high, shadows can "detach" from an object making the appear to float. If the bias value is too extreme in either direction, shadows might not be rendered at all.

**Binary number system** -- the number system of computers which uses “base-2”. Only 0 and 1 can be included.

**BIOS** -- (basic input/output system) is the program a personal computer's microprocessor uses to get the computer system started after you turn it on. BIOS is an integral part of your computer and comes with it when you bring it home. (In contrast, the operating system can either be preinstalled by the manufacturer or vendor or installed by the user.) BIOS is a program that is made accessible to the microprocessor on an erasable programmable read-only memory (EPROM) chip. When you turn on your computer, the microprocessor passes control to the BIOS program, which is always located at the same place on EPROM. When BIOS boots up (starts up) your computer, it first determines whether all of the attachments are in place and operational and then it loads the operating system (or key parts of it) into your computer's random access memory (RAM) from your hard disk or diskette drive.
**Bit** -- the smallest unit of computer memory, stands for “Binary digIT”. Eight bits make one Byte. Bits have only 2 possible values: 0 and 1.

**Bitmap** -- a digital image composed of rasters or rows of pixels. Bitmapped images may be saved as different files types (JPG, BMP, GIF, TIFF)

**Black** -- what results when mixing the three primary pigment colors (inkjet printer). Most inkjet printers also have a black pigment because black is used more frequently and black pigment is less expensive then the color pigment.

**Blinn Shading** -- A subtle variation on Phong shading. With Blinn shading, you can obtain highlights produced by light glancing off the surface at low angles.

**BMP** -- The standard *Windows* image format.

**Boolean** -- Combines two or more objects (i.e. Union, Intersection and Subtraction).

**Bubble Chart** -- Bubble charts are a variation of X-Y chart, where the data points are replaced by bubbles. The bubbles provide a means for displaying a third variable in the chart. Either the diameter or area of each bubble is proportional to the value it represents. Bubble charts are used instead of X-Y charts when the data has a third dimension that needs to be shown on the chart.

![Bubble Chart](image)

**Boom (camera)** -- simulates the camera being placed on a rolling cart so that the camera can roll around the scene.

**Border** -- An area, usually around an image, where a specific color or texture has been assigned; resembling a frame.

**Brightness** -- Adjusts the latitude between black and white.
**Bump Mapping** -- uses the intensity of the map to affect the **surface** of the material.

**Computer Aided Design** -- (CAD) computer programs, similar to 3D modeling software packages that allow for designing, and modeling of blueprints, and objects to exacting scale. Architects and draftsmen use CAD packages to design a house.

**Cardinal numbers** -- *One, two, three* are **cardinal numbers** and can be written as words or using numerical symbols (*1, 2, 3*, etc.).

**Cause and Effect Diagram** -- Fishbone diagram

**CD** -- (Compact Disc) a small, portable, round medium made of molded polymer. for electronically recording, storing, and playing back audio, video, text, and other information in digital form. Initially, CDs were read-only, but newer technology allows users to record as well. CDs will probably continue to be popular for music recording and playback.

**CD-ROM** -- (Compact Disc, read-only-memory) is an adaptation of the CD that is designed to store computer data in the form of text and graphics, as well as hi-fi stereo sound. The original data format standard was defined by Philips and Sony. Today, CD-ROMs are standardized and will work in any standard CD-ROM drive. CD-ROM drives can also read audio compact discs for music, although CD players cannot read CD-ROM discs.

**Color Cultural Association** -- certain colors have been associated with specific things in different societies (i.e. Blue for boys, Pink for girls, Yellow for caution, Red for stop, Green for Go, Red for Hot, Blue for Cold).

**CAD** -- Computer Aided Design (i.e. AutoCAD design software – Drafting)

**Cluster** -- Two or more sectors on a single track make up a cluster or block. Occasionally, the operating system marks a cluster as being used even though it is not assigned to any file. This is called a lost cluster.

**CODEC** -- a compression algorithm used to reduce file size. In animation, Cinepak is commonly used.
**Collage** -- An assortment of images, or other objects placed in a seemingly random order but whose overall appearance is graphically balanced; pasted together in an incongruous relationship for symbolic or suggestive effect.

**Color Depth** -- The amount of color information contained in each pixel; 1 bit color Depth is black and white; 8 bit grayscale has 256 shades of gray; 8 bit color depth has 256 different colors; 24 bit color depth has over 16 million different colors.

**Color Mixer** -- A software term for the process of blending and combining colors.

**Color Mixing** -- Mixing two colors together to form a third color.

**Color Scheme** -- A preset or user defined set of colors.

**Color Vision Deficiency** -- (Color Blindness) Between 8-10% of Caucasian males have color vision deficiency. In non-Caucasian males it is about 4%. People with color blindness confuses colors. When designing for industry graphic artists must factor in for this effect.
Column Chart -- Another kind of bar chart. Bar charts allow you to see the differences between events, rather than trends. Stacking and grouping bar charts can also serve to show relationships between data sets.

![Weekday Server Load](image)

Compression -- Uncompressed bitmap files can be huge, so you will likely want to choose a format that supports compression. Compression can be lossless, in which all of the information in the original bitmap is retained, or lossy, in which some information (subtle color shifts, for example) is discarded to obtain a smaller file size.

Computational Data -- Data generated by performing mathematical calculations; you have to “compute” the data.

Conceptual Data -- (Concept Driven Visualization) An example of a concept driven visualization would be if you illustrate how the blade of a fan speeds up and slows down. This would represent the concept without being concerned with actual RPM’s.

Continuous Tone Image -- another name for a photograph (Contone).

Contrast -- Increases or decreases all color components (red, green, and blue).

Crashing -- the computer hard drive can “crash” if even the smallest bit of dust makes its way onto the platter. The computer crashes as the dust scratches the platter. Some computer viruses can cause the hard drive to crash.

Crop tool -- A slicing tool used to select an area of interest of an image.

CYMK -- Cyan, Yellow, Magenta and Black; Usually refers to the pigments used in an inkjet or laser printer. Part of the Subtractive color model.

Cyan, Magenta and Yellow -- Three primary colors of pigment (inkjet/laser Printers).

Decay -- measures the amount of fade or lessening of intensity.
Density Calibration -- mathematically relates the value of one pixel to other pixels. If you know the elevation of a particular mountain, you can select those pixels and set the scale. From the scale, the relative elevations of other pixel values can be estimated.

Density Slicing -- This is where specific pixel values are represented by a specific color. For example: an MRI brain scan where the tumor shows up better because the tumor pixel values have been modified by the computer to be a specific color.

Depth of Field -- a measurement of focus accuracy for a given distance. For example: when you look at a scene, the main subject may be in focus while the background appears blurred.

Digital Elevation Models -- (DEM’s) using satellite photos, known elevation data can be quantitatively assigned to other pixels. A computer simulated image can be created that illustrates elevation.

Digital Images -- composed of pixels arranged in rows and columns; bitmapped (raster) images.

Digital Number (DN) -- digital images obtained by remote sensing contain numerical information stored with the pixel value. The pixels values of a weather satellite image may contain information about temperature or scale.

Directional light -- simulates the great distance of the Sun by producing light rays that are parallel to each other, but that shine in only one direction.

Disk Defragmenter -- a process where data is relocated in a contiguous way so it can be accessed more quickly. Defragmenting the hard drive speeds up computer programs.

.dot -- A Microsoft Word Document

Docking -- the ability to pull a toolbar away from the graphic user interface such that it can be placed on the desktop. The toolbar can be “pushed” back into place on the graphic user interface, a procedure known as docking.

Dot Pitch -- The dot pitch specification for a display monitor tells you how sharp the displayed image can be. The dot pitch is measured in millimeters (mm) and a smaller number means a sharper image. In desk top monitors, common dot pitches are .31mm, .28mm, .27mm,
.26mm, and .25mm. Personal computer users will usually want a .28mm or finer. Some large monitors for presentation use may have a larger dot pitch (.48mm, for example). Think of the dot specified by the dot pitch as the smallest physical visual component on the display.

**Dropoff** -- when the intensity of light decreased as it moves away from the cone.

**Dynamics** -- an underlying cause of change or growth. In 3D Max a dynamic modifier adds gravity or bounce.

**DVD** -- (digital versatile disc) is an optical disc technology that is expected to rapidly replace the CD-ROM disc (as well as the audio compact disc) over the next few years. The digital versatile disc (DVD) holds 4.7 gigabyte of information on one of its two sides, or enough for a 133-minute movie. With two layers on each of its two sides, it will hold up to 17 gigabytes of video, audio, or other information. (Compare this to the current CD-ROM disc of the same physical size, holding 600 megabyte. The DVD can hold more than 28 times as much information!)

**DVD-Video** -- is the usual name for the DVD format des

**Environment mapping** -- adds realism to a scene by the use of fog, fire, clouds and volume lights.

**.exl** -- A Microsoft Excel file.

**Extrude** -- adds depth to a shape and makes it a parametric object.

**Falloff** -- describes how the light energy is dispersed.

**Feathering** -- The gradual blending of pixels between a selection or an object and the surrounding background. Feathering produces a softer, more natural-looking edge.

**FireWire** -- Apple Computer's version of a standard, IEEE 1394 High Performance Serial Bus, for connecting devices to your personal computer. FireWire provides a single plug-and-
socket connection on which up to 63 devices can be attached with data transfer speeds up to 400 Mbps (megabits per second). Many video cards accept FireWire connections to import/export audio and video data. USB 2.0 (second generation) has replaced FireWire in many applications.

Font -- A particular shape or pattern assigned to text.

Fountain fill -- A fill progressing from one color to another, or through a series of colors, using a series of intermediate steps. Fountain fills are also called gradient or graduated fills.

Frame -- an animation term used to denote one moment in time. Animations have a specific frame rate such as 30 frames per second (fps).

Freehand tool -- Creating a line or path using control points. The points can usually be defined as corner points or bezier (curve) points.

GIF -- (Graphic Interchange File) the oldest Web-friendly graphic format. GIFs are recognized by all graphical Web browsers, provide good compression (LZW), but support only up to 256 colors. GIF is a safe choice for any Web images but is better for drawings or illustrations. Photographs suffer in GIF format. Additionally, GIF support of rudimentary animation and transparency makes GIFs quite popular for special effects on the Web.

Giga -- (G) 1,073,741,824 bits (billion)

Glossiness -- alters the location of highlights on an object (shininess).

Gouraud Shading -- method used in computer graphics to simulate the differing effects of light and color across the surface of an object. In practice, Gouraud shading is used to achieve smooth lighting on low-polygon surfaces without the heavy computational requirements of calculating lighting for each pixel. The technique was first presented by Henri Gouraud in 1971. Gouraud shading is much less processor intensive than Phong shading but does not calculate all desirable lighting effects as accurately. However, Gouraud shading is much superior to flat shading which requires significantly less processing than Gouraud, but gives low-polygon models a sharp, faceted look. Graphic User Interface

GUI -- (pronounced "gooey") is a method of interacting with a computer through direct manipulation of graphical images in addition to text.

Gradient fill -- An effect created by blending one color or transparency value into another through a series of intermediate steps.

Grayscale -- color palette with 256 different shades of black, gray and white. Grayscale has a color depth of 2^8 power or 256 combinations. Sometimes referred to as 8-bit grayscale.
**Grids** -- two-dimensional arrays of lines similar to graph paper, except that you can adjust the spacing and other features of the grid to the needs of your work. If you “Snap” to grid, the object automatically positions itself on the lines and vertices of the grid.

**Guideline** -- a lined “pulled down” from a ruler to help with alignment.

**Hard drive** -- where all of your programs and data are stored. The hard drive is the most important of the various locations of permanent storage. The hard drive differs in size, speed and permanence.

**Hierarchy** -- The ordinal relationship of one or more objects to another object.

**Histogram** -- Bars of varying width

![Histogram](image)

**Hue** -- the dominant wavelength that defines a color (i.e. red or orange, etc.)

**HSV** -- Hue, Saturation and Value.

**HTML** -- Hypertext Markup Language; common computer language for the Internet.

**Hyperlink** -- a word or text that takes you to another “anchored” file location.

**Hypothesis** -- the term for the “If/Then” statement that you develop to solve a problem.

**Index of Refraction** -- controls how much light is bent as it passes through the object (water, glass).

**Infinite lighting** -- is modeled as a parallel light source, which makes the incident direction of sunlight constant over all surfaces in the scene (Sunlight).

**IEEE 1394** -- High Performance Serial Bus, is an electronics standard for connecting devices to your personal computer. IEEE 1394 provides a single plug-and-socket connection on which up to 63 devices can be attached with data transfer speeds up to 400 Mbps (megabits per second). The standard describes a serial bus or **pathway between one or more peripheral**
devices and your computer's microprocessor. Many peripheral devices now come equipped to meet IEEE 1394. Two popular implementations of IEEE 1394 are Apple's FireWire and Sony's i.LINK.

Intensity -- refers to how bright a light is.

ISP -- Internet Service Provider (i.e. AOL, Road Runner)

Legend -- the titles that appear beside a graph, often defines units (miles per hour).

JPEG -- (Joint Photographic Experts Group) graphics are widely supported on the Web and are a good choice for photographs (contentious tone images). JPEG or JPG images support millions of colors and can be compressed to be quite small. However, the lossy (data is lost) compression makes JPG files a poor choice for archiving or any other applications in which you might later need the full image quality. If you need a JPG image (likely for the Web or for email), maintain a backup copy in a format like PNG or TIFF and save a copy as JPG when you need it.

Keyframing -- In computer animation the artist determines the position or function of an object at a particular motion frame.

Kilo -- (K) 1,024 bits

Lasso tool -- A tool used to manually select around an object.

Layer --

Lens flare -- the addition of streaks of light or secondary lights which can add realism to a scene.

Line Chart --

Linking -- Process that allows you to build a hierarchical structure between objects. The linkage may be described as unidirectional if superior objects control subordinates but subordinates have no effect on their superiors (hierarchy).
**Loft Object** (Lofting) -- Loft objects are two-dimensional shapes extruded along a third axis.

**Lossless Compression** -- In lossless compression, every single bit of data that was originally in the file remains after the file is uncompressed. All of the information is completely restored. This is generally the technique of choice for text or spreadsheet files, where losing words or financial data could pose a problem. The Graphics Interchange File GIF is an image format used on the Web that provides lossless compression.

**Lossy Compression** -- lossy compression reduces a file by permanently eliminating certain information, especially redundant information. When the file is uncompressed, only a part of the original information is still there (although the user may not notice it). Lossy compression is generally used for video and sound, where a certain amount of information loss will not be detected by most users. The JPEG image file, commonly used for photographs and other complex still images on the Web, is an image that has lossy compression. Using JPEG compression, the creator can decide how much loss to introduce and make a trade-off between file size and image quality.

**Lost Cluster** -- When a computer cluster is marked as being used and it is not associated with any file.

**LUT** -- Color Look up Table used to define specific colors applied to pixel values.

**LZW** -- LZW compression is the compression of a file into a smaller file using a table-based lookup algorithm invented by Abraham Lempel, Jacob Ziv, and Terry Welch.

**Magic wand tool** -- A tool used to automatically select around an object. The magic wand tool works best if these is a large contrast or color difference around the edge of the object.

**Marquee** -- (marching ants)

**Mask** -- An area of an image that is protected from alteration or an area of an image selected for alteration.

**.max** -- A 3D Max scene file.
Medical Imaging -- any of a number of techniques to view the human body (X-Ray, MRI, CAT)

Mega -- (M) 1,048,576 bits (million)

Microprocessor -- It's sometimes called a *logic chip*. It is the "engine" that goes into motion when you turn your computer on. A microprocessor is designed to perform arithmetic and logic operations that make use of small number-holding areas called *registers*. Typical microprocessor operations include adding, subtracting, comparing two numbers, and fetching numbers from one area to another. These operations are the result of a set of instructions that are part of the microprocessor design. When the computer is turned on, the microprocessor is designed to get the first instruction from the basic input/output system (*BIOS*) that comes with the computer as part of its memory. After that, either the BIOS, or the operating system that BIOS loads into computer memory, or an application program is "driving" the microprocessor, giving it instructions to perform (i.e. Pentium 4)

MIDI -- (Musical Instrument Digital Interface) is a protocol designed for recording and playing back music on digital synthesizers that is supported by many makes of personal computer sound cards. Originally intended to control one keyboard from another, it was quickly adopted for the personal computer. **Rather than representing musical sound directly, it transmits information about how music is produced.** The command set includes note-ons, note-offs, key velocity, pitch bend and other methods of controlling a synthesizer. The sound waves produced are those already stored in a wavetable in the receiving instrument or sound card. Does not contain voice (singing) information.

Mirror -- a clone of an object whose orientation is a mirror image.

Modifier -- A process, technique and application that causes a change in the appearance or function of an object. Bend or Taper are examples of modifiers applied in 3D graphics.

Moirés -- Patterns and colors that vibrate with each other and distract the reader.

Motion Blur -- blurs everything in the scene.
**Morphing** -- A Morph object combines two or more objects by interpolating the vertices of the first object to match the vertex positions of another object. When this interpolation occurs over time, a morphing animation results.

**Motherboard** -- A motherboard is the physical arrangement in a computer that contains the computer's basic circuitry and components.

**MPEG** -- (pronounced EHM-pehg), the Moving Picture Experts Group, develops standards for digital video and digital audio compression. It operates under the auspices of the International Organization for Standardization (ISO). The MPEG standards are an evolving series, each designed for a different purpose. To use MPEG video files, you need a personal computer with sufficient processor speed, internal memory, and hard disk space to handle and play the typically large MPEG file (which has a file name suffix of .mpg). You also need an MPEG viewer or client software that plays MPEG files.

**MP3** -- MP3 (MPEG-1 Audio Layer-3) is a standard technology and format for compressing a sound sequence into a very small file (about one-twelfth the size of the original file) while preserving the original level of sound quality when it is played. MP3 files are usually download-and-play files rather than streaming sound files that you link-and-listen-to with RealPlayer and similar products. (However, streaming MP3 is possible.)

**MPEG-4 ASP** -- (Advanced Simple Profile)

**MPEG-4 AVC** -- (Advanced Video Coding), is a video compression standard that offers significantly greater compression than its predecessors. The standard is expected to offer up to twice the compression of the current MPEG-4 ASP (Advanced Simple Profile), in addition to improvements in perceptual quality. The H.264 standard can provide DVD quality video at less than 1 Mbps, and is considered promising for full-motion video over wireless, satellite, and ADSL Internet connections.

**Multi-dimensional Visualization** -- Coping with more than 3 dimensions. Generally, you can only display 2D or 3D graphics on a 2D screen. Additional variables can be shown through color, sound or icons.
Multimedia -- The integration of text, graphics, sound, animation, video and interaction to convey information.

Multi-spectral -- remote sensing which measures the amount of energy reflected or emitted in several discrete bands that correspond to specific wave lengths. Scientist can “pick out” the specific wavelength of light that reflects where marijuana is being grown in NC.

Nib -- The shape and size of a writing tool often used in calligraphy.

NOAA -- National Oceanic and Atmospheric Administration. [www.noaa.gov](http://www.noaa.gov)

NTSC -- National Television Standards Committee, is the name of the video standard used in North America, most of Central and South America, and Japan. The frame rate is 30 frames per second (fps). The resolution of a TV screen is 640 (wide) x 489 (height) and contains 250,000 pixels.

Object blur -- blurs an individual object adding to the realism of motion (i.e. adding object blur to a bounding ball)

Omni Light -- an omni light (point light) casts rays in all directions from a single source. It behaves somewhat like a bare light bulb hanging in the middle of a room.

Opacity -- controls whether a material is opaque, transparent, or translucent.

Orbit (camera) -- rotating the camera around an object.

Ordered List --
- item
- item
- item

Ordinal Number -- describes the numerical position of an object, e.g., first, second, third, etc. They can be written as 1st, 2nd, 3rd, 4th, etc.

Oren-Nayar-Blinn Shading -- is a variant of the Blinn Shader. It contains additional "Advanced diffuse" controls, Diffuse Level and Roughness that you can use to give the material a matte effect. This shader is good for matte surfaces such as fabric, terra-cotta, and so on.

.ppt -- A Microsoft PowerPoint file.

PAL -- (Phase Alternate Line) is the video standard used in most European countries. The frame rate is 25 frames per second (fps).

PNG -- (Portable Network Graphics, pronounced ping as in ping-pong) is a file format for image compression that, in time, is expected to replace the Graphics Interchange Format GIF that is widely used on today's Internet. The GIF format (owned by Unisys) usage involves licensing
or other legal considerations. (Web users can make, view, and send GIF files freely but they can't develop software that builds them without an arrangement with Unisys.) The PNG format, on the other hand, was developed by an Internet committee expressly to be patent-free. It provides a number of improvements over the GIF format. Like a GIF, a PNG file is compressed in lossless fashion (meaning all image information is restored when the file is decompressed during viewing). Typically, an image in a PNG file can be 10 to 30% more compressed than in a GIF format.

**Parallel Port** -- the most commonly used port for interfacing home made projects. This port will allow the input of up to 9 bits or the output of 12 bits at any one given time, thus requiring minimal external circuitry to implement many simpler tasks. The port is composed of 4 control lines, 5 status lines and 8 data lines. It's found commonly on the back of your PC. Often used as the printer port.

**Particle Analysis** -- allows one to highlight certain pixel values (density slicing) and take measurements of the areas. Instead of selecting area by hand and applying measurement data, particle analysis lets the computer find the select the areas of interest.

**RAM** -- (Random Access Memory) is sometimes referred to as your “desktop”. The memory is where your current files are kept while you are working on them. Muti-tasking requires more RAM. In 3D Max we use the RAM player to load images that were networked rendered. All the data stored in RAM is lost when the power to the computer is cut off.

**Resolution** -- Refers to how sharp an image is. Usually the smaller the pixels (dots) and the greater number of pixels the higher the resolution.

**Panorama** -- A wide angle view.

**Panning** -- moves the view parallel to the current viewport plane.

**PANTONE** -- a color matching system that is standard in the graphic arts industry. It is an extensive, premixed opaque selections of colors used by graphic designers and printers. Used by computer graphic artist when the outcome is going to be printed for publication (not inkjet printers).

**Parallel** -- In the context of the Internet and computing, parallel means more than one event happening at a time. It is usually contrasted with serial, meaning only one event happening at a time.

**Performance** -- the speed at which the PC boots up and programs load and is directly related to hard disk speed. Performance is critical when multi-tasking or when processing large amounts of data.

**Phong Shading** -- smoothes the edges between faces and renders highlights realistically for shiny, regular surfaces. This shader interpolates intensities across a face based on the averaged face normals of adjacent faces. It calculates the normal for every pixel of the face.
**Platter** -- is a round magnetic plate that constitutes part of a hard disk. Hard drives typically contain up to a dozen platters.

**Pie Chart** -- Pie charts compare the components of a set to each other and to the whole. The angle or the area of each slice (sometimes called a segment or wedge) is the same percent of the total circle as the data it represents.

![Pie Chart Using Legend With Slice Labels](image)

**Pivot** -- the point, usually centrally located within an object, around which an object can be rotated.

**Pixel** -- (a word invented from "picture element") is the basic unit of programmable color on a computer display or in a computer image. Think of it as a logical - rather than a physical - unit. The physical size of a pixel depends on how you've set the resolution for the display screen. If you've set the display to its maximum resolution, the physical size of a pixel will equal the physical size of the dot pitch (let's just call it the dot size) of the display. If, however, you've set the resolution to something less than the maximum resolution, a pixel will be larger than the physical size of the screen's dot (that is, a pixel will use more than one dot).

**Plane (planar)** -- a plane is the fundamental two-dimensional object. Intuitively, it may be visualized as a flat infinite piece of paper. In three-dimensional space, two different planes are either parallel or they intersect in a line. A line which is not parallel to a given plane intersects that plane in a single point.

**Post Video Effects** -- Adding special effects to a rendered image (i.e. glow effects, transitions between animations).

**Projection mapping** -- a technique that works like a film projector by projecting the texture patterns on the surface of object. With projection mapping you can project a video onto an object in a scene (i.e. explosion).
Process color -- (full color) a method used in most high quality printing of magazines or publications. It is produced by using transparent inks (magenta, cyan, yellow and black) to print a wide range of continuous tone colors.

Protocol -- rules or formats that have been agreed-upon for transmitting data.

Pseudo-color -- (False color); Grayscale images can has special colors assigned to their pixel values to help visualize information. Weather satellite images are often converted to pseudo-color images to show a temperate scale where the hotter areas are red and the cooler areas are blue.

Qualitative -- data that does not have an assigned value (hot, cold, big, high, low).

Quantitative -- data that has an assigned value (75 degrees C, 1,245 ft high).

Radiosity -- A technique to calculate indirect light. Specifically, radiosity calculates the interreflections of diffuse light among all the surfaces in your scene. To make this calculation, radiosity takes into account the lighting you’ve set up, the materials you’ve applied, and environment settings you’ve made.

RAM -- (Random Access Memory) is the volatile memory that loses its contents when the power is turned off. The term RAM is synonymous with main memory. Network rendering requires a large amount of RAM to hold all of the images until they can be saved as an AVI file.

Raster -- A row of pixels. Bitmapped images are often referred to as raster graphics.

Raster Graphic -- An image made up of rows of pixels (i.e. bitmap, jpeg, tiff, gif).

Ray Traced Shadows -- Generated by tracing the path of rays sampled from a light source.

Rays -- are bright single – pixel lines that radiate from the center of the source object, providing the illusion of extreme brightness for the object.

Raw File Size -- The total number of pixels multiplied by the color depth. Units are in bits, bytes or KB.

Realism -- The quality of making a static or animation graphic appear as it would naturally. The quality of looking real.

Red, Green, Blue -- (RGB) the three primary colors of light (TV screen).

Reflection map -- creates the illusion of shiny metals and glass by reflecting rays off the object’s surfaces (i.e. ray-traced materials).
Remote Sensing -- gathering information with touching or coming into contact with it. Examples of remote sensing are weather satellites, MRI, electron microscopy and telescopes.

Rendering -- The processing of graphics or animation to reveal all textures, materials, lights and shadows.

Resampling -- The process of changing the resolution or size of an image to change the number of pixels it contains. Upsampling increases the resolution, increasing the number of pixels; downsampling reduces the resolution, decreasing the number of pixels.

Resolution -- The amount of information that an image file contains as well as the level of detail that an input, output or display device is capable of producing. Image resolution refers to the spacing of pixels in the image and is measured in pixels per inch (ppi) or dots per inch (dpi). Output resolution refers to the number of dots per inch (dpi) that an output device, such as an imagesetter or laser printer, produces.

RGB -- Red, Green and Blue; Usually refers to the wavelengths of light in the Additive color model (TV).

ROM -- (Read Only Memory) refers to special memory used to store programs that boot the computer and perform diagnostics.

S-VHS -- stands for Super VHS and was developed by JVC to offer better video quality than the VHS format. SVHS can offer over 400 lines of horizontal resolution compared to approximately 250 lines of VHS (and compared to approximately. 500 horizontal lines of regular TV broadcast).
**Saturation** -- (HSV) The amount of a specific color (Hue) used.

![Saturation Color](image)

**Scalar** -- Scalar quantities have magnitude but not a direction and should thus be distinguished from vectors (i.e. distance, power, speed). Just because you know the speed a car is traveling does not mean you know the direction the car is travelling in.

**Scaling (uniform)** -- Changes the size of an object in all planes.

**Scaling (non-uniform)** Changes the size of an object only in specific planes.

**Scatter Plot** --

![Scatter Plot](image)

**Scientific Visualization** -- The use of interactive graphical interfaced to display, measure and understand large amounts of data.
Sectors -- pie-shaped wedges on a track. A sector is the smallest unit of space on the hard disk that any software can access.

Sepia tone -- A brownish or copper color effect sometimes applied to images to give the illusion of old photographs.

Serial -- Serial means one event at a time. It is usually contrasted with parallel, meaning more than one event happening at a time.

Self-launching -- (self running)

Shadow -- shadows add depth and realism to a scene. The angle of your light source determines the length and size of the shadow.

Slope -- the mathematical formula for Rise divided by Run (Rise over Run).

Smear -- An artistic effect similar to dragging your finger across wet paint.

Smudge -- An artistic effect that creates the same effect as rubbing your finger on pastels.

Specular -- alters the color, size and shape of highlights.

Spline -- A general term referring to 2D objects such as a line, square, ellipse, and text.

Spot Light (free) -- A spotlight casts a focused beam of light like a flashlight. A free Spotlight has no target.

Spot Light (target) -- A target spotlight casts a focused beam of light like a flashlight at a particular object.

Surface roughness -- refers to the unevenness of a brick surface, the weave of a fabric or the bumpiness of an orange.

Static -- Unmoving, not animated. Usually applies to a still image.

Storage capacity -- The capacity of a drive or media to store and hold data.

Strauss shader -- Used for modeling metallic surfaces.

Streaming Sound -- Streaming sound is sound that is played as it arrives. The alternative is a sound recording (such as a WAV file) that doesn't start playing until the entire file has arrived.

Subtractive Color Process -- When you remove or omit all of the colors (CMY) the result is white. This occurs with inkjet printing. If you do not spray pigment on the paper, you get a white area – the printer does not spray white pigment.
Surface Normals -- or just normal, is a three dimensional vector which is perpendicular to a given surface (such as a triangle). They are commonly used in 3D computer graphics for lighting calculations—a surface's normal in comparison to a light source determines how the surface will be lit (dark, bright). In 3-D computer graphics, triangles are often used as the basic "building blocks" of a polygon since triangles are guaranteed to be planar. That is, given three points in space \((x, y, z)\), the smallest surface connecting them all is guaranteed to be a flat plane.

Surfacing -- applying textures to specific surfaces; an important part of making objects look realistic.

Texture Mapping -- The positioning of images or patterns onto an object using a coordinate system (UVW Mapping).

Three Dimensional (3D) Computer Graphics -- 3D computer graphics are distinct from 2D computer graphics in that a three-dimensional virtual representation of objects is stored in the computer for the purposes of performing calculations and rendering images. In general, the art of 3D graphics is akin to sculpting or photography, while the art of 2D graphics is analogous to painting. In computer graphics software, this distinction is occasionally blurred; some 2D applications use 3D techniques to achieve certain effects such as lighting, while some primarily 3D applications make use of 2D visual techniques.

TIFF (TIF) -- TIFF files are not Web-friendly, can be compressed in several ways (but need not be), support any color depth you choose, and are widely recognized. These files can be very large. Satellite and medical images are often saved as uncompressed TIFF files because the pixel values represent some other date such as temperature or location of tumors.

TIR -- (Thermal Infrared) exploits the fact that everything above absolute zero (−459F) emits radiation in the infrared range. Infrared weather satellites can sense temperature in the IR range.
**Topographical Map** -- Display the “lay of the land”; identifies both man-made and natural land features. Three dimensional characteristics are represented with 2D lines.

![Topographical Map](image)

**Torus** -- A ring with a circular cross-section (doughnut)

**Tracks** -- concentric circles on the surface of a disk where data can be written. A typical floppy disk has 80 (double-density) or 160 (high-density) tracks.

**Trajectory** -- the path an object travels over time.

**Transition** -- any change over time; a change that occurs as a factor of time.

**Transparency** -- refers to how opaque or “clear” a color or material is.

**True Color** -- True color is the specification of the color of a pixel on a display screen using a 24-bit value, which allows the possibility of up to 16,777,216 possible colors.

**Tweening** -- the advanced 3D modeling process where the “in between” frames are created from keyframes. Process where incremental changes from the previous frame are directed toward some goal.

**Two Dimensional (2D) Computer Graphics** -- In 2D computer graphics, the computer screen may be considered as a canvas on which an image is drawn or composed. Several techniques exist for rendering 2D graphics on a computer screen; these may be broadly categorized into raster graphics in which a rectangular array of pixels is drawn to the screen, and vector graphics in which images are composed of mathematical representations of lines, curves, and other geometric shapes. 2D computer graphics typically does not involve the need for any kind of three-dimensional internal representation of objects or lighting characteristics in the computer as found in 3D computer graphics.

**Uniform fill** -- adding a solid color to a specific area (using the “bucket” tool)
Unordered list --

• item
• item
• item
• item

URL -- Universal Resource Locator (i.e. http://www.weaveracadmy.net)

USB -- (Universal Serial Bus) is a plug-and-play interface between a computer and add-on devices (such as audio players, joysticks, keyboards, telephones, scanners, and printers). With USB, a new device can be added to your computer without having to add an adapter card or even having to turn the computer off. The USB peripheral bus standard was developed by Compaq, IBM, DEC, Intel, Microsoft, NEC, and Northern Telecom and the technology is available without charge for all computer and device vendors. USB supports a data speed of 12 megabits per second. This speed will accommodate a wide range of devices, including MPEG video devices. It is anticipated that USB will easily accommodate plug-in telephones.

UVW mapping -- The UVW coordinate system is similar to the XYZ coordinate system. The U and V axes of a bitmap correspond to the X and Y-axes. The W-axis, which corresponds to the Z-axis, is generally only used for procedural maps, although a bitmap's coordinate system can be switched in the Material Editor to VW or WU, in which case the bitmap is rotated and projected so that it is perpendicular to the surface.

Value -- (HSV)

Vector -- A mathematical concept represented as a line with a starting point, a length and direction. Vectors can be described with mathematical equations. Vectors have both magnitude and direction. Most 2D and 3D computer graphic software packages create shapes using vectors.

Vector Graphic -- 2D or 3D graphics created by the software using Vectors (math equations) rather than “Pixels” or “Dots”. Vector graphics can be scaled, resized, modified and enlarged with any loss of quality. In order to use Vector graphics in most other applications (MS Word, PowerPoint, etc.) the graphic must be exported as a bitmapped image.

VHS -- Vertical Helix Scan. Videocassette format and technology introduced by JVC in 1976. Competed with Sony's BETA format. Eventually VHS came out as a winner and BETA died out.

Volatile -- a form of computer memory that is lost when the power to the computer is turned off (RAM).

Virtual Reality (VR) -- an artificial, computer-generated environment which simulates The real world.
Visible Light -- wavelengths of light between 400 to 700 nanometers (nm) and have color.

WAV -- an audio file format, created by Microsoft, that has become a standard PC audio file format for everything from system and game sounds to CD-quality audio. A Wave file is identified by a file name extension of WAV (.wav). Used primarily in PCs, the Wave file format has been accepted as a viable interchange medium for other computer platforms, such as Macintosh. This allows content developers to freely move audio files between platforms for processing, for example. In addition to the uncompressed raw audio data, the Wave file format stores information about the file's number of tracks (mono or stereo), sample rate, and bit depth.

White -- what results when mixing the three primary colors of light.

Wireframe -- A model which shows all the vertices, edges and sides.

X-axis -- Usually runs right to left.

X-Y (Line) Chart -- X-Y charts, sometimes called scatter plots, are useful for comparing large numbers of data points without regard to time. Unlike bar charts, where the differences between the points are the main interest, in X-Y charts, it's the similarities that are interesting, especially the groupings that the data takes on due to the manipulation of the independent scales. The more data that is used in an X-Y chart, the better the comparisons that can be made.

Y-axis -- Usually runs forwards and backwards.
**Z-axis** -- Usually runs up and down.

**Zooming** -- Adjust the view magnification.

**.3ds** -- A 3D Max export file used to export objects from the current scene.

**24 bit color depth** -- $2^{24}$ power or 16,700,000 different colors; True Color