EXPERIMENT

Flubber

Visitors experiment with a piece of Silly Putty® by stretching, bouncing, and snapping it. They then create flubber, a similar substance, by mixing diluted glue and a solution of sodium borate.

OBJECTIVES:

Visitors learn about the nature of a type of polymer by experimenting with its properties. They use a chemical reaction to create a similar polymer, and they investigate the similarities and differences.

<table>
<thead>
<tr>
<th>SCIENCE TOPICS</th>
<th>PROCESS SKILLS</th>
<th>VOCABULARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Observing</td>
<td>Liquid</td>
</tr>
<tr>
<td>Polymers</td>
<td>Measuring</td>
<td>Molecule</td>
</tr>
<tr>
<td>Properties of Solids</td>
<td>Investigating</td>
<td>Polymer</td>
</tr>
<tr>
<td>Properties of Liquids</td>
<td>Comparing/Contrasting</td>
<td>Solution</td>
</tr>
<tr>
<td>Chemical Reactions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unit 6 The Chemistry of Toys
Experiencing Chemistry ©2007 OMSI
Experiment: Flubber

MATERIALS
(with amounts to have on hand)

- Changeable Silly Putty®, one egg (keep two spare eggs on hand) (Binney & Smith, Inc., 1100 Church Lane, P.O. Box 431, Easton, PA 18044-0431; 1-800-CRAYOLA) (available in most toy stores)
- Two 250-ml plastic squeeze bottles
- White glue (keep 1 gallon on hand)
- Na₂B₄O₇ • 10H₂O (sodium borate) (keep 100 g on hand)
- Dilute vinegar (keep 1 gal on hand)
- Plastic Stir sticks (keep 2 on hand)
- One 25-ml metal measuring spoon
- One 15-ml plastic measuring spoon
- One 1000-ml metal container
- One 60-mm by 15-mm plastic petri dish with lid
- One 100-ml plastic beaker
- One 50-ml plastic beaker
- One large plastic funnel cut wide at the bottom

Setup/Takedown Procedures

ORIGINAL SETUP

- Label the 50-ml plastic beaker “Flubber.”
- Label the 1000-ml metal container and the funnel “Used Flubber.”
- Label the petri dish “Silly Putty- please do not mix with flubber!”
- Label the metal spoon “glue spoon”
- Label the plastic spoon “borate spoon”
- Label one 250-ml squeeze bottle “Sodium Borate.” and the other “Glue Solution”
- Label the 50 ml plastic beaker “For making rude noises with flubber”

WEEKLY SETUP

- Place a small amount of Silly Putty (medium to large marble size) in plastic dish.
- Refill the 250-ml labeled squeeze bottle with 4% Na₂B₄O₇ (sodium borate) solution.
- Start the week with 3 L of 4% Na₂B₄O₇ solution and 3 gallons of glue solution. Prepare more if needed (see Materials Prep).
- Refill 250-ml squeeze bottle with glue solution.
DAILY SETUP

- Set out visitors’ instructions in a Plexiglas holder.
- On a tray lined with a white mat, set out the following:
  - Labeled 25-ml spoon and 15 ml spoon
  - Labeled flip-top squeeze bottle of glue solution
  - Labeled 100-ml flubber beaker and 50 ml beaker
  - Labeled large metal used flubber container
  - Labeled squeeze bottle of $\text{Na}_2\text{B}_4\text{O}_7$ (sodium borate) solution
- Set out the small white tray. Place the “Silly Putty” dish on the small tray. Put a marble-size piece of Changeable Silly Putty in the dish.
- Prepare new solutions if necessary (see Materials Prep). There should be 500 ml of glue solution on hand.
- Refill the $\text{Na}_2\text{B}_4\text{O}_7$ and glue solution squeeze bottles. Keep a full spare squeeze bottle of glue solution under the counter.

DAILY TAKEDOWN

- Wash the spoon, beakers, and the outside of the glue solution and $\text{Na}_2\text{B}_4\text{O}_7$ (sodium borate) bottles. Washing with vinegar will dissolve flubber goo.
- Return the Silly Putty to the dish and COVER IT WITH ITS LID.
- Rinse the flip-top caps of the glue solution bottles with hot water.
- Tightly recap all bottles.
- Return all equipment to the tub.
- Store all bottles in an upright position.

WEEKLY TAKEDOWN

- Seal the Silly Putty in the resealable plastic sandwich bag.
- Store the $\text{Na}_2\text{B}_4\text{O}_7$ (sodium borate) solution in a tightly capped bottle (not a squeeze bottle).
- Clean the lids and necks of the glue bottles with a damp paper towel.
- If necessary, soak all utensils and containers in dilute vinegar.
- Store all bottles in an upright position.
- Return the mat to general lab storage.
- Clean the tray and leave it at the station.
RUNNING SUGGESTIONS

◊ Make sure the Silly Putty® and flubber supplies are not mixed together.
◊ Set out small amounts of putty at a time.
◊ With the lid on, shake the glue bottles periodically to keep the glue solution well mixed.
◊ Rinse the flip-top lids of the glue solution bottles with dilute vinegar periodically.
◊ Silly Putty® may stain clothing; Spray ‘N’ Wash® removes putty and some of the stain from the dye.
◊ Flubber texture may vary. More sodium borate makes the flubber more liquid/stretchable, while more glue makes the flubber more solid/breakable.

EXTENSIONS

Binney & Smith produces more than 300 pounds (12,000 eggs) of Silly Putty each day.

More than 3,000 tons (200 million eggs) of Silly Putty have been made since 1950 (enough to stretch around the earth three times).

Use Silly Putty for impressions. (Note: new inks and printing processes prevent it from picking up newsprint images.)

SAFETY & DISPOSAL

No special precautions are needed; follow standard lab safety procedures.
To prepare glue solution:

- Using marked glue solution containers, fill with 250 ml white glue.
- Add water up to the 1 gal mark, shaking periodically.
- To color, add ~30 drops food coloring or ONE small-medium squirt of paint. Too much food coloring will stain visitor’s hands, and too much paint will settle out and solidify/stick to the bottom of the jug.
- Wash all glassware/plasticware.

To prepare 4% Na$_2$B$_4$O$_7$ (sodium borate) solution:

- Weigh 120 g Na$_2$B$_4$O$_7$ • 10H$_2$O.
- Dissolve 40 g at a time in 3 L of water.
- Store the solution in a 3 L labeled/dated bottle.