A Crazy Colloid

Formerly Goo Yuck

Revised by Judith Hillen

Topic Area

Chemistry: States of matter · Colloids

Introductory Statement

This activity provides free exploration with an unusual state of matter, a colloid made from corn starch and water. Students will experience a substance that displays the properties of both a liquid and a solid.

Math	Science
Classifying	Observing
Measuring	Comparing
Graphing	Recording data
	Generalizing

Materials

one box (454 g) cornstarch
250 ml of water
one mixing bowl and spoon
one hammer

For each group of students:

- aluminum foil · one 10 cm square
- two clear plastic cups
- plastic zip-lock sandwich baggy
- waxed paper · one 30 cm square
- one wooden clip type clothes pins
- one votive candle

Key Question

In what ways is this substance like a solid and a liquid?

Background Information

Some substances exist in states that do not totally comply with usual definitions of a gas, liquid, or a solid. A colloid is such a substance and will display properties of both a liquid and a solid. This is largely due to the size of the particles of a colloid which are large molecules or clumps of small molecules. The colloidal particles are small enough to move about randomly like the particles of a liquid. But they are also large enough to be bombarded by molecules of the surrounding medium equally on all sides with the result that they do not move much, thus resembling the properties of a solid. These particles range in size from 4 millionths to 4 hundred-millionths of an inch (10-4 to 10-6 millimeters across).

Furthermore, the particles are neither dissolved completely (solution) nor are 'they totally suspended (suspension). Colloid particles are intermediate in size between solutions and suspensions. In a solution, particles do not settle out. For instance, think about sugar dissolved in water. The sugar does not separate out. In a suspension, particles are temporarily suspended and settle out upon standing over a period of time. Here, one may think about muddy water where the sift may settle out after a period of time. Colloidal particles do not settle out (like a solution) but remain dispersed throughout the medium. Solutions also pass unchanged through ordinary filter paper and suspensions may be separated by filter paper. Colloidal particles again behave like a solution as they pass unchanged through filter paper. But colloids behave like suspensions in other ways. For instance, both colloids and suspensions scatter light and may be separated by parchment membrane while solutions cannot.

Thomas Graham, an English chemist is credited with much of the information regarding the behavior of colloids and crystalloids. The name colloid comes from the Greek word *kolla* which means glue. Familiar colloids are rubber, plastics, and synthetic fibers. Milk is a colfoid as are gels, gelatin (Jello) and foams.

References for this information include: *Physics Today,* World Book Encyclopedia of Science, World Book, Inc. (Chicago, 1987) and Smoot, Price and Smith. *Chemistry, A Modern Course.* Charles Merrill Publishing (Columbus, Ohio 1983).

Management Suggestions

It is convenient for the teacher to mix the corn starch and water in one bowl and then distribute an appropriate portion in a plastic cup to each group of students.

Allowing a five minute period of free exploration is helpful before beginning the formal process of the nine tests to be performed. During this period students may record their observations using their senses. While tasting is not harmful to students, it may be in good "taste" to omit it.

You may wish to perform the test for heat under teacher direction or demonstration depending upon the age and responsible nature of the students.

You may wish to discuss appropriate "manners" when exploring this substance. This may curtail throwing or tossing the mixture in playful ways at other classmates or objects.

Procedure

1. Mix cornstarch and water and distribute samples of mixture in clear plastic cups (about a third to one half full) to groups of 4 or 5 students.
2. Allow five minutes for free exploration and recording of observations of physical properties of the mixture.
3. Discuss the properties of liquids and solids. (See Fact Page) Predict whether the mixture is most like a solid or a liquid.

4. Review the nine tests and allow time for students to work through each part · doing and recording their observations and indicating whether it behaves like a liquid or a solid.
5. Each student generalizes the results by writing a paragraph that supports his conclusion.
6. The results may be pictured in a circle graph by using one color for liquid test results and a different color for solid test results. Students may use the graph to help explain their conclusions.

Discussion

1. Which of the tests showed this mixture to be a liquid?
2. Which tests showed this mixture to be a solid?
3. Which tests, if any, were inconclusive?
4. What variables might influence the outcome of this experiment? (Amount of water added, time, etc.)

Extensions

1. See literature correlations · Bartholomew and the OObleck, by Dr. Suess.
2. Research what other "powders" and liquids can be safely mixed to form colloids.
3. Invite a "chemist" to visit and share ideas about simple experiments in chemistry.
4. Research famous chemists and their contributions to science.

Scientist

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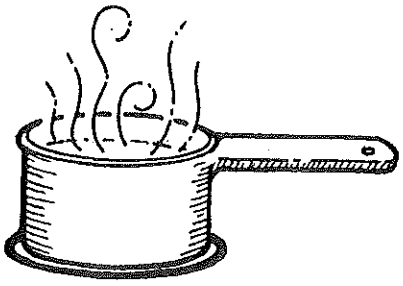
Matter: Properties of Liquids and Solids

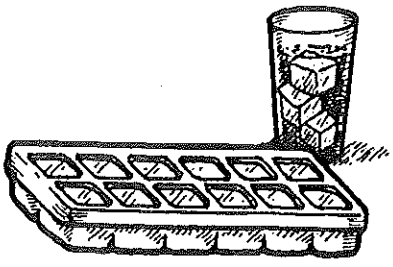
Solids:

* do not change shape easily
* will not allow another solid to pass through them easily
* are usually visible
* have a definite shape
* have a definite size
* become liquid when heated
* when cooled remain solid



Liquids:

* change shape easily (take the shape of the container)
* will allow a solid to pass through easily
* may be visible or invisible
* have a definite size (volume)
* when heated become gas
* when cooled become solid



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Experiment:

Do each test
Record your results

1. The quick finger poke test

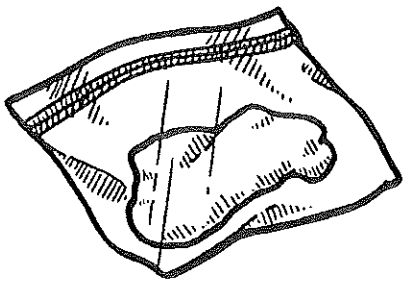
Try to poke your finger into the mixture so that the tip of your finger touches the bottom of the cup. To make sure that this is the quick finger poke test, try to touch the bottom of the cup in 1 second.

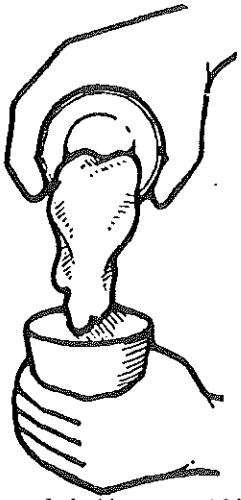
2. The slow finger poke test

Try to poke your finger into the mixture so that the tip of your finger touches the bottom of the cup. In order to make sure that this is the slow finger poke test, take 10 seconds to touch bottom.

3. Conformity test

Put the mixture into another container or a plastic baggie. Check to see if the mixture takes the shape of the container or stays in its original shape.





4. Pour test

Try to pour the mixture from one cup to another.

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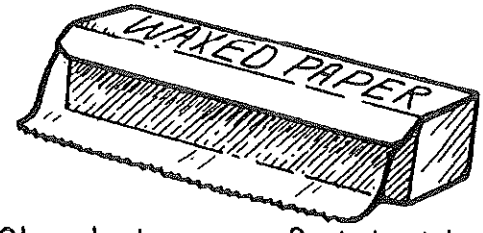
(Experiments, cont.)

5. Bounce test

Hold the mixture 50 cm up from the table / desk. Drop it.

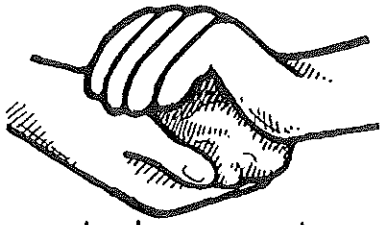
6. Shatter test

Put the mixture in waxed paper on the table / desk. Hit the mixture with a hammer.



7. Shape test

Try to form the mixture into a ball. Check to see if it holds its shape for 5 seconds.

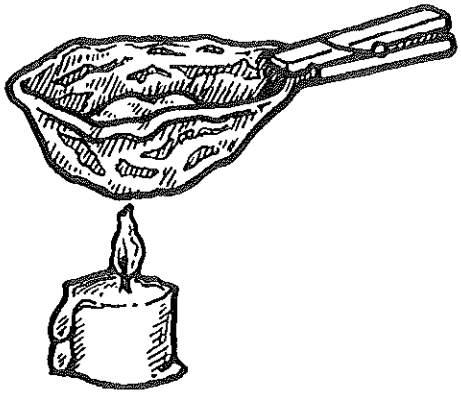


8. Heat test

Make a bowl out of foil. On one side leave a bump where you can clip a clothes-pin. Heat one teaspoon of the mixture in the bowl over a votive candle.

9. Cool test

Let the mixture cool to room temperature.



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Prediction: the mixture is a

Liquid Solid
(circle one)

Observation:

1. You have 5 minutes for free discovery and observation. Return the mixture to its container at _____ o'clock.
2. Record your observations.

Color: _____

_____

_____

Texture: _____

_____

_____

Shape: _____

_____

_____

Smell: _____

_____

_____

Other: _____

_____

_____

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Observation Record Sheet

Test	Observations	Liquid	Solid
1. The quick finger poke test			
2. The slow finger poke test			
3. Conformity test			
4. Pour test			
5. Bounce test			
6. Shatter test			
7. Shape test			
8. Heat test			
9. Cool test			
	Total		

Is this colloid a liquid or a solid ? _____

Write a paragraph that supports your conclusion.

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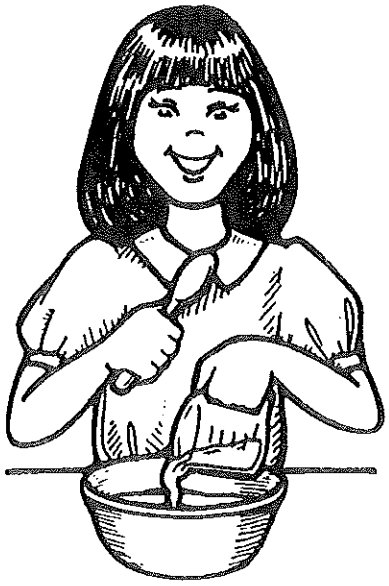
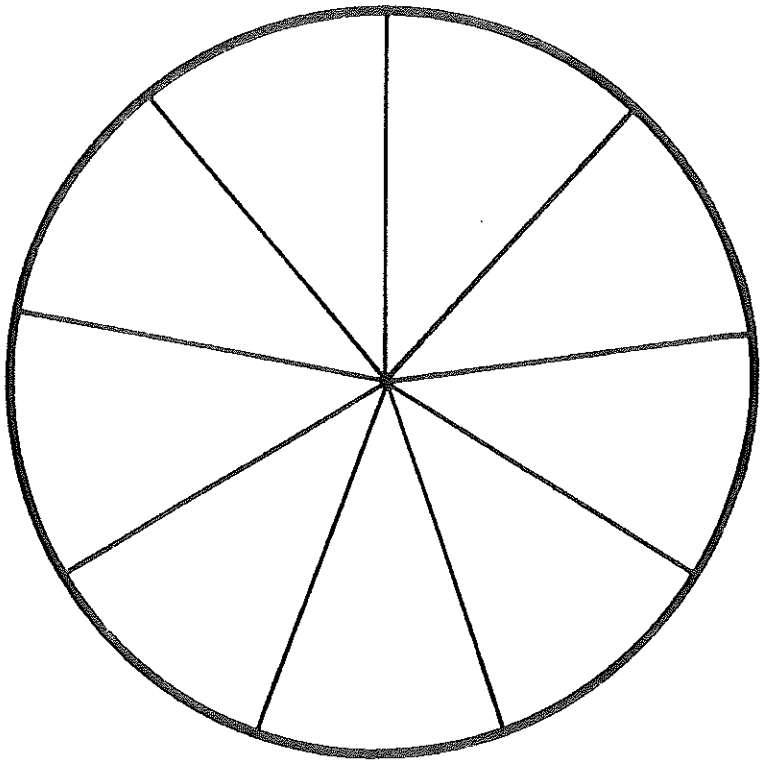


- Color in a section for each test result.
- Use one color for liquid test results, and another for solid.
- If a result falls into both categories fill in half with each color.
- Keep like results together.



According to your test results is the mixture a liquid or a solid ? Why ?