Aliana & Leina Logbook – “All About Slime”

December 20th, 2023:

**Problem:** Which household item activates glue to make the best slime?

Our definition of “best slime” is slime that is physically and visually the consistency of gak slime (or slime made using borax).

**Initial Hypothesis:**

Aliana: magic baking powder or laundry detergent would work because most slimes are made of laundry detergent and magic baking powder makes food bind. I thought either of these manipulated variables (magic baking powder & laundry detergent) when mixed with the controlled variable of glue would form slime.

Leina: I thought vinegar would work because it has a lot of chemicals in it that might be able to form slime. I thought one of those chemicals would combine with the glue and form slime.

**Research:**

## Gak slime:

## Make Slime, Gak,

One of my favorite “recipes” is the ever popular Elmer’s Glue Gak. Aside from the fact that it’s easy to make, it’s rare that you wouldn’t have most of the essential ingredients at your fingertips.

<http://blog.teachersource.com/2009/07/24/make-slime-gak-oobleck-gross-science/>

What is gak slime?

Adding a water-Borax solution to school glue causes a chemical reaction between the glue and the Borax molecules to produce a highly flexible, cross-linked polymer. Knead with your hands until you have Gak. And we couldn't end this without someone getting slimed. Oct 7, 2016

Video of Gak Slime 1: <https://www.youtube.com/watch?v=R0wX2katmRk>

Video of Gak Slime 2: https://www.youtube.com/watch?v=WpkymSDlouk

Activator: a substance that starts a chemical process. it is usually powdered borax dissolved in water, liquid starch, eye drops, or contact lens solution.

https://www.armandhammer.com/articles/kid-friendly-slime

All slime requires two things: polyvinyl alcohol + borate ion

Polyvinyl alcohol in washable glue is attracted to the borate ion from borax. This attraction makes the two molecules form long chains and tons of those chains together form slime.

https://science-u.org/experiments/smooshy-slime.html#:~:text=When%20these%20two%20ingredients%20are,form%20the%20slime%20we%20love!

Borax and boric acid are different chemicals, in the presence of water they change into borate ion. This is why you add water to borax powder.

https://www.funathomewithkids.com/2014/08/the-science-behind-slime.html

Gak slime or Glue slime: glue and borax slime

https://www.pbs.org/parents/crafts-and-experiments/create-your-own-blob#:~:text=Pour%20the%20glue%20into%20a,%C2%BD%20cup%20room%20temperature%20water.&text=Add%20the%20food%20coloring%20and%20mix%20your%20goo%20well.&text=In%20a%20small%20cup%20stir,the%20Borax%20is%20completely%20dissolved.&text=Add%20the%20Borax%20mixture%20to,the%20food%20coloring%20and%20stir.

Glue contains polyvinyl acetate which is a liquid polymer. Borax links the polyvinyl acetate molecules to each other, creating one large flexible polymer.

https://www.acs.org/education/whatischemistry/adventures-in-chemistry/experiments/slime.html

Slime forms when the borate ions (neutral pH) in the slime activator (sodium borate, borax powder, or boric acid) mix with the PVA (polyvinyl acetate) glue and forms this cool stretchy substance. This is called cross-linking! The glue is a polymer and is made up of long, repeating, and identical strands or molecules. how does slime form?  You need two things: polyvinyl alcohol (a main ingredient in washable school glue) and borate ion (which you can get from borax, sodium tetraborate, or boric acid).  What happens is that the polyvinyl alcohol in washable school glue is attracted to the borate ion from borax or boric acid (depending on whether you are using borax, liquid starch, certain brands of laundry detergent). Even though Borax (from, well, Borax and also from Sta Flo liquid starch) and Boric Acid (from certain laundry detergents) are different chemicals, in the presence of water they change into Borate Ion.  This is why you add water to borax powder if you are preparing slime using a borax-based recipe.

https://littlebinsforlittlehands.com/how-to-make-borax-slime-easy/

borate ions (activator) + polyvinyl acetate (glue) = slime

<https://littlebinsforlittlehands.com/slime-activator-list/#:~:text=Slime%20forms%20when%20the%20borate,and%20identical%20strands%20or%20molecules>.

Adding baking soda to your slime recipe helps it have more form and firmness.

If your slime is too oozy-gooey, add another pinch of baking soda to help it firm up. Continue adding baking soda a pinch at a time until the slime is your preferred consistency. If it’s too firm, add warm water, a teaspoon at a time

<https://www.armandhammer.com/articles/kid-friendly-slime#:~:text=Adding%20baking%20soda%20to%20your,a%20teaspoon%20at%20a%20time>.

Borate ion is created when bicarbonate of soda (baking soda) is mixed with contact lens solution. It’s super important to make sure that the solution you’re using contains the ingredients **boric acid** and **sodium borate.**

[**https://www.curiscope.com/blogs/blog/the-perfect-slime-recipe**](https://www.curiscope.com/blogs/blog/the-perfect-slime-recipe)

Hypothesis after research:

Combined Hypothesis: Once we did further research, we realized that we need 3 different ingredients:

1) water +

2) a manipulated variable that contains boric acid. When boric acid is mixed with water it becomes borate ion.

3) Borate ion then reacts with the third ingredient, which is glue containing polyvinyl acetate, causing a chemical reaction producing slime.

Variables:

January 26, 2024

Controlled variables:

Clear glue: amazon basics (1 gal/ 3.8L)

Clear glue: ¼ cup

Measurement of household items and borax solution: ¼ teaspoon

Time: 15 stirs, wait 3 minutes, observe visually, repeat x 2 times. Then observe visually and physically 1 hour later.

Manipulated variables: ¼ teaspoon of each

1. Bausch + Lomb renu fresh (contact lens solution)
2. Magic Baking Powder
3. Compliments White Vinegar
4. Kirkland UltraClean Premium Laundry Detergent Free & Clear (no dyes/ perfumes)
5. Arm & Hammer Baking Soda
6. OxiClean Max Efficiency Laundry Stain Remover
7. Boric Acid (powder)
8. Borax Solution (½ teaspoon boric acid into ¼ cup water)

Materials:

* **measuring cup - baking powder**
* **teaspoon - vinegar**
* **16 clear containers & 9 lids - laundry detergent**
* **metal spoon - contact lens solution**
* **clear glue - stain remover**
* **water - boric acid powder**
* **sharpie - computer**
* **printer - phone**
* **paper - art supplies**

Responding variable:

**Location (bottom, top, side flat)**

**Bubbles (foam)**

**Size (small, big)**

**Amount (few, lots)**

**Texture (chunky, blob, hard, rubber, stringy, sticky, watery, clumpy, thick, condensed, consistency)**

**Color Change (clear cloudy)**

**Process**

**Step 1:** add a ¼ cup of clear glue to 8 plastic containers and mark one manipulated variable per container and lid + control

**Step 2:** add ¼ teaspoon of each manipulated + control variable to the ¼ cup of glue

**Step 3:** stir glue + manipulated & controlled variable 15X

**Step 4:** wait 3 minutes, visually observe and record observation in logbook

**Step 5:** repeat step 2, 3 & 4 in the same containers from step 1

**Step 6**: wait one hour after step 5 and physically/ visually observe changes. Record observations in the logbook

**REPEAT the experiment or all steps 3X**

Results:

January 6th 2024

Procedure:

VISUAL: Initial VISUAL observations of variables (prior to mixing)

Step 1: add a ¼ cup of clear glue to 6 plastic containers and mark one manipulated variable per container and lid

Observation:

Step 2: Glue x 6: clear, very tiny bubbles barely visible

Step 3: Add ¼ teaspoon of one of the manipulated variables below to one of the ¼ cups of clear glue:

1. Bausch + Lomb renu fresh: clear on the bottom, white bubbles on the top
2. Magic Baking Powder: white powder
3. Compliments white vinegar: clear like water
4. Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): looks like clear glue, thicker then water, very few tiny bubbles
5. Arm & Hammer Baking Soda: white powder
6. OxiClean Max Efficiency Laundry Stain Remover: slightly cloudy or white tint, thicker (glue consistency)

Step 4: stir 15 times using a metal spoon and wait 3 minutes to observe

Step 5: Visual observations

1. (3) Bausch + Lomb  renu fresh: clear and stringy
2. (2)Magic Baking Powder: clear -> Grey -> white bubbles
3. (2)Compliments white vinegar: clear with little bubbles on the bottom and a little bit bigger bubbles on the top
4. (3) Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): clear with a few bubbles throughout
5. (1)Arm & Hammer Baking Soda: cloudy, lots of bubbles
6. (1)OxiClean Max Efficiency Laundry Stain Remover: cloudy, few bubbles and not fully mixed

Step 6: add second ¼  teaspoon of manipulated variable

Step 7: stir 15 times using the metal spoon and wait an additional 3 minutes

Step 8: Visual Observations

(3) Bausch + Lomb  renu fresh (contact lens): clear, tiny bubbles throughout (same as before)

(2) Magic Baking Powder: condensed, many more bubbles and foamed to the top of the container, very little clear left in the bottom

(2) Compliments white vinegar: stringy, clear, scattered tiny bubbles

(3) Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): purplish hue, tiny clear bubbles throughout

(1) Arm & Hammer Baking Soda: bubbles throughout in many sizes and cloudy because of bubbles

(1) OxiClean Max Efficiency Laundry Stain Remover: condensed liquid, appears thicker and cloudy, very few if any bubbles

Step 9: January 6th 2024 (1:20pm): 1 hour after both sets of manipulated variables were added

Physical & Visual Observations

1. (3) Bausch + Lomb renu fresh (contact lens): glue
2. (2) Magic Baking Powder: clump, sticky, bubbly
3. (2) Compliments white vinegar: watery glue
4. (3) Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): glue
5. (1) Arm & Hammer Baking Soda: feels like glue, sticking to hands
6. (1) OxiClean Max Efficiency Laundry Stain Remover: feels like glue, sticking to hands

Jan 11, 2024

Experiment 1 Continued:

Step 1: Create Control = Borax Solution (¼ cup warm water and ½ tsp borax powder)

Step 2: Glue x 2: clear, very tiny bubbles barely visible

Step 3: 4:48pm add ¼ teaspoon of one of the manipulated variables below to one of the ¼ cups of clear glue

Step 4: stir 15 times using a metal spoon and wait 3 minutes to observe

Step 5: Visual Observations

1. Control: clear, little bit of bubbles, chunky (some sticking out and not flat)
2. Borax powder: White blob inside the clear glue, a little bit of bubbles, clear

Step 6: add second ¼ teaspoon of manipulated variable

Step 7: stir 15 times using the metal spoon and wait an additional 3 minutes

Step 8: Second ¼ teaspoon and 6 minutes

Visual Observations

7) Control: clear, little bit bigger bubbles, chunky (some sticking out and not flat) - looks like clear ice bergs

8) Borax powder: 2 white blob inside the clear glue, a little bit of bubbles, clear

Step 9: January 11th 2024 1 hour after both sets of manipulated variables were added

Physical and Visual Observations:

7) Control: clear over activated slime - hard, glue surrounding hard part of the slime.

8) Borax powder: clear parts feel like glue, rubber substance surrounding the borax pellets and borax pellets are powder inside once broken

Experiment 2: January 13th 2024

Procedure:

Step 1: add a ¼ cup of clear glue to 8 plastic containers and mark one manipulated variable per container and lid

Step 2: Glue x 8: clear, very tiny bubbles barely visible

Step 3: Add ¼ teaspoon of one of the manipulated variables below to one of the ¼ cups of clear glue:

Visual Observations:

(1) Bausch + Lomb renu fresh: clear on the bottom, white bubbles top

(1) Magic Baking Powder: white powder

(2) Compliments white vinegar: clear like water, tiny bubbles throughout (very fee bubbles)

(2) Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): looks like clear glue with a hue of purple, thicker than water, very few tiny bubbles

(3) Arm & Hammer Baking Soda: very foggy throughout with little bubbles throughout

(3) OxiClean Max Efficiency Laundry Stain Remover: slightly cloudy throughout, greyish tint

(4) Control: clear, little bubbles throughout

(4) Borax powder: 1 white chunk in middle and glue surrounding

Step 4: stir 15 times using a metal spoon and wait 3 minutes to observe

Step 5: Visual observations after 3 minutes and second ¼ teaspoon of manipulated variable

(1) Bausch + Lomb renu fresh: clear, tiny bubbles that amount increases as we get closer to bottom of the container

(1) Magic Baking Powder: more foam and less bubbles on top, still 2 layers and the top layer is foam is white and bottom layer cloudy

(2) Compliments white vinegar: stringy at the top (glass type strings), tiny bubbles throughout the container, clear

(2) Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): medium bubbles throughout but mostly on top, still clear and purple hue

(3) OxiClean Max Efficiency Laundry Stain Remover: light grey fog, tiny bubbles at top

(3) Arm & Hammer Baking Soda: bunch of tiny bubbles that it appears cloudy and medium bubbles at the top

(4) Control: really big chunky in the middle, sides clear and all sizes of bubbles throughout

(4) Borax powder: big and medium bubbles on top, tiny bubbles throughout, 2 white chunks from the powder in the glue

Step 6: add second ¼ teaspoon of manipulated variable

Step 7: stir 15 times using the metal spoon and wait an additional 3 minutes

Step 8: Visual & Physical Observation after 1 hour

(3) Bausch + Lomb  renu fresh (contact lens): clear, tiny bubbles throughout (same as before)

(2) Magic Baking Powder: super foggy, 2 layers (clear at the bottom and foggy at the top), bunch of bubbles on top and foamed up)

(2) Compliments white vinegar: stringy, clear, scattered tiny bubbles

(3) Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): purplish hue, tiny clear bubbles throughout

(1) Arm & Hammer Baking Soda: bubbles throughout in many sizes and cloudy because of bubbles

(1) OxiClean Max Efficiency Laundry Stain Remover: condensed liquid, appears thicker and cloudy, very few if any bubbles

(4) Control: clear, little bit of bubbles, chunky (some sticking out and not flat)

(4) Borax powder: 2 x white blobs inside the clear glue, a little bit of bubbles, clear

Step 9: 1 hour after both sets of manipulated variables were added

Physical & Visual Observations

Bausch + Lomb renu fresh (contact lens): glue

Magic Baking Powder: clump, sticky, bubbly

Compliments white vinegar: watery glue

Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): glue

Arm & Hammer Baking Soda: feels like glue, sticking to hands

OxiClean Max Efficiency Laundry Stain Remover: feels like glue, sticking to hands

Control: clear over activated slime - hard, glue surrounding hard part of the slime.

Borax powder: clear parts feel like glue, rubber substance surrounding the borax pellets and borax pellets are powder inside once broken

Experiment 4: March 10th 2024

Procedure:

VISUAL

Step 1: add a ¼ cup of clear glue to 8 plastic containers and mark one manipulated variable per container and lid

Observation:

Step 2: Glue x 8: clear, very tiny bubbles barely visible

Step 3: Add ¼ teaspoon of one of the manipulated variables below to one of the ¼ cups of clear glue:

(1) Bausch + Lomb renu fresh: clear on the bottom, white bubbles on the top and some in the middle, little bubbles (all clear)

(1) Magic Baking Powder: super foggy, 2 layers (clear at the bottom and foggy at the top), bunch of bubbles on top and foamed up)

(2) Compliments white vinegar: small clear chunk, clear like water, tiny bubbles throughout

(2) Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): medium bubbles on top (small amount), small bubbles in the middle, clear purple

(3) OxiClean Max Efficiency Laundry Stain Remover: foggy (chunks throughout), medium bubbles on top and small thoughout and clear layer in the bottom

(3) Arm & Hammer Baking Soda: foggy, can’t see through, medium bubbles throughout and lots on top, small on bottom, tiny chunks of baking soda throughout

(4) Control: really chunky in the middle, sides clear and all sizes of bubbles throughout

(4) Borax powder: big and medium bubbles on top, tiny bubbles throughout, 2 white chunks from powder in the glue

Step 4: stir 15 times using a metal spoon and wait 3 minutes to observe

Step 5: Add the second ¼ teaspoon of one of the manipulated variables below to one of the ¼ cups of clear glue:

(1) Bausch + Lomb renu fresh: clear, really small bubbles and not many, bubbles on the top are slightly larger

(1) Magic Baking Powder: foamed up more, less bubbles on the top, still 2 layers and the top layer is foam is white and bottom layer foggy

(2) Compliments white vinegar: strings at the top (glass type strings), tiny bubbles throughout the container, clear and one chunk of bubble variety at the top of the container

(2) Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): medium bubbles throughout but mostly on the top, still clear and purple hue

(3) OxiClean Max Efficiency Laundry Stain Remover: really foggy, tiny bubbles at top

(3) Arm & Hammer Baking Soda: bunch of tiny bubbles throughout – so many cannot see through and medium bubbles at the top

(4) Control: really chunky in the middle, sides clear and all sizes of bubbles throughout

(4) Borax powder: big and medium bubbles on top, tiny bubbles throughout, 2 white chunks from powder in the glue

Step 6: add second ¼ teaspoon of manipulated variable

Step 7: stir 15 times using the metal spoon and wait an additional 3 minutes

Step 8: wait 1 hour and observe physically and visually

Step 9: Physical and Visual Observations

(1) Bausch + Lomb renu fresh: looks like glue, feels like thinner glue

(1) Magic Baking Powder: foamed over and out of container, looked like foaming egg whites, very small bubbles and cloudy. It feels like foamy shaving cream.

(2) Compliments white vinegar: stringy at the top, liquid throughout consistency of glue

(2) Kirkland UltraClean premium laundry detergent Free & Clear (no dyes/ perfumes): still clear purple, a lot less bubbles, feels like glue

(3) OxiClean Max Efficiency Laundry Stain Remover: really foggy throughout with many tiny bubbles. Feels like thicker glue.

(3) Arm & Hammer Baking Soda: looks like our definition of slime. First when you make slime there is a lot of bubbles. Cloudy with small bubbles throughout, small thin layer of clear bubbles on very bottom. Feels like glue.

all sizes of bubbles throughout

(4) Control: clear and chunky with small bubbles. Feels like slime that hasn’t been physically manipulated enough but is in the beginning of formation

(4) Borax powder: less bubbles throughout container. Two white chunks in clear glue. The white chunks are hard, the glue around it is also hard, the rest feels like glue.

Results/ Observations:

Graph 1:

|  |  |  |  |
| --- | --- | --- | --- |
|  | No | Sort of | Yes |
| Contact Lens Solution | X |  |  |
| Baking Powder |  | X |  |
| Vinegar | X |  |  |
| Laundry Detergent | X |  |  |
| Baking Soda | X |  |  |
| Stain Remover | X |  |  |
| Boric Acid |  | X |  |
| Borax Solution |  | X |  |

Graph 2:

|  |  |  |  |
| --- | --- | --- | --- |
|  | No | Sort of | Yes |
| Contact Lens Solution | X |  |  |
| Baking Powder |  | X |  |
| Vinegar | X |  |  |
| Laundry Detergent | X |  |  |
| Baking Soda | X |  |  |
| Stain Remover | X |  |  |
| Boric Acid |  | X |  |
| Borax Solution |  |  | X |

Graph 3:

|  |  |  |  |
| --- | --- | --- | --- |
|  | No | Sort of | Yes |
| Contact Lens Solution | X |  |  |
| Baking Powder |  | X |  |
| Vinegar | X |  |  |
| Laundry Detergent | X |  |  |
| Baking Soda | X |  |  |
| Stain Remover | X |  |  |
| Boric Acid |  | X |  |
| Borax Solution |  |  | X |

January 26th 2024

Conclusion:

We learnt to make slime you need water, glue and borate ion with the glue containing polyvinyl acetate. Borate ions can be found in some contact lens solutions, borax powder and some laundry detergents - but not all.

We also learnt that vinegar breaks down slime instead of making it.

We learnt that stirring 30x total does not form slime even if all 3 ingredients are present. To make slime you have to mix it A LOT for the chemical reaction to occur which in the case of slime is the two molecules mixing to form long chains and a lot of those chains make SLIME.

We had read that contact lens solution contains small amounts of boric acid. When mixed with baking powder you can also make slime. We decided to try it out even though our contact lens solution did not work during our initial observations. We also noticed that the contact lens solution ingredient list did not contain borate ion. However this reaction did start to produce slime on the outer edge meaning there must be some borate ion present.

We have come to the conclusion that all SLIME is made the same and has to have Boric Acid and Poly Vinyl Acetate present.

https://encounteredu.com/take-action/slimy-chains

Materials:

clear glue, plastic containers, household items (vinegar, laundry detergent, baking powder, baking soda, contact lens solution, stain remover, borax powder, water), ¼ teaspoon, ¼ cup, metal spoon, sharpie, hands, eyes

January 25th, 2024

Problem: What household items can be combined with clear glue to make slime?

WATER + BORIC ACID = BORATE ION

BORATE ION + POLYVINYL ALCOHOL = SLIME

Our Control (water + borax powder) = Activator

Activator + Clear Glue (controlled variable) = Slime

Manipulated Variable (Activator???) + Controlled Variable (Glue) = Responding Variable (Slime???)

January 27th 2024

Application:

Our results show other people the best way to make slime, what ingredients are required and the best household items you can use. We also showed the importance of hand mixing in creating the slime chemical reaction. If you do not use ingredients that contain polyvinyl acetate or borate ion it will not form slime.

If we did our experiment again, we would use contact lens solution to see if borate ion is present even though it is not listed in the ingredients on the bottle. We went ahead and tried this and found renu fresh (borate ion or acid not listed) + baking soda did indeed make slime when mixed with clear glue.

We also would add more of the manipulated variable, maybe increasing it to half a teaspoon of each manipulated variable each time to see if the chemical reaction occurs faster. We would still use clear glue instead of white glue so we can observe visually what is happening inside of the glue.

Jan 28th 2024

Fun Facts:

 Slime in nature is called mucus, and you have some in your nose right now!

<https://kansasdiscovery.org/nine-serious-fun-slime-facts/>

Manipulating slime and measuring ingredients can strengthen fine motor skills in kids

<https://slimeobsidian.com/blogs/slime-blog/10-interesting-facts-about-slime>

Slime was a toy product manufactured by Mattel, sold in a plastic trash can and introduced in February 1976.

<https://slimeobsidian.com/blogs/slime-blog/10-interesting-facts-about-slime>

If you store the container in the fridge, you can get slime to last as long as a month without drying out or molding.

https://www.cnet.com/home/smart-home/everything-you-need-to-know-about-slime/