SCIENTIFIC EXPLORER™

SLIPPERY SLIMES™

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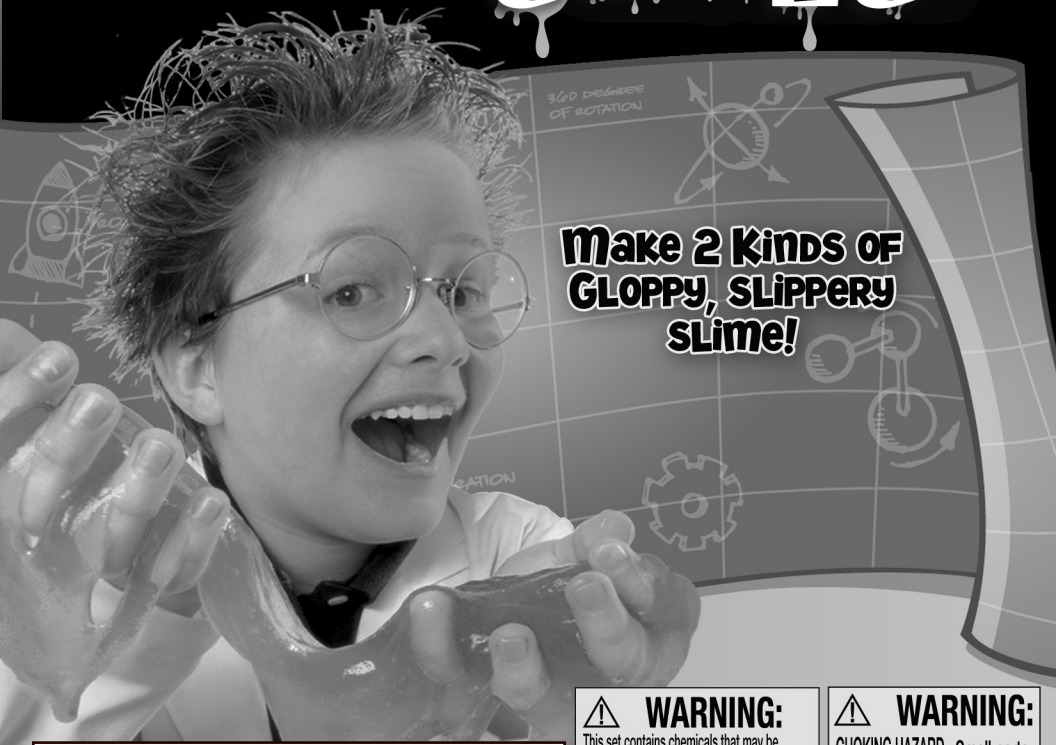

Make 2 Kinds of Gloppy, Slippery Slime!

For medical emergencies 24 hours a day, 7 days a week, Call 1 (800) 535-5053.

⚠ WARNING:
This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

⚠ WARNING:
CHOKING HAZARD - Small parts. Not for children under 3 years.

Adult Supervision Required

What is in your kit?

- 1 Measuring spoon (1 tablespoon and 1/4 teaspoon)
- Sodium tetraborate solution
- Guar Gum
- Cornstarch

What you need from home:

- Newspaper
- Water
- Resealable bag
- Plastic cups or bowls
- Stirring spoon
- Green food coloring (optional)
- Measuring cup

Welcome to the lab!

Congratulations! You are about to create things...Slimy things. Things that ooze in the night. Things you wouldn't want to meet in a dark sewer. But you won't be making these slimy things with a hammer and nails. You will be creating with chemistry-using science to make changes in substances, sometimes very big changes!

With this great power comes responsibility. The chemicals you will use and make are safe, but you must use care and common sense in handling them. Two rules stand out above all:

- Keep your chemicals and slimes out of the reach of young children!
- Keep your chemicals and slimes away from cloth or furniture - they may stain! Also, don't pour chemicals or slimes down drains - they may clog.

Here are some other rules to follow to keep your slime science fun and safe:

- Set up your laboratory where you will have a clear surface to work.

- Lay out newspaper to make cleaning up spills easier.

- Keep your projects away from food.

- Label your chemicals clearly so they won't be mistaken for something else.

- Wash your hands and any tools you've used (like spoons, cups, or bowls) thoroughly with warm, soapy water.

- Put all of your chemicals and tools away when you have finished using them.

Getting Started

What do you think of when you think of slime? You might think of classic horror movie slime. Imagine how it feels-moist and sticky. Pick it up, and it slowly oozes out through your fingers. These facts-how it feels and how it moves-are a few of the properties of the slime. With this kit, you will be able to make two different slimes, each with special properties that you will find useful and fun. You may wish to keep a Lab Notebook handy to keep track of the special properties of each slime and the effects of a change in their recipes.

When you are done with each slime, seal it in a reclosable bag. Label the bag and store it in the refrigerator. Each slime will keep for a different period of time. Most will last for at least a few days before becoming moldy or unusable. That's another property you might want to keep track of!

Sewer Slime

Let's start with that classic movie slime. The two main ingredients are guar gum and sodium tetraborate solution. Guar gum is a natural material we get from a plant called the guar plant. It is used to thicken many food products. Some ice creams use it as a cheap substitute for part of the milk or cream that is normally used. Sodium tetraborate is a mineral found in nature, which is used as a cleaning agent. It is also used to soften "hard" water.

You need from your kit:
guar gum, sodium tetraborate solution, measuring spoon

You need from home:
water, reclosable bag, mixing bowls (disposable plastic cups work well), something to stir with (like a spoon), green food color (optional)

1. Measure out 7 **tablespoons** of water into a bowl or cup.

2. Measure out 1/4 **teaspoon** of guar gum. Add the guar gum to the water, but only a little bit at a time. Stir as you add the guar gum, and keep stirring for a minute after all the gum is in the water. Let this solution sit for 3 to 5 minutes.*

3. While you are waiting, pour 1 **tablespoon** of water into another mixing bowl or a measuring cup. Mix 1/2 **teaspoon** of sodium tetraborate solution into this water. Stir this sodium tetraborate solution solution for 2 to 3 minutes.

4. Slowly add 1 **teaspoon** of the sodium tetraborate solution to the guar gum solution, stirring as you pour. Mix well and let stand several minutes, until it thickens.

5. If your slime doesn't thicken in 5 to 10 minutes, stir in another 1/2 **teaspoon** of sodium tetraborate solution. Let stand again.

Once your Sewer Slime has thickened up, it is ready to go. Pick it up and start playing with it! Take notice of its properties. What color is it? How does it feel? Is it sticky? Can you see through it? Can you stretch it? Will it run through your fingers? Does it look or act anything like two solutions you started with?

**** A tiny drop of green food color (optional) will make your slime even creepier.***

Polymers on Parade

So what exactly is slime? Well, scientists call what slime is made of polymers-which is Greek for “many parts”. A polymer is a big group of smaller parts, called molecules, all hooked together like a chain of paper clips, or a bicycle chain. Lots and lots of the things you see around you are polymers, including plastics, rubber, and spider silk! Even wood is a combination of polymers with different properties.

One polymer, by itself, looks kind of like Figure 1-a long chain. Plain white glue contains a polymer called polyvinyl acetate. All of those long chains of polyvinyl acetate are tangled up together like a big plate of spaghetti!

Fig. 1

What about the sodium tetraborate solution? Its job is to take individual chains of polyvinyl acetate and hook them together. Scientists call this cross-linking. But you don't get one really long chain, you get a net of connected chains, like Figure 2. The more sodium tetraborate solution you add, the more connected the chains of polyvinyl acetate become, and the thicker the slime becomes!

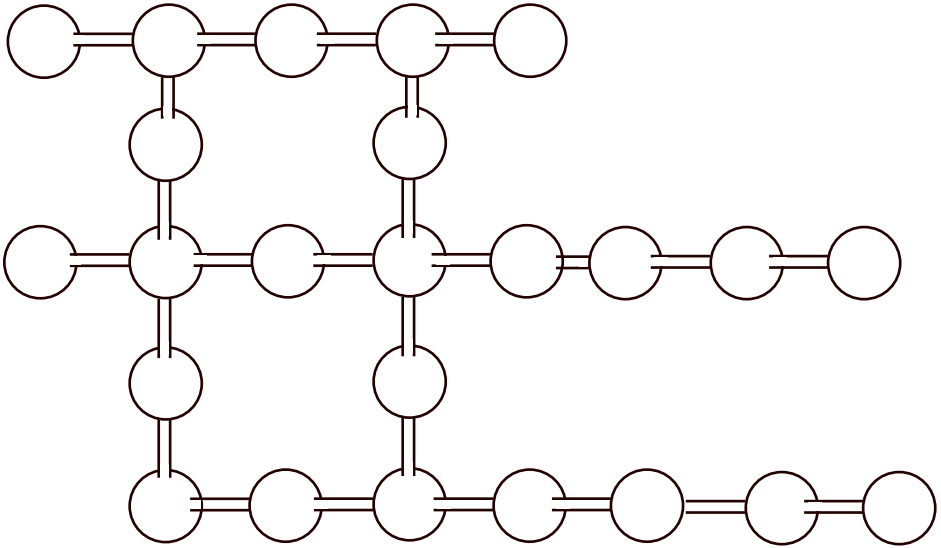

Fig. 2

A Polymer Demonstration

You need from home:
a sheet of newspaper

1. Open up your sheet of newspaper. Tear partway down the page. Does the paper rip straight down between your hands or does it pull to the left or right?

2. Turn the paper sideways. That is, if the top of the sheet had been pointing to 12 o'clock, turn it so the top points either to 3 or 9 o'clock. Hold and rip the page again. Does the paper rip straight down or pull to one side?

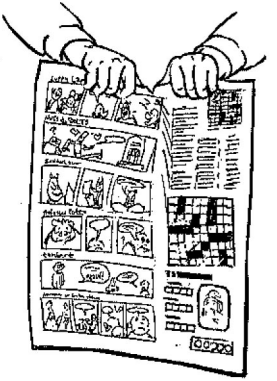

Fig. 3

What happened? Most of the time you should get a clean, straight tear one way, but a jagged tear the other. Why does this happen? Newspaper is made from a polymer called cellulose. When it is made, it is rolled out and pressed. That forces all the polymer chains to line up in the same direction. If you tear the sheet one way, you are ripping across many chains. That makes it very hard to get a straight tear. If you tear the other way, you are ripping between chains, making a straight tear much easier!

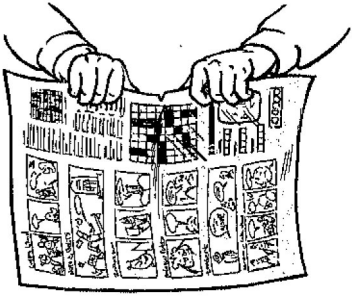

Fig. 4

Flip-Flop Slime

You're pretty deep in Slime Science now. You know what "cross-linking a polymer" means. Better still, you know how to do it chemically-using sodium tetraborate solution with certain polymers. But are there other ways to tangle up those polymer chains? You bet! Let's make a Flip-Flop Slime that can't decide whether it wants to be a solid or a liquid.

You need from your kit:
corn starch

You need from home:
warm water, reclosable bag, mixing bowl and stirrer

1. Measure 1/2 cup of cornstarch into a bowl.
2. Add 1/4 cup of water to the cornstarch. Stir until the slime is smooth. It may become hard to mix, but keep going!

Pretty simple instructions, right? Try a few simple tests.

- Poke the Flip-Flop Slime with your finger. Try poking both quickly and slowly. Can you poke all the way through it?
- Run your finger through the slime. Again, try it both quickly and slowly.
- Grab a handful and squeeze it.
- Roll the slime into a cylinder between your hands.
- Lay out some newspaper and place some slime onto it. Smack the slime with your open hand.
- Pour all of your Flip-Flop slime back into the bowl. Set something small, like a coin or a toy soldier, onto the slime.

What happened? Sometimes the Flip-Flop Slime is runny liquid, but sometimes it's a solid! Did you see a pattern to when the slime acts as a liquid or a solid? Stirring, squeezing, or even slapping it made it act like a solid, if the movement was quick or hard enough. If the movement was slow or gentle, the slime stayed liquid.

This kind of behavior is so weird and interesting that scientists have a name for it. A Non-Newtonian Fluid is a liquid that gets more viscous (sometimes to the point of acting like a solid) when it is stirred or squeezed. You've probably seen one-quicksand-in movies or on television. In the very unlikely event that you fall into the some quicksand, now you know what to do. Stay calm and try to float the way you would in a swimming pool. Paddle very, very slowly to dry land!

How does it work? Your Non-Newtonian Fluid, the Flip-Flop Slime, is what scientists call a colloid. A colloid is made up of tiny particles (cornstarch, in this case) hanging in something else (the water). What makes a colloid special is that the particles are so tiny that they will hang there forever instead of settling to the bottom. A collloid that you probably are very familiar with is mayonnaise. Mayonnaise contains lots of tiny beads of oil hanging in water.

So, Flip-Flop Slime is a colloid. What does that do for us? If you followed the recipe, your colloid slime is packed tight with cornstarch. Normally, the starch particles still have lots of room between them. If they move a little, there's space for them to slide around, and the slime stays liquid. But if they move a lot, the starch chains start tangling and banging around. When that happens, the water acts as a cross-linker, and the slime becomes solid. But the linking only lasts for a little while. As soon as the slime stops getting pushed around, everything unhooks and goes back to being a squishy liquid.

New Slimes

You should have enough guar gum, sodium tetraborate solution, and corn starch left to do additional experiments. Based on what you now know, you should be able to make educated guesses about the effects of changing the recipes. What do you think will happen if you:

-Add more (or less) water to the mixture?

- Add more (or less) sodium tetraborate solution?

- Add more (or less) guar gum?

Work like a real scientist. Write down your educated guesses about the results, and why you think things should happen that way. This is called a hypothesis. Then do an experiment to test your hypothesis. Follow your new formula and compare the results to your guess. If you guessed wrong, can you figure out what happened?
For example, let's say you think that adding 1/2 teaspoon of guar gum to Sewer Slime should make it much thicker. Write down that hypothesis. Then, mix up a new batch of Sewer Slime, changing the amount of guar gum. Compare your original sample to the new batch. Hold them from the same height and let go. Which one stretches the furthest?

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