Mad Scientist

Pre-Visit Activities

3rd through 5th Grades

VIRGINIA AIR & SPACE CENTER

Revised: February, 2009

Standards of Learning

The following Standards of Learning are addressed in the "Mad Scientist" Demonstration.

Science Standards of Learning

Scientific Investigation, Reasoning, and Logic

3.1 The student will plan and conduct investigations in which
- a) predictions and observations are made;
- b) objects with similar characteristics are classified into at least two sets and two subsets;
- c) questions are developed to formulate hypotheses;
- d) volume is measured to the nearest milliliter and liter;
- e) length is measured to the nearest centimeter;
- f) mass is measured to the nearest gram;
- g) data are gathered, charted, and graphed (line plot, picture graph, and bar graph);
- h) temperature is measured to the nearest degree Celsius
- j) inferences are made and conclusions are drawn;

Matter

3.3 The student will investigate and understand that objects are made of materials that can be described by their physical properties. Key concepts include
- a) objects are made of one or more materials;
- b) materials are composed of parts that are too small to be seen without magnification;

Scientific Investigation, Reasoning, and Logic

4.1 The student will plan and conduct investigations in which
- a) distinctions are made among observations, conclusions, inferences, and predictions;
- b) hypotheses are formulated based on cause-and-effect relationships;
- c) variables that must be held constant in an experimental situation are defined;
- d) appropriate instruments are selected to measure linear distance, volume, mass, and temperature;
- e) appropriate metric measures are used to collect, record, and report data;
- f) data are displayed using bar and basic line graphs;
- g) numerical data that are contradictory or unusual in experimental results are recognized; and
- h) predictions are made based on data from picture graphs, bar graphs, and basic line graphs.

Scientific Investigation, Reasoning, and Logic

5.1 The student will plan and conduct investigations in which
- c) appropriate instruments are selected and used for making quantitative observations of length, mass, volume, and elapsed time;
- d) accurate measurements are made using basic tools (thermometer, meter stick, balance, graduated cylinder);

e) data are collected, recorded, and reported using the appropriate graphical representation (graphs, charts, diagrams);
f) predictions are made using patterns, and simple graphical data are extrapolated;
g) manipulated and responding variables are identified

Matter

5.4 The student will investigate and understand that matter is anything that has mass, takes up space, and occurs as a solid, liquid, or gas. Key concepts include
a) atoms, elements, molecules, and compounds;
b) mixtures including solutions; and
c) the effect of heat on the states of matter.

Math Standards of Learning

Measurement

3.14 The student will estimate and then use actual measuring devices with metric and U.S. Customary units to measure
a) length — inches, feet, yards, centimeters, and meters;
b) liquid volume — cups, pints, quarts, gallons, and liters; and
c) weight/mass — ounces, pounds, grams, and kilograms.

3.17 The student will read temperature to the nearest degree from a Celsius thermometer and a Fahrenheit thermometer. Real thermometers and physical models of thermometers will be used.

Probability and Statistics

3.23 The student will investigate and describe the concept of probability as chance and list possible results of a given situation.

Measurement

4.10 The student will
a) estimate and measure weight/mass, using actual measuring devices, and describe the results in U.S. Customary/metric units as appropriate, including ounces, pounds, grams, and kilograms;

4.11 The student will
a) estimate and measure length, using actual measuring devices, and describe the results in both metric and U.S. Customary units, including part of an inch (1/2, 1/4, and 1/8), inches, feet, yards, millimeters, centimeters, and meters;

4.12 The student will
a) estimate and measure liquid volume, using actual measuring devices and using metric and U.S. Customary units, including cups, pints, quarts, gallons, milliliters, and liters;

4.13 The student will
a) identify and describe situations representing the use of perimeter and area; and

b) use measuring devices to find perimeter in both standard and nonstandard units of measure.

Measurement

5.8 The student will describe and determine the perimeter of a polygon and the area of a square, rectangle, and right triangle, given the appropriate measures.

5.10 The student will differentiate between perimeter, area, and volume and identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation.

5.11 The student will choose an appropriate measuring device and unit of measure to solve problems involving measurement of

a) length — part of an inch (1/2, 1/4, and 1/8), inches, feet, yards, miles, millimeters, centimeters, meters, and kilometers;
b) weight/mass — ounces, pounds, tons, grams, and kilograms;
c) liquid volume — cups, pints, quarts, gallons, milliliters, and liters;
d) area — square units; and
e) temperature — Celsius and Fahrenheit units.

Activities

These activities are intended for use before your visit to the Virginia Air and Space Center. It is beneficial for the students to have some prior knowledge about the content area covered in the program. All of the activities can be tailored to your specific classroom needs, and the procedures listed are suggestions for teaching.

Moving Molecules

The purpose of this experiment is to reinforce the concept that molecules are always moving and that they move faster as their temperature increases. When food color is placed in water, it would remain still if nothing in the water were moving. When hot water is used, the food color mixes faster because the molecules are moving faster. The Experiment Sheet is attached.

Crossword Puzzle

The Crossword Puzzle reviews important science vocabulary words. See attachments for Puzzle and Key.

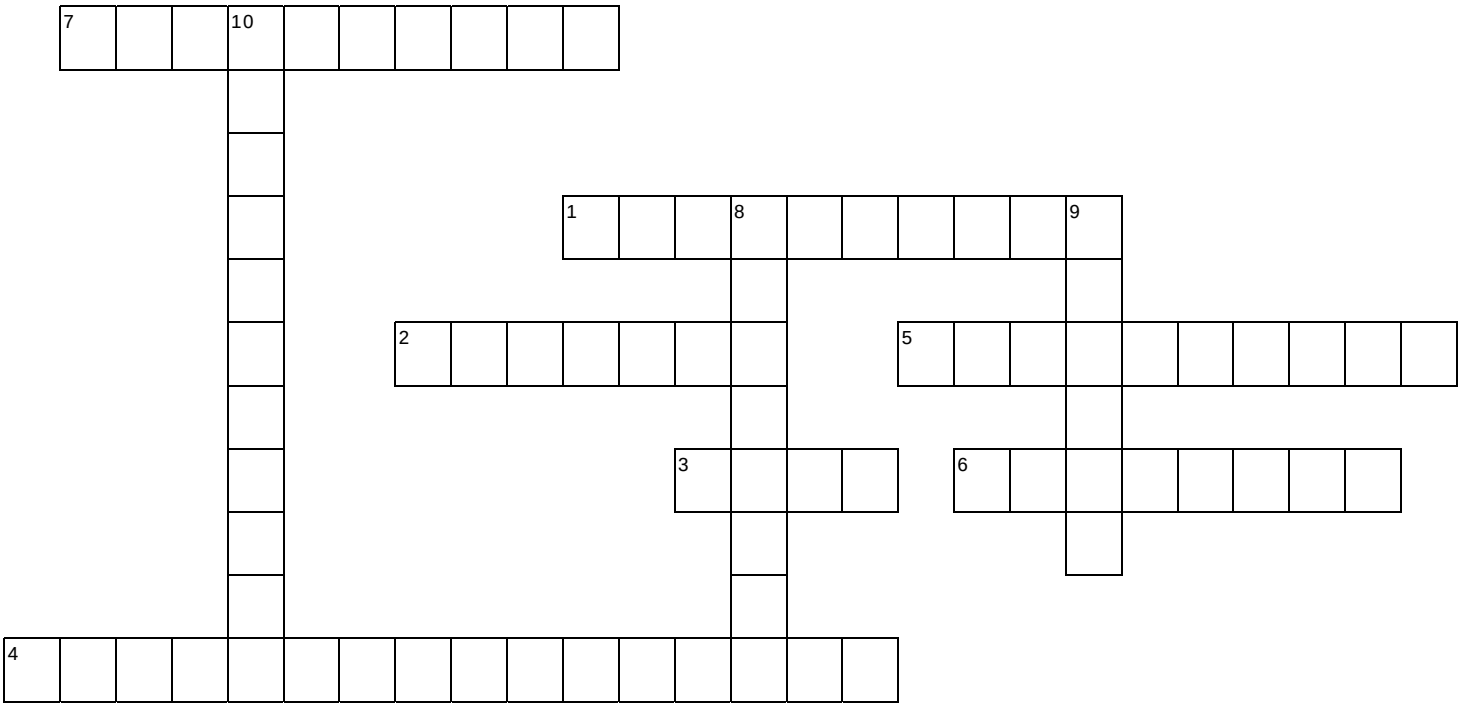
Science Vocabulary

The Science Vocabulary Sheet contains a Word Box from which to choose the vocabulary words. The Vocabulary Sheet and a Key are attached.

Graphing

The Graphing Activity page reinforces the need to make comparisons when presenting scientific data. See attachment, please.

Crossword Puzzle



Across

1. A temperature scale on which water freezes at 32 degrees and boils at 212 degrees.
2. A temperature scale on which water freezes a 0 degrees and boils at 100 degrees.
3. A group of measurements or facts.
4. How scientists solve problems: by breaking their work into smaller steps.
5. A series of actions carried out to test a theory, demonstrate a fact, or find out what happens.
6. Something that is changed on purpose in an experiment.
7. An educated guess or idea that can be tested or investigated.

Down

8. The processing of collecting information and data about a topic being studied.
9. A general principal that explains or predicts facts or events.
10. Using your senses to learn something new.

Science Vocabulary

Fill in the blanks with the vocabulary words from the box below.

1. Matter that has a definite volume and shape. _____
2. A measure of the amount of matter in something. _____
3. The amount of space that matter takes up. _____
4. This describes the amount of matter packed into a given space. _____
5. The temperature at which a liquid changes from a liquid to a gas.

   _____
6. Anything that takes up space and has mass. _____
7. A measure of how fast the particles in matter are moving. _____
8. Matter that has no definite volume or shape. _____
9. The temperature at which a liquid changes from a liquid to a solid.

   _____
10. Matter that has a definite volume but no definite shape. _____

temperature	solid	liquid	freezing point
matter	volume	mass	density
gas	boiling point		

Moving Molecules

Materials Needed

* **Beaker**
* Food color
* Hot water and cold water

Hypothesis

Predict what happens to the movement of molecules in a substance when it is heated.

Procedure

1. Put 300 ml. of water in the beaker. Let it sit until the water appears to be very still.
2. Add a drop of foot coloring. Be careful not to move the beaker or disturb the water.
3. Observe carefully for a few minutes, and then answer the following question.
   What happens to the food color and why?

4. Do you think there would be a difference if the water were hot? Why?

5. Clean the beaker, and put 300 ml. of hot water in it. Let it sit until the water appears to be still.

6. Place a drop of food color in the beaker, and be careful not to stir or shake the beaker.

7. What happens this time?

Conclusion

What happens to the movement of molecules in a substance when the substance is heated? Write your conclusion.

Graphing Activity

Planet	Diameter in KM
Mercury	4,8810
Venus	12,104
Earth	12.756
Mars	6,794
Jupiter	142,984
Saturn	120,536
Uranus	51,118
Neptune	49,532
Pluto	2,274

Creating a graph is a good way to make comparisons.
Make a bar graph to compare the size of the planets in this chart.
Be sure to have a title, and label the data.

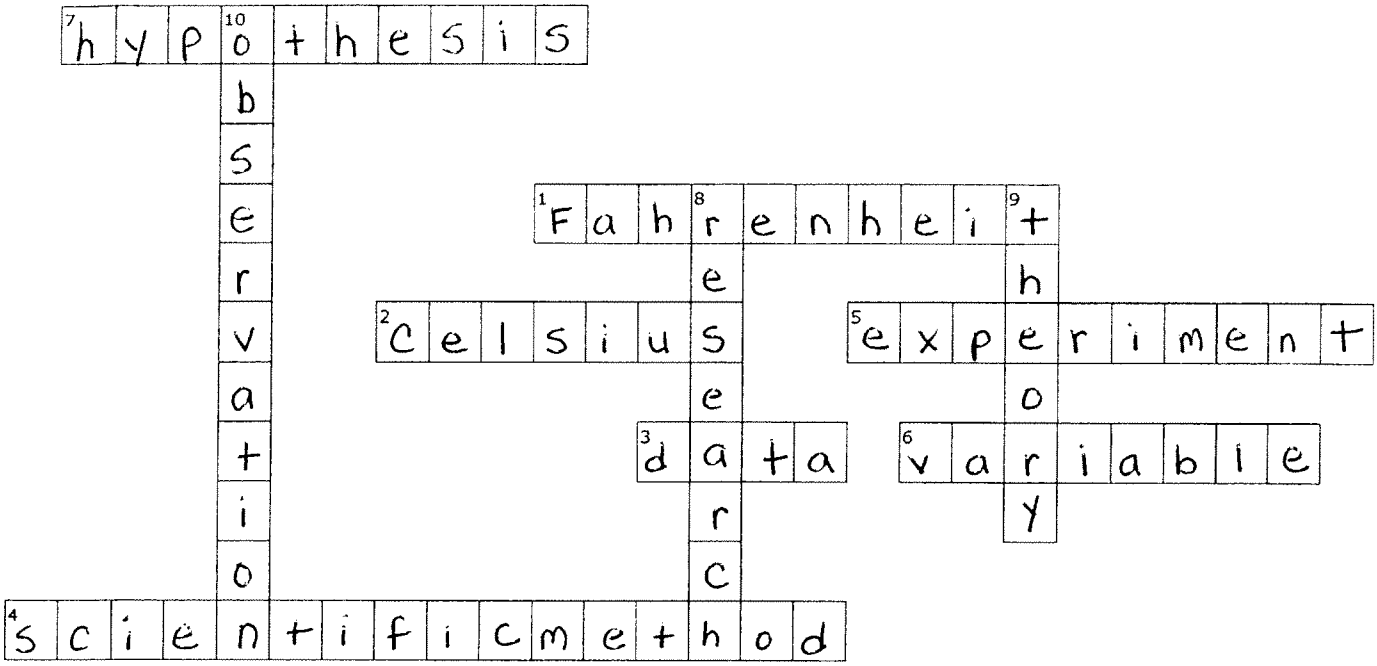
Science Vocabulary

Fill in the blanks with the vocabulary words from the box below.

1. Matter that has a definite volume and shape. solid
2. A measure of the amount of matter in something. mass
3. The amount of space that matter takes up. volume
4. This describes the amount of matter packed into a given space. density
5. The temperature at which a liquid changes from a liquid to a gas. boiling point
6. Anything that takes up space and has mass. matter
7. A measure of how fast the particles in matter are moving. temperature
8. Matter that has no definite volume or shape. gas
9. The temperature at which a liquid changes from a liquid to a solid. freezing point
10. Matter that has a definite volume but no definite shape. liquid

temperature	**solid**	**liquid**	**freezing point**	**matter**
volume	**mass**	**density**	**gas**	**boiling point**

Crossword Puzzle



Across

1. A temperature scale on which water freezes at 32 degrees and boils at 212 degrees.
2. A temperature scale on which water freezes a 0 degrees and boils at 100 degrees.
3. A group of measurements or facts.
4. How scientists solve problems: by breaking their work into smaller steps.
5. A series of actions carried out to test a theory, demonstrate a fact, or find out what happens.
6. Something that is changed on purpose in an experiment.
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