Instant Snow

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Subject: Chemistry

Grade Level: K-6

Standards: *Next Generation Science Standards (www.nextgenscience.org)*

5-PS1-3 Make observations and measurements to identify materials based on their properties.

5_PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in a new substance.

5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.

Schedule: This can be adapted for a one day and/or week lab

Objectives: Students will experiment with two kinds of sodium polyacrylate to see how they behave when hydrated. Students will perform a scientific experiment utilizing sodium polyacrylate polymer to create instant snow.	**Vocabulary:** Atom Molecule Monomer Polymer Physical Change Chemical Change Conservation of Mass
Students Will: **Science:** * Students will observe the properties of matter by examining the characteristics of polymers. * Students will observe how polymers are formed and how they can have different properties. * Students will explore conservation of matter by investigating physical changes. **Language Arts and Reading:** * Students will use writing as a tool for learning and research. * Students will compile written notes into a report. * Students will develop questions to form hypotheses and direct research. * Students will evaluate their research to form new questions.	**Materials:** **For Class:** ___ Sodium Polyacrylate ___ Instant Snow Polymer **For Each Group (3-5 Students):** ___ 2 Plastic Cups ___ Graduated Cylinder ___ 3 Paper Plates ___ Spoon **For Each Student:** ___ Activity Sheet (ES or MS version) ___ Polymer Reading (ES or MS version) **Provided by Teacher:** ___ Electronic Scale ___ Thermometer ___ Containers of Varying Size
	Students should wear goggles when performing the experiment. They should wash their hands after handling the sodium polyacrylate.

Science Content for the Teacher:

Polymers are large molecules made up of simple repeating units. The word is derived from

poly…Greek word meaning "many."

mer…Greek word meaning "part."

A monomer is the simple repeat unit that makes up a polymer.

mono…Greek word meaning "single."

Examples of Natural Polymers: spider silk, rubber, proteins (DNA), and cellulose (most abundant organic compound on the planet, found in wood and plants).

Examples of Synthetic Polymers: fibers (polyester, nylon), coatings (paint), adhesives (glue), rubber, plastic (polyethylene, polypropylene & polystyrene).

Expected Lifetime: Centuries, except for a few biodegradable ones, which is why recycling is so important.

Polymers are substances whose molecules have high molar masses and are composed of a large number of repeating units. There are both naturally occurring and synthetic polymers. Among naturally occurring polymers are proteins, starches, cellulose, and latex. Synthetic polymers are produced commercially on a very large scale and have a wide range of properties and uses. The materials commonly called plastics are all synthetic polymers.

Polymers are formed by chemical reactions in which a large number of molecules called monomers are joined sequentially, forming a chain. In many polymers, only one monomer is used.

See Reading Handout for information on the polymers used in this lab.

Preparation:

1. Photocopy print materials (*Activity Sheet & Reading*) for each student.
2. Distribute materials evenly for each group.

Classroom Procedure:

Engage (Time: 15 mins)

1) Discuss with the class what atoms and molecules are. Have a student stand up and represent a single molecule (monomer). Call another student up and have them link arms. They are now two molecules joined together (polymer). Have 3 more students come up and add to the chain. Have 5 more students form another polymer chain.

2) Some polymers are more flexible because the different chains can slide easily by each other (show this with two chains). Have two students get in between two chains and grab one person from each chain. Have the two chains try to move. It is more difficult for the chains to move now. The polymer is less flexible. This is called cross-linking.

3) Tell the students that they will now perform an experiment to see how the difference between these two types of polymers can affect how it reacts with water. Hand out activity sheet.

Explore (Time: 2-40 min periods. Then about 5-10 minutes a few days to observe and collect data)

1) Have students perform the activity with sodium polyacrylate and Instant Snow Polymer. They will record their observations.

2) Discuss with the class what happened and why. Hand out reading assignment (can be done in class or for homework)

3) Have students brainstorm what variables might affect the evaporation rate of the water over a long period of time. Possible variables might be the size of the container it is left in, the shape of the container, the temperature of the room, the humidity of the room,etc.). Students should select ONE of these variables to test how the evaporation rate of the hydrated polymer is affected. All the other possible variables must be kept constant. A sample lab sheet is included for students.Students should design an experiment based on the variable they select to examine.

Each group should have 3 different values to test. For example, if they select the size of the container the snow is kept in, there should be three different containers. Students should be sure that the containers are all made from the same material, are kept in the same area, etc.

4) After the groups have properly planned their experiment they should begin the data collection stage. Give each group the same amount of expanded snow to use to test their hypothesis. Over the next two weeks have students measure each of their samples, using a balance each day and recording the mass on their data table. This should take very little time, so the remainder of the experiment can be completed for homework.

Explain (Time: 20 mins)

Have students present their findings to the class.

Assessment:

The following rubric can be used to assess students during each part of the activity. The term "expectations" here refers to the content, process and attitudinal goals for this activity. Evidence for understanding may be in the form of oral as well as written communication, both with the teacher as well as observed communication with other students. Specifics are listed in the table below.

1= exceeds expectations
2= meets expectations consistently
3= meets expectations occasionally
4= not meeting expectations

	Engage	**Explore**	**Explain**
1	Shows leadership in the discussion and polymer activity, displays good understanding of polymers.	Completes work accurately while providing an explanation for what is observed. Works very well with partners.	Provides an in-depth explanation of findings. Makes excellent and thoughtful comparisons to everyday life. Completes activity sheet and lab report clearly.
2	Participates in the discussion and activity; shows an understanding of polymers.	Completes work accurately and works cooperatively with partners.	Provides clear explanation of findings. Notes good correlations to everyday life. Completes activity sheet and lab report clearly.
3	Contributes to the discussion and activity, but shows little understanding of polymers.	Works cooperatively with partners, but makes some mistakes with the procedure.	Provides a limited explanation of findings. Struggles to make comparisons to everyday life. Completes some of the activity sheet and lab report.

Acknowledgements:

Adapted partially from: Marie Sherman, Missouri Polymer Ambassador 2004
Polymer Ambassador Website: www.polymerambassadors.org