Measure for Measure: Time and Temperature:
Teacher’s Guide

Grade Level: 6-8  Curriculum Focus: Scientific Inquiry  Lesson Duration: One or two class

Program Description
Many different systems of measurement—and their value to science—are featured in this presentation. Segments cover celestial events, mass extinction, and the effects of extremes in temperature and weather. Vivid examples demonstrate how scientists evaluate and quantify very large intervals of time, temperature, and distance. This program includes one feature segment and four short segments.

Onscreen Questions
• How do stars spread heavy elements throughout the universe?
• What clues help scientists form their theories about what killed the dinosaurs?
• What are the differences between Fahrenheit, Celsius, and Kelvin temperature scales?
• How do scientists gather information about hurricanes?

Lesson Plan

Student Objectives
• Discuss the tools of scientific inquiry.
• Develop a template to solve scientific problems.
• Use the template to work through a problem in science.

Materials
• Forensic Detectives: Time and Temperature video and VCR, or DVD and DVD player
• Paper and pencils
• Newsprint and markers
• Computer with Internet access
Procedures

1. Begin the lesson by asking students if they know the steps of scientific inquiry. Write their ideas on a sheet of newsprint. Students may respond as follows:
   - Inquiry is the way that scientists ask questions.
   - Inquiry has something to do with conducting experiments.
   - Inquiry involves solving problems.

2. Next, have students discover scientific inquiry for themselves. They can find information on the following Web sites:
   - [http://regentsprep.org/Regents/biology/units/laboratory/scientificmethods.cfm](http://regentsprep.org/Regents/biology/units/laboratory/scientificmethods.cfm)
   - [http://w3.dwm.ks.edu.tw/bio/activelearner/01/ch1c8.html](http://w3.dwm.ks.edu.tw/bio/activelearner/01/ch1c8.html)

3. Have each student develop a template to solve a problem using the steps of scientific inquiry. The steps should include the following:
   - Identify a problem.
   - Hypothesis, or prediction, of the solution
   - Steps required to solve the problem. (The steps may be an experiment, library or online research, or interviews.)
   - Examine and organize the results.
   - Conclusions based on research or outcomes of the experiment
   - Comparison of the initial hypothesis and the conclusion based on research or experimentation

4. Have students use their templates to solve a scientific problem. Divide the class into small groups, and have each group select one of the following problems:
   - Why did the dinosaurs die out?
   - Why do scientists think that birds may be descended from dinosaurs?
   - Why did the woolly mammoth die out?
   - What evidence do scientists have for global warming?

5. The Web sites listed below have information on each of these topics. If a group selects the first topic, have them watch the segment entitled “The End of Dinosaurs” for information about why the dinosaurs died out.

   Why did the dinosaurs die out?
Why do scientists think that birds are descended from dinosaurs?
- [http://www.dmtturner.org/Teacher/Library/4thText/VerPart5.html](http://www.dmtturner.org/Teacher/Library/4thText/VerPart5.html)
- [http://www.ucmp.berkeley.edu/diapsids/avians.html](http://www.ucmp.berkeley.edu/diapsids/avians.html)
- [http://www.bbc.co.uk/dinosaurs/howdoweknow/q62.shtml](http://www.bbc.co.uk/dinosaurs/howdoweknow/q62.shtml)

Why did the woolly mammoth die out?
- [http://www.crystalinks.com/woollymammoth.html](http://www.crystalinks.com/woollymammoth.html)
- [http://www.unmuseum.org/missingm.htm](http://www.unmuseum.org/missingm.htm)
- [http://www.exn.ca/mammoth/Extinction.cfm](http://www.exn.ca/mammoth/Extinction.cfm)

What evidence do scientists have for global warming?
- [http://www.ecobridge.org/content/g_evd.htm](http://www.ecobridge.org/content/g_evd.htm)

6. Give students time in class to work on this activity. Complete templates should include the following information:
   - identification of the problem
   - hypothesis
   - steps taken to solve the problem
   - organization of results
   - conclusion
   - comparison of the initial hypothesis with conclusion

7. Ask groups to share their findings with the class, following the steps of scientific inquiry.

8. Conclude the lesson by asking students: Is scientific inquiry an effective way to solve problems? Can it be used to solve other kinds of problems? How can this approach help in other academic areas? (A social studies example is determining the cause of death of a 5,300-year-old mummy found in the Alps; see segment entitled “Frozen in Time.”)

**Assessment**

Use the following three-point rubric to evaluate students’ work during this lesson.

- **3 points**: Students participated actively in class discussions; developed a complete template for the steps of scientific inquiry; used the template effectively to solve a problem.
• **2 points:** Students participated in class discussions; developed a mostly complete template for the steps of scientific inquiry; used the template somewhat effectively to solve a problem.

• **1 point:** Students did not participate in class discussions; developed a mostly incomplete template for the steps of scientific inquiry; had difficulty using the template to solve a problem.

**Vocabulary**

*evidence*
*Definition:* A group of animals or plants presumably related by descent from common ancestors
*Context:* In conducting an experiment, scientists collect evidence to support their hypothesis.

*hypothesis*
*Definition:* A prediction about what caused a particular event to take place
*Context:* Developing a hypothesis based on prior knowledge is the starting point in the problem-solving strategy defined by the steps of scientific inquiry.

*observation*
*Definition:* Information gathered to determine how to solve a problem or answer a question
*Context:* Young children may make the observation that dark clouds mean that rain is on the way.

*scientific inquiry*
*Definition:* The approach that scientists use to study the natural world; it involves asking questions, developing a hypothesis, collecting evidence to answer the question or prove or disprove the hypothesis, organizing information, and developing a conclusion.
*Context:* Scientists using scientific inquiry have been able to determine that an asteroid struck Earth, which may have lead to the extinction of the dinosaur.

**Academic Standards**

*National Academy of Sciences*

The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K-12. To view the standards, visit [http://books.nap.edu](http://books.nap.edu).

This lesson plan addresses the following science standards:

- Science as Inquiry: Abilities necessary to do scientific inquiry; Understandings about scientific inquiry

*Mid-continent Research for Education and Learning (McREL)*

McREL’s Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit [http://www.mcrel.org/](http://www.mcrel.org/).
This lesson plan addresses the following national standards:

- Science—Nature of Science: Understands the nature of scientific inquiry
- Language Arts—Viewing: Uses viewing skills and strategies to understand and interpret visual media

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- [http://school.discovery.com/teachingtools/teachingtools.html](http://school.discovery.com/teachingtools/teachingtools.html)

DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How To Use the DVD

The DVD starting screen has the following options:

Play Video—This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index—Here the video is divided into five parts (see below), indicated by video thumbnail icons. Watching all parts in sequence is similar to watching the video from start to finish. Brief descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Curriculum Units—These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher’s Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

Standards Link—Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources—This screen gives the technical support number and Web site address.
Video Index

I. Stardust Elements (7 min.)
Journey into space to see what happen when a star dies. Then learn what’s in store for the medium-sized star we call our sun.

II. The End of Dinosaurs (6 min.)
Travel 65 million years back in time to explore the geologic events that may have caused the dinosaurs’ mass extinction.

III. Earthly Thermometers (21 min.)
We take temperature scales for granted every time we check the weather or put a meal in the oven. But creating them took many years of trial and error.

IV. Frozen in Time (5 min.)
Discover how freezing temperatures have preserved a valuable link to our distant past as scientists examine a prehistoric body.

V. Hurricanes Take the Heat (6 min.)
A slight temperature change in ocean water is all it takes to turn a run-of-the-mill thunderstorm into a destructive hurricane.

Curriculum Units

1. Hydrogen and Stars

Pre-viewing question
Q: How many stars are in the Milky Way galaxy?
A: Answers will vary.

Post-viewing question
Q: What is nuclear fusion?
A: Answers will vary.

2. Death of the Sun

Pre-viewing question
Q: Will there be life on Earth after the sun dies?
A: Answers will vary.

Post-viewing question
Q: Will the sun produce iron and magnesium when it dies?
A: No; medium-mass stars do not have enough energy to produce elements heavier than oxygen.
3. Supernovas and Space Junk

Pre-viewing question
Q: What do you know about supernovas?
A: Answers will vary.

Post-viewing question
Q: How do massive stars produce iron?
A: These stars die in layers, with each layer fusing heavier and heavier elements. Finally, at the core of massive stars, silicon and sulfur fuse, creating iron.

4. Separation of Pangaea

Pre-viewing question
Q: What did Earth look like when dinosaurs roamed it?
A: Answers will vary.

Post-viewing question
Q: How do we know that there used to be one supercontinent on Earth?
A: Evidence of Pangaea can be found in the shorelines of South America and Africa, which fit together from one continent to the other. Additionally, the fossil and mitochondrial DNA evidence found on separate continents show that long-ago land connections must have existed.

5. Mass Extinctions

Pre-viewing question
Q: What are the greatest geologic dangers on our planet?
A: Answers will vary.

Post-viewing question
Q: Do you think there will be another mass extinction on Earth?
A: Answers will vary.

6. Thermal Colors

Pre-viewing question
Q: How do you measure temperatures in your daily life?
A: Answers will vary.

Post-viewing question
Q: How do thermal cameras represent the different levels of heat?
A: The infrared heat energy they detect is converted into different colors—white is hottest, then red; green is in the middle; blue and black represent the coldest temperatures.

7. Early Thermometers and Scales

Pre-viewing question
Q: What happens to most substances when they are heated and cooled?
A: When heated, most substances expand; when cooled, most contract.
Post-viewing question
Q: Why did scientists choose mercury for thermometers?
A: Because it remained liquid at the boiling and freezing points of water and it expands in a very regular way over a wide range of temperatures.

8. Fahrenheit, Celsius, and Kelvin

Pre-viewing question
Q: Do you use Celsius or Fahrenheit to measure temperatures?
A: Answers will vary.

Post-viewing question
Q: What is absolute zero?
A: It’s a theoretical absolute developed by Lord Kelvin in the 1850s. If you could remove all the pressure from a gas, you’d theoretically remove all the heat from it too. It would get colder and colder until it eventually reached a bottom point, below which it could not go. Kelvin called this absolute zero. It occurs at minus 273 Celsius.

9. Keeping Cool

Pre-viewing question
Q: What would life be like without ice?
A: Answers will vary.

Post-viewing question
Q: Why do you think humans lose heat as we grow older?
A: Answers will vary.

10. Volatile Temperatures

Pre-viewing question
Q: Do you like spicy foods?
A: Answers will vary.

Post-viewing question
Q: How do we measure temperatures that exceed the boiling-point of mercury?
A: At 357 degrees Celsius, almost 675 degrees Fahrenheit, mercury itself boils. Any higher than that and ordinary thermometers are useless. So we use the effect that it has on the flow of electricity, or analyze the color of light that it gives off, or study what it does to laser beams.

11. Clues From the Ice Man

Pre-viewing question
Q: What do you think life was like for prehistoric humans?
A: Answers will vary.

Post-viewing question
Q: Who do you think Ötzi was, and why was he killed?
A: Answers will vary.
12. Studying Hurricanes

Pre-viewing question
Q: What do you know about hurricanes?
A: Answers will vary.

Post-viewing question
Q: How does a tropical depression become a hurricane?
A: If the water temperature reaches 26 degrees Celsius (80 degrees Fahrenheit) or higher, the depression may build and become a hurricane. As the warm ocean heats the humid air, it rises. Then moisture in the air condenses to form clouds. The low-pressure center of the storm takes in more moist air and heat from the ocean surface, driving up the air below it even faster. And, as with other storm systems, the winds spiral inward toward the area of low pressure, rising and drawing in additional air. The storm continues feeding upon the warm ocean water and gets stronger and stronger. As the storm travels, its spiral tightens, and it becomes even more powerful. A column of clear, relatively calm air develops called the eye of the storm. Updrafts surrounding the eye are balanced by air going back down inside the eye. The area surrounding the eye is called the eyewall. The eyewall is where the winds are at their strongest. And when the winds exceed 119 kilometers per hour, the storm becomes a hurricane.