

SCIENTIFIC METHOD				Student/Class Goal Students will understand and apply the basic principles of scientific method in preparation for the physical science section of the GED test.	
Outcome <i>(lesson objective)</i> Students will conduct an experiment and complete a chart demonstrating an understanding of some basic properties of water and the scientific method.				Time Frame Two 45 minute sessions	
Standard <i>Read with Understanding</i>				NRS EFL 3-4	
Purpose	Benchmarks	Word Knowledge	Benchmarks	Comprehension	Benchmarks
Purpose for reading	3.1, 4.1	Decoding skills	3.3, 4.3	Strategy use	3.11, 4.11
Select text		Word parts		Text structural elements	3.12, 4.12
		Context clues		Genres	
		Reference materials		Literary analysis	
		Word relationships		Drawing conclusions	3.15, 4.15
		Content vocabulary	3.8, 4.8	Making connections	3.16, 4.16
		Figurative language			
		Fluency			
Materials <i>Scientific Method Chart</i> Handout Dimes, pennies, cups of water, eyedroppers, calculators <i>The Scientific Method Key Elements</i> Handout <i>Water's Chemical Properties</i> Teacher Resource					
Learner Prior Knowledge Reading ability of at least a pre-GED level. Finding an average will be helpful, but if students do not know the calculation, it will be explained during the activity. They may receive help from other students, as the math calculation is not the focus of the lesson.					
Instructional Activities Step 1 - Explain that the steps of the scientific method can be used to solve any problem. Tell students that the class will be learning more about the method and conducting experiments to apply it. Give each student a copy of the <i>Scientific Method Chart</i> . Talk through the steps in the chart using the example of arriving home one night to find your front porch light is out. What could be some possible causes? Bulb burnt out? Test your ideas. Replace the bulb. Come to conclusion. Does it work? Problem solved. If not, test other ideas. Draw conclusions. Step 2 - Students will conduct an experiment testing how many drops of water will fit on the head of a coin. Introduce vocabulary for activity: variables (coins are different sizes; water drops may be larger or smaller) and controls (all are using the same type of water and droppers). Define hypothesis . Ask students what else they might need to know in order to form a hypothesis. Ask students what they know about water. How will it react in the experiment? On blackboard, instructor will illustrate hydrogen bonding and surface tension of water. See <i>Water's Chemical Properties</i> Teacher Resource. Does this information change the hypothesis? Step 3 - Students will form a hypothesis before beginning and predict how many drops will fit on their coins. They will each fill out a <i>Scientific Method Chart</i> as they progress through the experiment (prompts on the chart will assist them). Have students work in pairs; one conducts the experiment, the other student counts and records. With eyedropper, student drops water onto coin until it rolls off the edge. Students switch roles and repeat steps. Each student will have 3 attempts. They will each find their own averages from the three figures. They may help one another or other pairs to calculate the results. Make calculators available to those who want them.					

Step 4 - Class will brainstorm about results.

- Was your hypothesis correct? Higher, lower?
- What conclusions can you make about the class experiments in general?
- What are some possible reasons for different numbers?

Step 5 - Students will practice placing key elements of the scientific method into a blank chart. From *The Scientific Method Key Elements* Handout have each bulleted item on separate strips of paper in random order. Each student should receive one full set. Using a blank scientific method chart, they will place each element into the appropriate section (they may glue them). They may need to define word meanings, form judgments, question, or ask for clarification as they analyze the material. They may need to think back on the experiment for examples. Discuss answers in class.

Assessment/Evidence *(based on outcome)*

Student responses
Observation
Scientific Method Chart

Teacher Reflection/Lesson Evaluation

Not yet completed.

Next Steps

Scientific Method Learning Objects will give students additional practice with the scientific method and research.

Technology Integration

Properties of Water <http://ga.water.usgs.gov/edu>

Purposeful/Transparent

Students realize the need for a background in science concepts in order to increase their scores on the GED science test.

Contextual

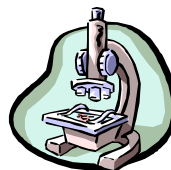
The scientific method can be applied to many situations. Strategies used in this activity may be used in any problem solving process.

Building Expertise

Students see from this activity that they already use the scientific method as a problem-solving tool in their daily lives.

The Scientific Method

can be used to solve **any** problem



<p>Step 1: State the problem.</p>	<p>You cannot solve a problem until you know exactly what it is.</p>
<p>Step 2: Research the problem.</p>	<p>What will it take to solve my problem? What do I know and need to know, about my problem?</p>
<p>Step 3: Form a hypothesis.</p>	<p>A possible solution to my problem.</p>
<p>Step 4: Test the hypothesis.</p>	<p>Perform an experiment to see if your hypothesis works.</p>
<p>Step 5: Draw conclusions from the data.</p>	<p>Data are the results of an experiment.</p>

The Scientific Method Key Elements

Step 1

- What idea are you trying to test?
- What is the scientific question you are trying to answer?

Step 2

- List all materials and equipment that were used.
- Be clear about the variables versus the controls

Step 3

- Explain how you think your project can demonstrate your purpose.
- Make a prediction (hypothesis) regarding the outcome of your experiment.
- State the results you are predicting in measurable terms.

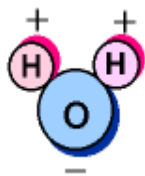
Step 4

- Keep a detailed journal of observations, data, and results.

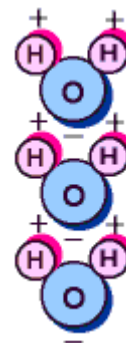
Step 5

- Why did the results occur? What did your experiment prove?
- Was your hypothesis correct? Did your experiment prove or disprove your hypothesis?
- What further study do you recommend given the results of your experiment? What would be the next question to ask?

Water's Chemical Properties Teacher Resource



You probably know water's chemical description is H_2O . As the diagram to the left shows, that is one atom of oxygen bound to two atoms of hydrogen. The hydrogen atoms are "attached" to one side of the oxygen atom, resulting in a water molecule having a positive charge on the side where the hydrogen atoms are and a negative charge on the other side, where the oxygen atom is. Since opposite electrical charges attract, water molecules tend to attract each other, making water kind of "sticky." As the right-side diagram shows, the side with the hydrogen atoms (positive charge) attracts the oxygen side (negative charge) of a different water molecule. (If the water molecule here looks familiar, remember that everyone's favorite mouse is mostly water, too).



All these water molecules attracting each other mean they tend to clump together. This is why water drops are, in fact, drops! If it weren't for some of Earth's forces, such as gravity, a drop of water would be ball shaped -- a perfect sphere. Even if it doesn't form a perfect sphere on Earth, we should be happy water is sticky.

Water is called the "universal solvent" because it dissolves more substances than any other liquid. This means that wherever water goes, either through the ground or through our bodies, it takes along valuable chemicals, minerals, and nutrients.

Water is called the "universal solvent" because it dissolves more substances than any other liquid. This means that wherever water goes, either through the ground or through our bodies, it takes along valuable chemicals, minerals, and nutrients.



<http://www.wisconline.org>

Psychology and Research

Author: Therese Nemed

School: Fox Valley Technical College **Date:** 8/12/2002

Description: Students read about the scientific method and the three main types of research. They enter their answers to questions on the screen.

http://www.wisc-online.com/objects/index_tj.asp?objID=I2P2502

The Scientific Method

Author: Marise Hussey, Pat Griffin, Pat Cipriano

School: Waukesha County Area Technical College, Chippewa Valley Technical College, Western Wisconsin Technical College **Date:** 11/12/2002

Description: Students choose the hypothesis and practice describing bacterial colonies using the steps of the scientific method.

http://www.wisc-online.com/objects/index_tj.asp?objID=MBY2102

Scientific Method Learning Objects