The Preparation of Guar Gum Slime

Introduction

Curiosity often overwhelms those who see an unrecognizable substance. "What is it?" they wonder, "What can it be?" Capture your students' attention with this "goopy" slime recipe.

Concepts

- Polymers

Materials

Guar gum, 0.5–1.0 g
Sodium borate solution, 4%, $Na_2B_4O_7$, 5 mL
Water, distilled or deionized, 100 mL
Food coloring (optional), 1–2 drops
Balance
Graduated cylinder, 10-mL
Graduated cylinder, 100-mL
Small plastic cup, 5–8 oz
Stirring rod

Safety Precautions

Slime is generally considered nonhazardous; however, it should not be ingested and should only be used in the manner intended. It is not recommended that students be allowed to take slime home. Slime will easily stain clothing, upholstery, and wood surfaces. With food coloring added, it will stain these surfaces and skin even more readily. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

1. Add 100 mL of distilled or deionized water to the small plastic cup. If desired, add 1–2 drops of food coloring to the water and stir.
2. Stirring constantly, slowly sprinkle, a pinch at a time, 0.5–1.0 g of guar gum to the water. *Note:* If the guar gum is added too quickly, it will form large, undesirable clumps. Stir until dissolved. The mixture will thicken slightly within 1–2 minutes.
3. Add 5 mL of 4% sodium borate solution. Stir. The mixture should gel in 1–2 minutes.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. Slime may be thrown out according to Flinn Suggested Disposal Method #26a

Tips

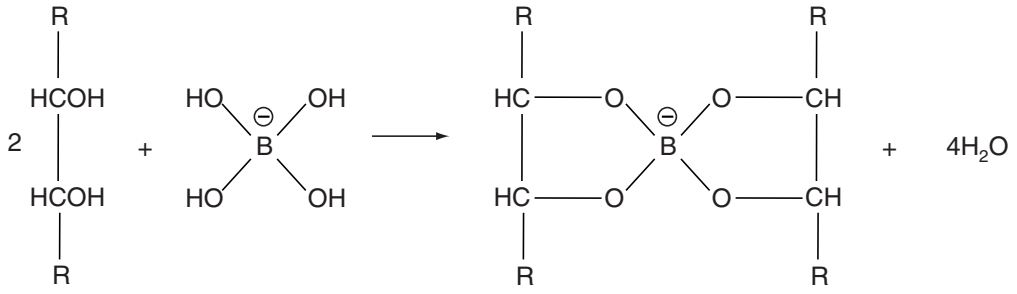
- Use only distilled or deionized water. The ions present in tap water may interfere with the polymerization reaction, causing the slime to turn watery after only an hour or two. Slime made with distilled or deionized water will retain its properties and consistency for several days.
- Store the slime in an airtight container or bag to prevent it from drying out.

Publication No. 377.10
032317

Discussion

Guar gum, a natural polymer with a molecular weight of about 220,000 g/mole, is made from the ground endosperms of *Cyamopsis tetragonolobus*, a legume cultivated in India as livestock feed. Guar gum has 5–8 times the thickening power of starch and is commonly used as a binding or thickening agent in foods and cosmetics.

Guar gum is a long-chain polyalcohol with 1,2-diol groupings capable of complexation with the borate ion, $B(OH)_4^-$. The structures given below are oversimplified, but may help to visualize the network complex as it extends in three dimensions.



Guar gum Borate ion Cross-linked guar gum–borate gel

In addition to forming complexes with the borate ion, the interaction of long-chain polyalcohols, such as guar gum, with the borate ion leads to crosslinking of different polymer chains, or sometimes part of the same chain, in such a way that a three-dimensional network of connected chains is formed. When the concentration of cross-linked chains is high, solvent is immobilized within the network and a semisolid gel results. Because the borate ion can bond with four alcohol groups it is particularly effective in creating three-dimensional gel networks from gums such as guar gum. Other examples of networks and gels are rubber cement, gelatin, fruit jellies, agar, and yogurt.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, m odels, and explanation
Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standard F: Science in Personal and Social Perspectives; science and technology in society
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, structure and properties of matter
Content Standard F: Science in Personal and Social Perspectives, science and technology in local, national, and global challenges

Acknowledgment

We would like to extend a special thanks to David A. Katz for providing us with the instructions for this activity.

Reference

Casassa, E. Z.; Sarquis, A. M.; Van Dyke, C. H. *J. Chem. Ed.* **1986,** *63*, 57.

Materials for *The Preparation of Guar Gum Slime* are available from Flinn Scientific, Inc.

Catalog No.	Description
G0039	Guar Gum, 100 g
S0363	Sodium Borate Solution, 4%, 500 mL
V0003	Vegetable dyes, Set
W0001	Water, Distilled, 1 Gallon
AP9081	Fluorescent Slime—Chemical Demonstration Kit

Consult the Flinn Scientific website for current prices.