Transforming Education ...Inspiring Learning

Teacher Instructions

Title: Ancient Observatories and Timeless Knowledge
(timekeeping using angles and the sun)
Grade Focus: 6, 7, 8, 9
Subject: Science, math, and history
Technology Integration Activities: Digital imaging, PowerPoint, and web content creation
Recommended Time to Completion: Six weeks (one class each week)

INTRODUCTION:
Students will learn how cultures from ancient times to the present have used the sun and other objects in the sky to mark the passage of time. They will see how archaeoastronomers use ancient observatories to predict seasons and special events. Digital imaging (or one or more of the other technologies) will be used to help document and present student observations.

NOTE: The initial part of this lesson plan helps the teacher plan and prepare to teach the lesson; the following sections (Engage through Evaluate) provide instruction for the students and may be printed/provided to students, as desired. The Standards section helps teachers correlate this lesson into their curriculum.

PREREQUISITE EXPERIENCE:
Students should be able to use a digital camera and upload digital images to a computer. Students with more advanced skills may use these images to create a time-lapse animation. Students may also present their findings either by using PowerPoint or through a web page.

TEACHER PREP TIME: 1 – 2 hours
Teachers should review the following tutorials:

- imaging:
  www.NortelLearniT.org/technology/Imaging

- PowerPoint presentations:
  www.NortelLearniT.org/technology/PowerPoint_Presentations

- web content creation:
  www.NortelLearniT.org/technology/Webpage_Creation

PROJECT:
Students view segments of the NASA CONNECT™ program, "Ancient Observatories: Timeless Knowledge," http://nortellearnit.org/LearniT/lessons/Multi-subject_Lesson_Plans/Test/ancient_flash_video

This will allow them to learn more about the sun's role in past and present cultures as a timekeeping tool. Working in groups, they use simple tools to create a working sundial, which they then use to measure, collect and analyze data to make predictions. Students record what they observe using digital imagery. Other resources for this lesson plan include the:

- Making a Sun Dial PowerPoint presentation available for view or download at http://nortellearnit.org/lessons/Multi-subject_Lesson_Plans/Test/
- NASA Ancient Observatories: Timeless Knowledge (Flash video) at http://nortellearnit.org/lessons/Multi-subject_Lesson_Plans/Test/
- Smartboard Presentation file available as a compressed zip file at http://nortellearnit.org/lessons/Multi-subject_Lesson_Plans/Test/

If time permits, they may extend this project using the web to conduct more research into the sun's role in past and present cultures. They may use PowerPoint or design a web page to present findings and demonstrate their understanding of the sun's influence on culture and its use as a timekeeping device.

For schools and organizations with Smartboard™ access and software, the Ancient Observatories Smartboard™ Presentation file is provided as a downloadable compressed zip file. Smartboard™ Presentations require an interactive whiteboard and compatible software, such as Microsoft Word or PowerPoint. Note: If you don't have the software, this file will open as simply a character string.

ASSESSMENT / GRADING:
Through answers to discussion questions, students will demonstrate their understanding of the use of the sun as a timekeeping tool.

Rubrics (assessment tools) will be used to evaluate their digital images, PowerPoint presentations and web sites, to determine the students' subject knowledge, analytical skills and applied understanding of the material.

If students create a PowerPoint project, a presentation rubric will be used for this purpose. Similarly if a web site is created, a different rubric will be used. Refer

to the *Evaluate* section of this document. Consult the following URL for help regarding rubrics in general: http://NortelLearniT.org/resources/Handouts/

TIME MANAGEMENT TIPS:
Students may need to gain some experience with one or more of the suggested technologies. It would be useful to have the students explore the training videos as they progress through the project

Students should work in teams. Each team should select from the technology options a single technology to use for their project, i.e., digital imaging, a PowerPoint presentation, or developing web page content.

Engage

Through the centuries, people of all cultures have been curious about the sun and have wanted to better understand and explain how it affects life on earth. Many cultures have used legends to explain their observations of the sun. Many have built observatories, marking the position of the shadows the sun casts on specific days like the summer and winter solstices and the spring and fall equinoxes.

People throughout history have been able to use their growing knowledge of the sun to help them make choices concerning the planting of crops, keeping track of time and seasons, and the use of the sun for solar energy. Additionally, people have learned to deal with *safety issues* concerning the sun and to better understand the earth's overall relationship with the sun.

Ancestral Puebloans along the Utah-Colorado border noted the summer solstice by marking the sun's shadows with petroglyphs. Do you wonder what significance the sun had for the Ancestral Puebloans? What did light and shadows mean to ancient cultures?

Do you wonder…

- What causes shadows?
- Why do shadows change throughout the day?
- What do light and shadows mean to people today?

Explore

1. As a group, view segments of the NASA CONNECT™ program *Ancient Observatories: Timeless Knowledge*, (http://NortelLearniT.org/lessons/Multi-subject_Lesson_Plans/Test/) to learn more about the sun-earth connection and timekeeping by shadows and the sun.

2. Split into teams of four to six students. Make a sun-shadow plot by marking the ends of shadows made by the sun and a gnomon (a stick used to cast a shadow) every half-hour throughout the day. You will observe and record how the length and position of shadows change throughout the day because of the earth's spin changing its position in relation to the sun.

After you have mapped most of a day's-worth of shadows, measure and record the shadow angles and lengths. Directions for this activity, as well as handouts and data charts, can be downloaded from: http://connect.larc.nasa.gov/programs/2004-2005/ancient/Ancient_Observatory.pdf (pages 10 - 12 and 17 - 19).

3. You will want to capture the movement of the sun and changes in the gnomon's shadow through digital imagery and animation. For this, you will need a digital camera to take still images of the chart and gnomon. Once you have taken pictures of the movement of the shadow, you will want to assemble these images into a presentation. You can use either PowerPoint or Microsoft Word to present your findings.

TIP: Before you begin your research, you might want to review the Nortel LearniT imaging training videos at: http://www.NortelLearniT.org/technology/Imaging/.

4. Continue your project by exploring an ancient culture that used the sun-earth relationship. Keep an accurate personal journal. Follow the steps below and include lots of details so you can share what you learn. Organize your answers using a word processor.

a. Pick an ancient civilization, e.g., ancient Rome, ancient Egypt, the Aztecs, the Mayans, or ancient Greece, that used the sun-earth relationship, for further study.

b. As you explore ancient civilization web sites, make notes on: major events, time-lines, clothing, architecture, family, traditions, food, marriage, culture, technology, religion, customs, tools and government. Be sure to note how the sun-earth relationship influenced the society and culture of this civilization.

c. Provide background information on your topic. Be sure to answer the 5 W's: who, what, when, where and why?

Be sure to save your work at regular intervals. Also, be sure to document the sources of your Internet research. This is called "making a citation" of someone else's work. The format that is typically used is as follows:

Last Name, First Name of Author (if known). Title of work/article/page. *Title of Complete Document* (if applicable). Date last modified. URL (date visited).

Explain

1. Organize your thoughts by discussing these questions with your class.

   - what have you observed about changes in the sun's shadows throughout the day?
   - how do these changes reflect the sun-earth relationship?
   - describe the sun-earth movement responsible for changes in the sun's shadow.
   - what did you learn about ancient cultures and the sun's importance to these cultures?
   - how would you explain the importance the sun plays in our culture?
   - how would our lives change without the sun?

The sun is stationary in relation to the earth, but it appears to move across the sky because the earth is rotating on its axis every 24 hours, producing night and day. The earth, slightly tilted on its axis, orbits around the sun once each year. For half the year, the Northern Hemisphere is tilted toward the sun while the Southern Hemisphere is tilted away from it. The reverse is true for the other half of the year, causing the seasons.

Summer solstice, the longest day of the year, occurs when one hemisphere is tilted towards the sun. Winter solstice, the shortest day of the year, occurs when one hemisphere is tilted away from the sun. The fall and spring equinoxes occur when light from the sun just reaches both the north and south poles, resulting in the length of day and night to be equal for both hemispheres.

The sun-earth relationship and apparent movement of the sun can be seen in the sun-shadow plots. Using digital imaging and animation, these changes can be "sped up" and repeated.

Ancient cultures depended on their physical world for information and explanations. Time, seasons and traditions were based on their environment and the natural cycles. Consider how understanding the connection between the scientific and the cultural, helped or hindered the ancient culture you are studying. How does science affect our culture today?

Elaborate

Use a gnomon of a different length than the one you used originally. Predict the shadow plot for this gnomon. Place small objects or marks where you predict the ends of the shadows will be cast at several times during the day.

1. Capture the new shadow plot digitally. Could you accurately predict the location of the shadows?

2. As you are collecting images and conducting research, be sure to save backups of your digital data, to avoid losing valuable work.

Record not only your findings, but the sources of the information. Store photos of the other students working on the project, as well as photos of the gnomon. And, of course, save facts concerning the history of the gnomon technique, e.g., the ancient Mayans.

Remember to cite references for ALL your information, including pictures.

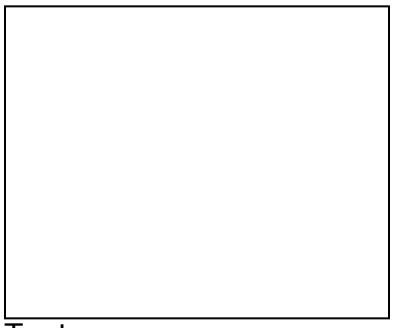
1. Edit your notes and the data that you have collected. Discuss the material with your team members.

2. Using a storyboard, plan how you will display your digital images, research, graphics and other information, into a "virtual museum." This information can then be presented to your audience as either a PowerPoint presentation, or as web site content, or both.
3. Create a PowerPoint presentation focusing on past cultures and their use of the sun as a timekeeping tool. Begin by creating a storyboard to creatively organize your slides. Below and available on this lesson plan's web page at http://nortellearnit.org/lessons/Multi-subject_Lesson_Plans/Test/ is a blank storyboard:

Storyboard Template

Name:
Title of Presentation:

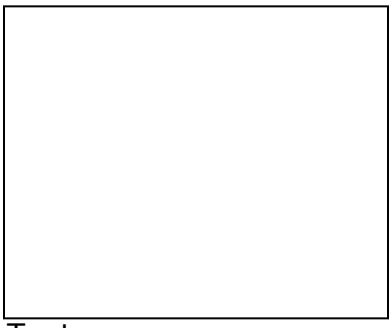
Slide #1



Text:

Main Idea:

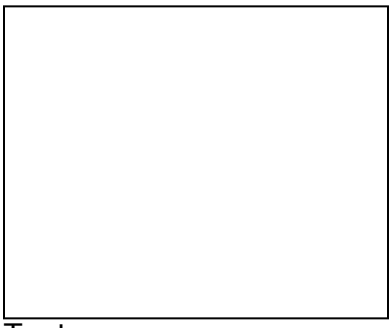
Slide #2



Text:

Main Idea:

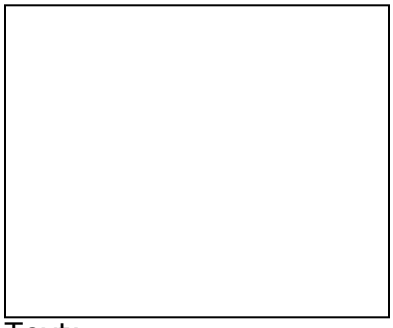
Slide #3



Text:

Main Idea:

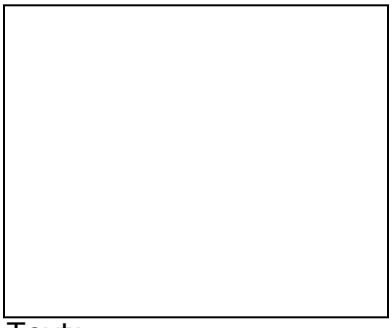
Slide #4



Text:

Main Idea:

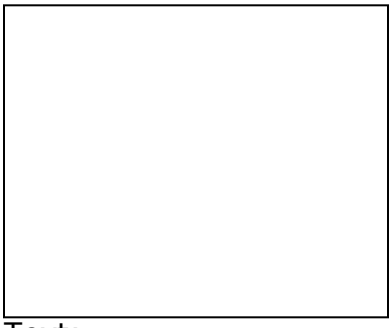
Slide #5



Text:

Main Idea:

Slide #6



Text:

Main Idea:

a. Before you begin creating your own PowerPoint slides, you might want to review one of the Nortel LearniT PowerPoint video tutorials to get some good tips on making a great presentation. View these at the following URL: http://NortelLearniT.org/technology/PowerPoint_Presentations

b. Find and use pictures and sounds to emphasize the points about sundials and sun timekeepers. You may want to research Sun Daggers and Medicine Wheels—depicted here in these photographs.

Photo credits: NASA/GSFC

You can find out more at these web sites:

- sun-watchers of the southwest
  www.chabotspace.org/vsc/solar/educationresources

- sun-earth day – ancient observatories
  sunearthday.nasa.gov/2005/index.htm

c. Include a descriptive title screen at the beginning of your PowerPoint presentation. Use multimedia techniques, e.g., images and sounds, throughout the presentation—to help communicate the key information to your audience. Finally, place your credits and references at the end of the presentation.

6. Your team may want to create a web site, or web content, using the pictures and other information that you have gathered.

Detailed information regarding HTML coding and the actual production of a web site can be found at:
http://NortelLearniT.org/technology/Webpage_Creation/

7. The final step in your project is for your team to share your PowerPoint presentation, or web content with the entire class.

   Tip: Remember to ONLY use images, or sounds that you have permission to include in your presentation. To learn more about copyrights (and Copy Wrongs!), watch the Nortel LearniT video tutorial at http://NortelLearniT.org/technology/Digital_Ethics/

Evaluate

PowerPoint and Imaging Project Evaluation Rubric				
Criteria	**Level 1 (D)**	**Level 2 (C)**	**Level 3 (B)**	**Level 4 (A)**
Research	Limited research, from limited sources; provides no evidence of critical thinking to evaluate content	Somewhat efficient & uses some critical thinking to evaluate content from somewhat varied sources.	Well researched, from various sources and uses critical thinking to evaluate content	Thorough research from varied sources presenting different points of view & uses critical thinking to evaluate content
Storyboard / planning	Limited planning evident	Some planning evident	Planning evident	Thorough planning evident
Content	Lacks detail	Some detail	Good detail	Excellent detail
Technology Use to Demonstrate Under-standing	Technology use with little purpose	Technology use with some purpose	Technology use with purpose	Intuitive technology use with specific purpose
Applied Under-standing	Applied understanding is not evident	Applied understand-ing somewhat evident	Applied under-standing evident	Applied understanding clearly evident
Overall Final Project	Inconsistent and inappropriate aesthetics & technical functionality	Somewhat consistent & appropriate aesthetics & technical functionality	Consistent & appropriate aesthetics & technical functionality	Consistent, creative & appropriate aesthetics & technical functionality

Web Page Project Evaluation Rubric				
Criteria	**Level 1 (D)**	**Level 2 (C)**	**Level 3 (B)**	**Level 4 (A)**
Hyperlinks	Few links are active and access the correct destination	Some links are active and access the correct destination	Most links are active and access the correct destination	All links are active and access the correct destination
Font / Colors	Font & color choices are not professional or aesthetically pleasing	Font & color choices are somewhat professional & aesthetically pleasing	Font & color choices are professional & aesthetically pleasing	Font and color choices are professional, consistent and aesthetically pleasing
Storyboard / Architecture of Site	Architecture of site is not logical or comprehensive	Architecture of site is somewhat logical and comprehensive	Architecture of site is generally logical and comprehensive	Architecture of site is logical and comprehensive
Intuitive Navigation	Navigation is not intuitive	Navigation is somewhat intuitive	Navigation is intuitive	Navigation is consistent and intuitive
Overall use of Technology to Present Findings	Use of technology to present findings using a few simple ideas	Use of technology to present findings using a variety of simple ideas	Use of technology to present findings using ideas of some complexity	Use of technology to present findings using complex ideas

Extend

Complete this *Squeak* activity to demonstrate an animated sundial.

Norbert has lost his watch and needs to be able to tell the time of day so he doesn't miss any important appointments. As you know, the ancients could tell time by looking at the direction of the shadow a gnomon casts.

The direction of the gnomon's shadow is simulated in the activity and a protractor is provided to help you measure angles. There are several challenges in the activity, including challenges relating to: angles, symmetry, measurement, plotting and analysis. You will see how scientists use measurements, plotting and data analysis to learn about nature's secrets.

You can find this activity at http://connect.larc.nasa.gov/programs/2004-2005/ancient/activity.html.

This activity uses a free, exciting, multimedia, programming environment called Squeak that can run on 12 different computer platforms. You can download the plug-in for Squeak at www.squeakland.org. Once the downloaded icon is on your desktop, double-click on it for easy installation. (This activity uses the version of Squeak made available in September 2004. If your version of Squeak is older than that, you need to obtain an updated version—available at www.squeakland.org.)

> Caution: Although the Squeak plug-in works for Windows 95 and 98, those operating systems are older and less stable and you may experience problems when running Squeak. It is preferable to have a processor speed of 300 MHz or greater and at least 64 MB of RAM.

Resolution: Depending on the resolution of your monitor, we have prepared two different versions of the activity for you. If you have a PC you can check the resolution of your monitor in the Control Panel by clicking on the Display icon and then the Settings tab. If you are using a Macintosh computer with OS 10, click on the System Preferences icon along the bottom, then the Displays icon and finally the Display tab if you need to. The first button on the left is for resolution set to 800x600 and the second is for resolutions set to 1024x768 or higher.

Standards

Science

NS.5-8.4 EARTH AND SPACE SCIENCE

As a result of their activities in grades 5-8, all students should develop an understanding

- Earth in the solar system

NS.5-8.5 SCIENCE AND TECHNOLOGY

As a result of activities in grades 5-8, all students should develop--

- Abilities of technological design

Social Studies

NSS-WH.5-12.2 ERA 2: EARLY CIVILIZATIONS AND THE EMERGENCE OF PASTORAL PEOPLES, 4000-1000 BCE

The student in grades 5-12 should understand

- the major characteristics of civilization and how civilizations emerged in Mesopotamia, Egypt, and the Indus valley.

National Technology Standards

NT.K-12.3 TECHNOLOGY PRODUCTIVITY TOOLS

- Students use technology tools to enhance learning, increase productivity, and promote creativity.

NT.K-12.4 TECHNOLOGY COMMUNICATION TOOLS

- Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.

- Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

NT.K-12.5 TECHNOLOGY RESEARCH TOOLS

- Students use technology to locate, evaluate, and collect information from a variety of sources.

Virginia SOL

Earth Science

Standard ES.4 a, b

The student will investigate and understand the characteristics of the Earth and the solar system. Key concepts include
a) position of the earth in the solar system; and

b) sun-Earth-moon relationships (seasons, tides, and eclipses).

Standard ES.4 c, d

The student will investigate and understand the characteristics of the Earth and the solar system. Key concepts include
c) characteristics of the sun, planets and their moons, comets, meteors, and asteroids; and

Technology

Grades 6-8

Technology Research Tools

C/T 6-8.6 The student will use technology to locate, evaluate, and collect information from a variety of sources.

- Use Internet and other electronic resources to locate information in real time.

Technology Communication Tools

C/T 6-8.9 The student will use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

- *Independently use technology tools to create and communicate for individual and/or collaborative projects.*