

GUAR GUM SLIME

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Slime, a product of the Mattel Toy Corporation, was described by Dr. Maki Papavasiliou, of the Mattel Materials Laboratory, as a reversible cross-linking gel made from Guar gum, a vegetable gum used as a protective colloid, stabilizer, and thickening agent for foods, cosmetics, and lotions. The cross-linking is accomplished by the addition of sodium borate, $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, commonly called borax. Slime is a non-Newtonian fluid that is dilatant, that is, under stress it tends to dilate or expand rather than be compressed.

Guar gum, the main component of Slime, is a vegetable gum derived from the guar plant, *Cyamopsis tetragonolobus*. It is composed of a linear (1→4) D-mannose, $\text{C}_6\text{H}_{12}\text{O}_6$, chain with D-galactose, $\text{C}_6\text{H}_{12}\text{O}_6$, units attached by (1→6) linkages. (See Figure 1) Guar gum has a molecular weight of about 220,000-250,000. It is used as a protective colloid, stabilizer, thickening and film forming agent for cheese, salad dressing, ice cream and soups; as a binding and disintegrating agent in tablet formulations; in suspensions, emulsions, lotions, creams, and toothpastes.

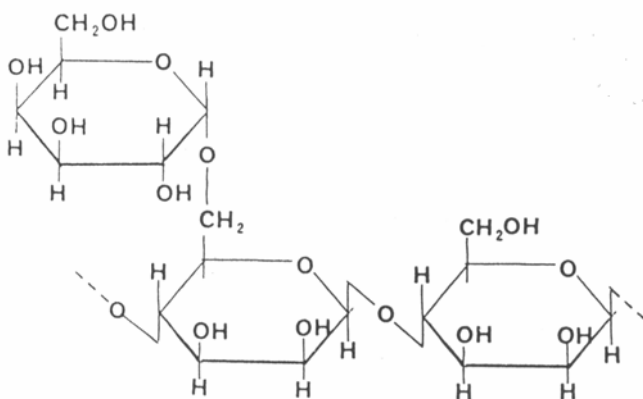


Figure 1. The structure of guar

Slime was originally marketed during the time period from 1976 to about 1979, then later, in the 1980's, as Masters of the Universe Slime, and, again, as Nickelodeon Green Slime. Slime-type materials have also been available as Weird Ball Sludge® (in Lucky Yellow, Putrid Purple, and Ghastly Green colors) from Mel Appel Enterprises, Inc., as purple Ecto-Plazm® from Kenner Parker Toys Inc, as Living Nightmare® Body Fluids from Fun World, as Teenage Mutant Ninja Turtles Retromutagen Ooze from Playmates Toys, as Toxic Crusaders™ Toxic Waste™ from Playmate Toys, as Dinosaur Ooze™ from Imperial Toys, and other similar materials. Slime-type materials continue to be available in many different names and can be found in many toy stores.



Slime is a non-Newtonian fluid that is dilatant, that is, under stress, the material dilates or expands. Other stress-thickening materials are quicksand, wet sand on the beach, some printer's inks, starch solutions, and Silly Putty. Dilatant materials tend to exhibit some unusual properties.

- a) Under low stress, such as slowly pulling on the material, it will flow and stretch. If careful, you can form a thin film.
- b) Pull sharply (high stress) and the material breaks.
- c) Pour the material from its container then tip the container upward slightly, the gel will self siphon.
- d) Put a small amount of the material on a table top and hit it with your hand, there is no splashing or splattering.
- e) Throw a small piece onto a hard surface, it will bounce slightly.
- f) Stuff the material through a tube, die swell occurs as it emerges.



PROCEDURE

1. Materials needed:

guar gum (available from Flinn Scientific Co. – This is the same grade of guar gum that was used by Mattel. You can also use food grade guar available from health food stores, but the concentration of guar may have to be increased.)

water

saturated borax solution, sodium borate, $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, (prepared by mixing borax with water until no more dissolves)

stirring rod or popsicle stick

5 oz plastic or paper cup

food color (optional)

air tight jar or plastic bag with twist tie for storing Slime

1/8 teaspoon measure (1/8 teaspoon guar weighs 1/2 gram)

plastic funnel

funnel support (such as a ring stand with ring)



2. Safety Precautions

Guar gum, as used in this experiment, may not be food grade. It should not be considered safe to taste.

Borax, sodium borate, is moderately toxic in quantities of more than one gram per 1000 g of body weight. Wash any borax from the hands with water. Wash hands after handling the Slime.

Do not allow Slime to remain on clothing, upholstery, or wood surfaces. The Slime will stain or mar the surface. Clean up any spilled Slime immediately.

3. Removing Slime from Clothing, Furniture, or Rugs

If Slime gets on any material, it can be removed by first wetting it with vinegar to break down the gel, followed by soapy water or foam type upholstery cleaner.

4. Experimental Procedure

Measure 100 mL of water into a 5 ounce plastic or paper cup. If desired, add two or three drops of food color to the water.

Weigh out one-half gram of guar gum. (NOTE: A level 1/8 teaspoon of guar weighs 1/2 gram) Add it to the water and stir until dissolved. The mixture will thicken within one to two minutes.

Add 5 mL of saturated borax solution and stir. The mixture should gel in one to two minutes.

5. Experiments with Slime

Pull the Slime slowly. What happens?

Pull the Slime hard. What happens?

Take a piece of the Slime and throw it onto a smooth, hard, non-porous surface such as a table or a floor. (Do not put it on a good wood table top.) What happens?

Put some Slime on a smooth, hard, non-porous surface. Hit it with your hand. What happens?

Place a funnel on a funnel support. Put some slime into the funnel. Push it through the funnel. Describe what happens as the Slime comes out the hole.

6. Storage

When finished playing with your Slime, wet it with a small amount of water and store it in an air-tight container to keep it from drying out.