

THE WORLD OF GLUE

A Cross-Curricular
Investigation
of Adhesives
For Grades K-5

Provided by:



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The World of Glue: An Investigation of Adhesives

This interactive inquiry-based instructional unit teaches students about adhesives in their world of day-to-day activities. Students will understand the properties of common adhesives and the science of polymers that create the fundamental building blocks of adhesives essential to so many of the products that we use every day. The learning experiences provided within this guide address English/language arts, writing, science, history and art for students in grades K-5. Teachers can easily adapt the lessons and provide engaging, hands-on creative learning experiences for their students.

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Student Objectives

- Students will understand the concepts related to polymers as the building blocks for adhesives and glues.
- Students will identify examples of adhesives used in the world around them.
- Students will read informational text about a relevant topic to understand events, procedures, ideas, or concepts in a historical context.
- Students will demonstrate their understanding of these scientific concepts in oral presentations or dramatic performances to the class.
- Students will work in teams to solve a problem.
- Students will observe and record the properties observed when two substances are combined.

Academic Standards

Common Core State Standards

- CCSS.ELA-Literacy.CCRA.R.2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
- CCSS.ELA-Literacy.CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCSS.ELA-Literacy.CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
- CCSS.ELA-Literacy.CCRA.SL.6 Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
- CCSS.ELA-Literacy.CCRA.R.9 Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.
- CCSS.ELA-Literacy.CCRA.R.10 Read and comprehend complex literary and informational texts independently and proficiently.

National Science Education Standards

- Science and Technology Content Standard E: Abilities of Technological Design
- Physical Science Content Standard B: Properties of Objects and Materials
- The Nature of Technology: 3C- Issues in Technology
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Background Information

By identifying adhesives in our everyday lives, students get a sense of why they need to understand the science of polymers that enables adhesives to bond two or more things together.

Polymers are large molecules formed when repeated chemicals bond together. Polymers are all around us. Polymers are in DNA, starch, cotton, rubber, leather, and plastics. Polymers are the fundamental building block in glues and adhesives.

One of the big shifts in Common Core Standards is "inductive learning." A key component of inductive learning is teaching students how to support their thinking and understanding with evidence. This unit includes many opportunities for students to explore scientific principles and support their learning with the evidence they discover.

List of Materials

Elmer's School Glue
Elmer's School Glue Naturals®
Elmer's Classic Glitter Glue
Examples of products that use adhesives
Evidence Log 1 (PDF handout included)
Evidence Log 2 (PDF handout included)
Parent Letter (PDF handout included)
Non-fat or skim milk
White vinegar
Coffee filters or paper towels
Flour
Waxed paper
Eye droppers
Various types and weights of paper
Cardboard
Fabric

Recommended Reading and References

Too Much Glue by Jason Lefebvre

Plastics and Polymers Science Fair Projects by Madeline P. Goodstein



Required Knowledge/Vocabulary

Student will develop an understanding for the following terms by the conclusion of the unit:

Adhesives

Polymers

Monomers

Casein

Synthetic (man-made) vs. natural

Springboard for Learning

1. Begin by reading the book, *Too Much Glue* by Jason Lefebvre aloud to the students. This fun story is great to use as a springboard for learning, and even older children will enjoy the vibrant language and illustrations. Stop periodically to discuss the character and the plot.
2. After reading the story, ask students if they ever wondered how glue is made or why it is sticky. Engage them in a discussion about their own experiences with different types of glue. Introduce the word *adhesives* and tell them that they will be conducting an investigation to identify examples of adhesives around us as well as how white glue is made.
3. Present the challenge to students by explaining that they will work as detectives in search of adhesives. The idea is to hook the students and have fun while making them aware of adhesives in the world around them.

Discussion Questions

- What is an investigation?
- What is an adhesive?
- What do you already know about adhesives?
- Do you see any adhesives in the classroom?
- How many examples of adhesives do you think you can find by tomorrow?

Activity: Investigation of Adhesives

Provide a copy of the Evidence Log for each student (student activity page). Explain that they will record each piece of evidence that they find and explain what it shows, proves, or demonstrates. You may want to model this for students with a few examples on the board so that they are clear about your expectations. For example, a sticky note might be one example they find. However, they should recognize that it is not as sticky as other adhesives. It “proves” that adhesives have different levels of “stickiness” or levels of *cohesion*. Introduce two new vocabulary words to the students:

Adhesion is the force between two materials.

Cohesion is the internal strength of the adhesive.

Explain to the students that they will conduct their own investigation of adhesives and present their evidence to the rest of the class. Invite students to work with a partner, and tell them that they will present their evidence to the class in a dramatic performance. This may be in the form of a courtroom drama, television show, or play. Invite them to include costumes, props, or visual aids to better communicate their findings. As each small group presents their evidence, students should record any new examples they learn from other students to their own evidence log.

Activity: Understanding Polymers

Use the PowerPoint presentation to help students understand the properties of adhesives and introduce the concept of polymers (available for download at <http://www.elmers.com/teachers/lesson-plan/the-world-of-glue>). As you share the presentation, engage students in a discussion to review the examples they found in the previous investigation. Review the definitions of *monomers* and *polymers* to ensure students have a solid understanding.

Tell the students that they have a new case. Now that they have a basic understanding of how adhesives work, they will investigate different combinations of substances to create their own glue. Discuss how teams of scientists experiment with different materials to solve problems and invent new products. Provide each student with a copy of Evidence Log 2 (student activity page). Instruct them that they will be experimenting with different materials and again be searching for evidence to support a new type of glue. Provide students with The Story of Elmer handout (student activity pages). Discuss that Elmer’s first glue was made from a polymer substance found in milk called casein. Explain that they will make a casein polymer the same way that Elmer’s did.

Provide vinegar, milk, a bowl, and paper towels to small groups of students. Instruct them to put 7 tablespoons of milk in the bowl.

(Note: Whole milk contains more fat and won't produce the same results, so be sure to use skim or non-fat milk.)

Ask them to add one tablespoon of white vinegar to the milk and observe what happens. They should see solids beginning to form in the liquid. Explain that the solids are actually monomers that have joined together into polymers. When the vinegar was added to the milk, it caused the casein to separate from the liquid part of the milk and join other casein polymers to form solids. Wait a few minutes until the solids settle to the bottom of the bowl and then carefully use paper towels to absorb the liquid on top.

Students can now experiment with the slimy casein substance as glue. Invite them to glue different types of paper or cardboard together. Instruct them to record their findings on their evidence log.

Next, explain that students will experiment with different combinations of flour and water to create glue. Allow small groups to determine different formulas of flour and water. Remind them to record their results on their evidence log.

Create a testing board on which students can test their glue formulas. Instruct them to glue samples to the board, but remind them to label each sample so that they can share their findings with the class.

Activity: Make a Mini Glue Suit

Explore the line in Lefebvre's book "glue raindrops not puddles." Ask students what they think it means and how they can use it to remember the right way to use glue. Highlight how the character did NOT use the glue the right way and ways he could have used it to make less of a mess.

Allow students to experiment with glue and art supplies and make their own mini glue suit just like in the story. Provide a copy of the body template (student activity page) for each student. Follow the instructions on the page to create a mini glue suit just like Matty's.

Activity: Observe and Compare

Allow students to experiment and observe the properties of different types of glue noting similarities and differences in a Venn diagram (student activity pages). Depending on the developmental level of your students, decide if you want them to compare and contrast two different glues or three. Provide small groups of students with Elmer's School Glue, Elmer's Glitter Glue, and Elmer's School Glue Naturals®. Give each small group a sheet of waxed paper and allow time for students to pour small amounts of each type of glue on to the waxed paper.

As they observe the different types of glue on the waxed paper, instruct them to identify similarities and differences in color, consistency, drying time, etc. As the glue dries, ask the students to include any information they can add from the labels of the bottles.

Activity: Write to the Author

Read the interview with Jason Lefebvre (student activity page) and discuss his thoughts about writing the book and the process of getting his book published. Ask students to think about how they feel when they create a project or score well on a test and get positive feedback for their work. Explain to the students that they will write a letter to Jason Lefebvre to share their own positive feedback about the book. Review the parts of a friendly letter and provide enough time for students to work through the write and revise process.

Send letters to: Jason Lefebvre
 P.O. Box 6466
 Holyoke, MA 01041

Extension Activities

Write a paragraph explaining how polymers are formed.

Create an advertisement or a commercial for a new glue. What would make people want to buy your glue? What features does your glue have that would make people want to buy it?

Write a story about a world without glue. What problems would people face? Using classroom materials like building blocks, and yarn have students work in groups to try to create their own clicky brickly tow trucks and yarn lassoes. Then have them use other classroom materials to create other escape plans.

Extend science inquiry by allowing students to continue testing different formulas of glue and adding additional ingredients such as glitter, confetti, or food coloring. Do these additional ingredients make the glue more or less effective?

Parental Involvement

There is an abundance of research that demonstrates the positive affects of parental involvement on student achievement and social and emotional growth. The most accurate predictor of a student's achievement in school is not income or social status but how the family supports learning at home. Creative and fun activities like the ones provided on the Parent Letter can help parents foster a home environment that encourages learning and creativity.

Provide the Parent Letter for students to take home. Communicate to parents what their children have learned and enable them to apply the science concepts even further in an at-home activity that students will share with the class.

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Student activity pages and handouts

EVIDENCE LOG



Date:	Investigator	
Case:	Partner:	
Evidence:	Location:	What does it prove?

EVIDENCE LOG



Date:	Investigator	
Case:	Partner:	
Test 1 Casein (milk and vinegar)	Formula 7 tbsp of skim milk 1 tbsp of white vinegar	Findings
Test 2 Flour and water		
Test 3 Flour and water		
Test 4 Flour and water		

Home-School Connection

Dear Parent or Guardian,

This week, we have been exploring adhesives in the world around us. Your child has investigated the history of glue, the properties of polymers, and how adhesives are created. Today, your child worked on an engineering team with other students experimenting to create casein and effective formulas for glue.

Have a conversation with your child to provide an opportunity to share what he or she has learned. This is an important way that you can reinforce and apply the history of glue, the scientific principals of polymers, and the way scientists and engineers experiment with substances to solve problems.

I'd like to invite you to extend this learning even further by creating an additional learning experience at home that students will be able to share with the class. Please select one of the following activities to enjoy with your child.

1. You can create polymer slime by combining 7 tablespoons of skim milk, one tablespoon of white vinegar, and $\frac{1}{4}$ teaspoon of baking soda. Ask your child to start the process the same way we did in class by creating a casein polymer first with the milk and the vinegar and then add the baking soda to the solids after the left-over liquid from the milk has been absorbed with a paper towel. Ask your child if he/she knows why the solids are forming.
2. Create a different type of slime using Elmer's White School Glue, cornstarch and water. A good formula is 8 tablespoons of glue, 2 tablespoons of cornstarch, and 2 tablespoons of water. Combine the water and the cornstarch and then add the glue gradually as you stir. The mixture will slowly thicken and turn into slime as the polymers form.
3. Create an "edible adhesive" with your child by making marshmallow treats. Talk to your child about how heating the marshmallows causes them to melt and become sticky. Ask your child if he or she can tell you what is happening to the polymers as the marshmallows are heated.

Students will have an opportunity to share their at-home learning experiences with the other students on (date)_____.

Thank you for your continued support.

Sincerely,

THE STORY OF ELMER



Did you ever wonder where the bull on the Elmer's glue bottles and sticks came from? Would it surprise you to know that Elmer is a real bull? The story actually starts back in 1857 when Gail Borden started the Borden Company. At one time, Borden was the largest U.S. producer of dairy and pasta products. They made jellies and pastries too, but they were best known for their ice cream. In the early 1900s, the Borden Company learned that they could make glue from a substance found in milk called casein. Borden introduced its first non-food consumer product, Casco Glue, in 1932. Immediately after World War II, they wanted to make the glue even better. So they began to experiment with different ingredients and found the perfect recipe made from synthetic materials. The first glue known as Elmer's, Elmer's Glue-All, was introduced in 1947.

Elsie the cow was named the mascot for the Borden Company in 1936. Elmer's career as the mascot for Elmer's glues did not begin until 1951, but his name has been well-known in American homes for many years. In 1940, Borden needed a replacement for Elsie the Cow at the World's Fair and Elmer, Elsie's husband, was a natural choice.



Elmer was a huge hit with the public and since that time his popularity has only increased as a full-time "spokesbull" for Elmer's glues and adhesives. Since that time, Elmer and Elsie have continued to travel with their daughter Bea and son Beau to promote Borden products and Elmer's Glue around the country.



The scientists that work at Elmer's today are always trying to improve their products and develop new ones. The school glue that you use today was first introduced in 1967 and is still available today. In 2013, Elmer's introduced the first school glue made from natural ingredients. The main ingredient in Elmer's School Glue Naturals Glue is American-grown corn, an important renewable resource. Since that first bottle of Elmer's Glue-All was sold in 1947, Elmer's picture is now on more than 150 glue bottles and other products. It's no wonder that Elmer is so recognized by both children and adults today!

Elmer's Timeline

Directions:

Read the Story of Elmer. Cut out the important events listed on this page. Glue the events in the correct place on the timeline. Then write the date that each event happened on the timeline.

Elmer's introduced the first school glue made from all natural ingredients.

Elmer the Bull was named the mascot for Elmer's Glue.

Elsie the Cow was named the mascot for the Borden Company.

Elmer's Glue-All was introduced.

Borden began producing Casco Glue, their first non food product.

Gail Borden founded the Borden Company.

Elmer's Timeline



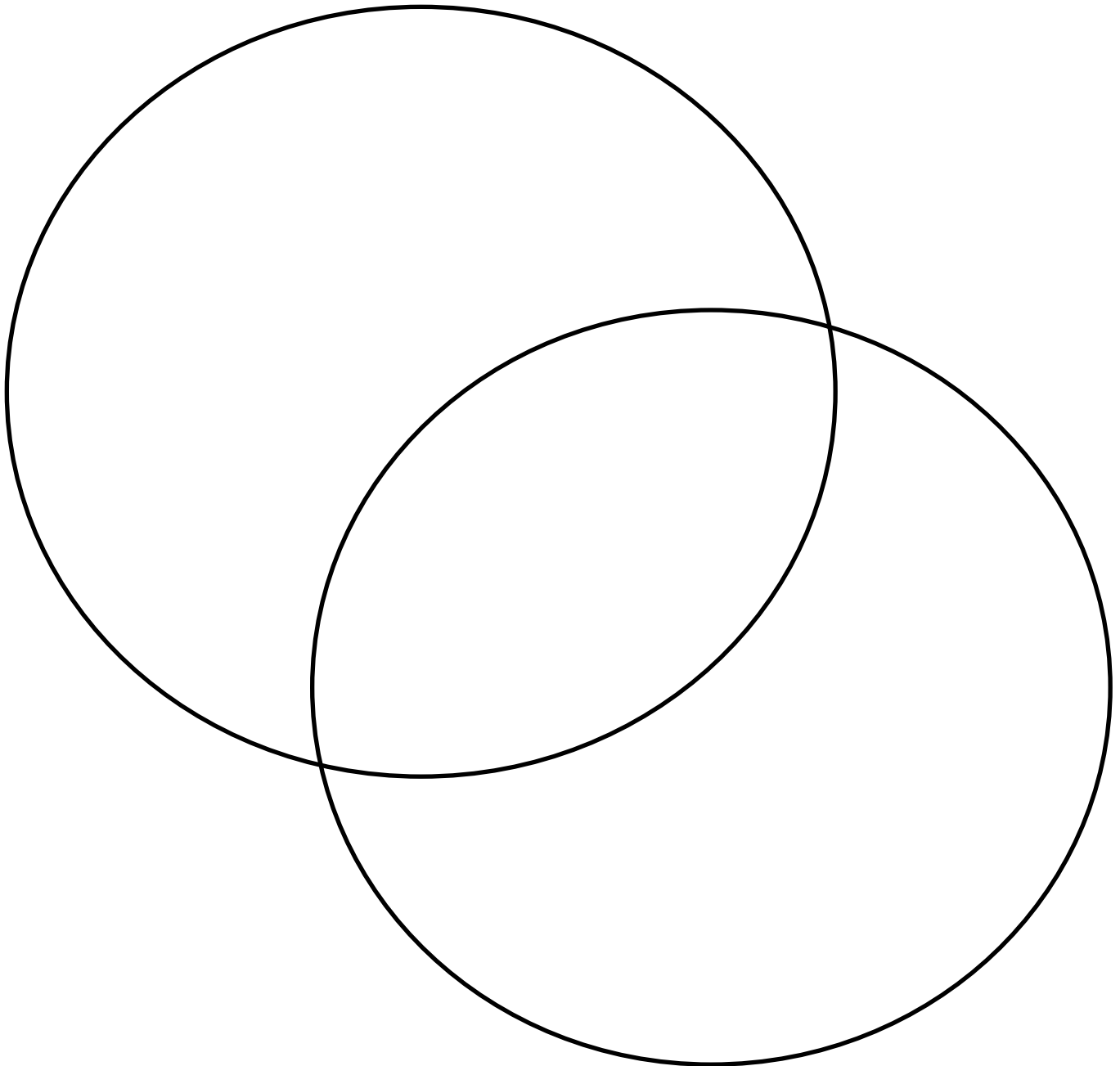
Interactive Notebook - 6 Tab Vocabulary Review

Directions: Cut the entire template out along the thick black lines. Fold the left side tab on the thin line and glue the short fold on to a page in your notebook. Cut the tabs on the dotted lines. Write the definition of the vocabulary word on the back of the tab, and draw an example of the word on the notebook paper under the tab.

Glue this tab to notebook	Adhesive
	Polymer
	Monomer
	Adhesion
	Cohesion
	Synthetic

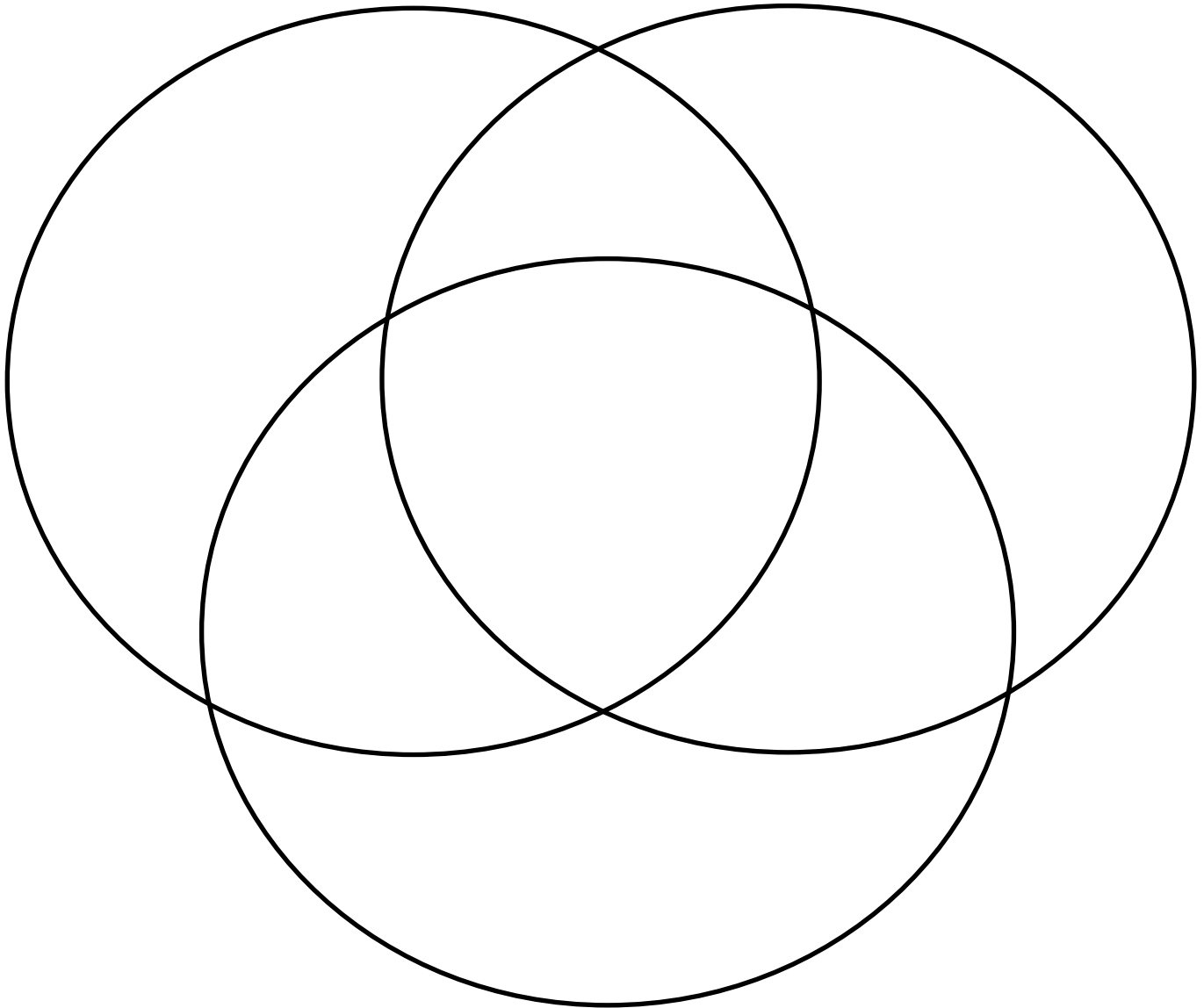
COMPARE AND CONTRAST

Compare and contrast the properties of different types of glue as you complete the Venn diagram below. Do the glues look different? Do they smell different? Do they have different consistencies? How many similarities and differences can you find?



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Compare and contrast the properties of different types of glue as you complete the Venn diagram below. Do the glues look different? Do they smell different? Do they have different consistencies? How many similarities and differences can you find?



An Interview with Jason Lefebvre Author of *Too Much Glue*

*Where did you get the idea for the book, *Too Much Glue*?*

“I got the idea for the book after a game went awry in my preschool classroom. I had an art project set up with glue in cups on the art tables, but decided to play a movement game first. We played the sleepy animal game. I called out an animal and the kids moved around the room like that animal until I said the word sleepy three times. The kids then had to lie on the floor and pretend to sleep until I called out the next animal. In all of the excitement, someone bumped the art table, one of the cups of glue overturned, and glue was dripping off of one of the tables and on to one of my little sleeping animals. As I was getting a clean shirt for the student, I wondered what would have happened if I had never noticed. The idea for the book was born.”



Is Matty’s character based upon a real person?

“Matty is a combination of every precocious, energetic, quirky student I’ve ever had. He’s the kid who drives you nuts but you love just the same.”

There is a process to writing a book and getting it published. What was the best part of the process?

“Oddly, I think the best part of the process is the revision. After I write something I’ll set it aside for a few weeks and then check back on it. Finding the glaring holes and faults on the next reading is good for two reasons: I get to spend more time working on a story I love, and I know that when it’s finished, the story will be that much better. The writing process is a lot of work, but it is really worthwhile.”

Other than your book, what is your favorite picture book?

“My favorite picture book is *Alexander and the Terrible, Horrible, No Good, Very Bad Day* by Judith Viorst. The first line “*I went to sleep with gum in my mouth and now there's gum in my hair and when I got out of bed this morning I tripped on the*

skateboard and by mistake I dropped my sweater in the sink while the water was running and I could tell it was going to be a terrible, horrible, no good, very bad day” is one of the greatest opening lines in literature no matter what the genre. I remember my mom reading *Alexander* to me before bed. Even now, when I open the book I can almost smell the hand lotion she used to put on after doing the dishes. That's the joy of a book you love. And when I have a bad day, I remember that some days are like that, even in Australia.”

What advice do you have for students who may have a good idea for a children's book?

“It's never too early to create something, and when you write something you love it's an amazing feeling to share it with others. I always tell kids that their ideas are always light years better than anything an adult can think of because they are able to look at the world in such a different way.”

Can we expect to see Mattie in another adventure? Are you planning another book?

Maybe some day. There is definitely a world of hyjinx that awaits him, but I don't have a specific Matty story in the works. I do hope to write another book, but for now I'm enjoying this one. And let's face it, there aren't many things out there that are more fun than glue!

Make a Mini Glue Suit – just like Matty’s!

Print this page. Place a sheet of wax paper over it. Spread a thick layer of glue on the wax paper, staying inside the lines of the ‘suit.’ Stick on lots of small objects (sequins, string, pompoms, raw noodles, googly eyes, glitter, scraps of colored paper) in a pattern or any which way. Leave the project in a safe place until it is completely dry (might be 2-3 days). Then peel the ‘suit’ off the wax paper, being careful not to tear it. Glue a magnet on the back and hang it on your fridge.



A mini glue suit on the author’s mom’s fridge

