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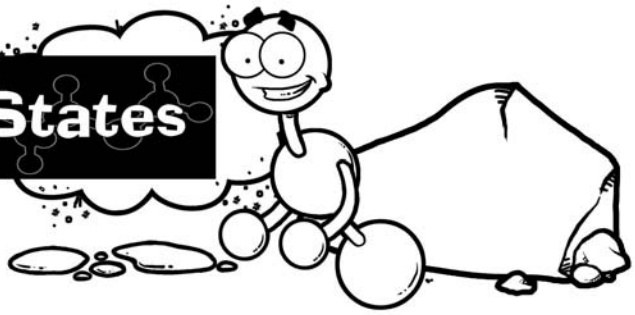
A Matter of States



by David Mitchell
AIMS Research Fellow

Topic
States of matter

Key Question
How can models help us understand some of the physical properties of matter?

Learning Goals
Students will:
1. identify that matter can be a solid, liquid or a gas;
2. construct a model of the three states of matter; and
3. identify some of the characteristics and behaviors of each of the three states.

Guiding Documents
Project 2061 Benchmarks
- *Materials may be composed of parts that are too small to be seen without magnification.*
- *One way to make sense of something is to think how it is like something more familiar.*

NRC Standards
- *Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models.*
- *Develop descriptions, explanations, predictions, and models using evidence.*
- *Materials can exist in different states—solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling.*

*NCTM Standards 2000**
- *Recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life*
- *Develop, understand, and use formulas to find the area of rectangles and related triangles and parallelograms*

Math
Measurement
area

Science
Physical science
matter
states

Integrated Processes
Observing
Comparing and contrasting
Communicating
Collecting and recording data
Interpreting data

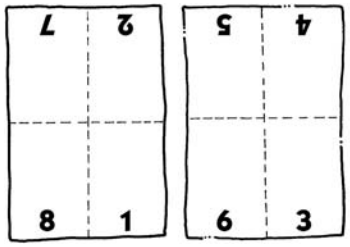
Materials
For each student:
A Matter of States rubber band book
48 circle punch outs (see *Management 1)*
student sheet
#19 rubber band

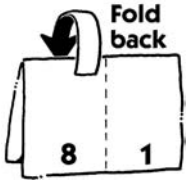
For each group:
glue stick

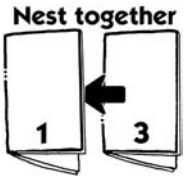
Background Information
Gases, liquids, and solids are all made up of molecules. The arrangements of the molecules, as well as their movements, differ with the state that they are in. In solids, the particles are tightly packed together, usually in a regular pattern. The molecules in a solid vibrate but generally do not move from place to place. The particles in a liquid are fairly close together, but have no particular arrangement. The molecules in a liquid vibrate and slide past each other. The particles in a gas are well separated with no regular arrangement. The molecules vibrate and move freely at high speeds. This activity will model some of the properties of these three of the states of matter.

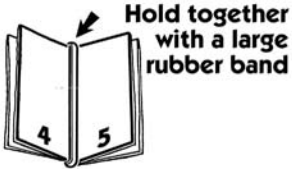
Management

1. Each student will need 48 circle punch outs. Colored paper cut from a $\frac{1}{4}$" hole punch is ideal.
2. Each student will need his or her own rubber band book describing the states of matter. Large rubber bands (size #19) will be used to hold the rubber band books together.









Procedure

1. Ask the *Key Question* and state the *Learning Goals*.
2. Distribute the rubber band book *A Matter of States,* the student sheet, and circle punch outs.
3. Direct the students to read the rubber band book and to use the student sheet and circle punch outs to create the three models.
4. Ask the students to share some of the characteristics and behaviors of each of the three states beside the models they created.

Connecting Learning

1. Why was it important to keep the number of circle punch outs the same for each model? [This showed that mass stayed the same for each model.]
2. Which state has the most space between the molecules? [gases]
3. Which state seems to be the most organized? [solids]
4. Why are models used in science?
5. What are some things this model did not show about the states of matter? [The model does not show movement.]
6. What are you wondering now?

A Matter of States

The three most common states of matter are solids, liquids, and gases. All matter is made up of molecules. All molecules vibrate or move and have space between them. The type of movement and space determine the state of the matter.

You will create models that show some of the characteristics of a solid, a liquid, and a gas. You will use circle punch-outs to represent the mass of each model.

Use what you learned in this book to record some of the characteristics and behaviors of each of the three states. Write beside the models you just created.

The third grid represents a gas. Glue the last 16 circle punch-outs in this grid. The particles in a gas are well separated with no regular arrangement. The molecules vibrate and move freely at high speeds. Gases take the shape and volume of the container that they are in.

This model shows that the molecules in solids are tightly packed together and are usually in a regular pattern with little free space between them. The molecules in a solid vibrate but generally do not move from place to place. Solids keep a set volume and shape.

Look at the three area grids on the *A Matter of States* page. Label the grid with the smallest area a solid. You will need to glue a circle punch-out in each section of the grid.

Select the grid with the next largest area, and label it a liquid. Glue 16 circle punch-outs in the grid, but do not put them into any pattern. The molecules in a liquid are fairly close together, but have no special arrangement. The molecules in a liquid vibrate and slide past each other. Liquids take the shape of the container that they are in.

The first thing you will need to do is to make sure you have 48 circle punch-outs. You will use 16 circle punch-outs for each model.

A Matter of States

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