 

**ELEMENTARY SCHOOL**

**Sustainable Science**

**Properties of Adhesives:**

**A Sticky Situation**

**Lesson 4: Just Glue It!**

**Teacher Background and Overview:**

When scientists and engineers innovate and invent, they are usually responding to challenges related to the environment or market demands. Green chemistry provides scientists with a set of principles and practices for the intentional design of safer, better-performing, and more cost-effective products and processes. Glues are an important part of our world, but their manufacture sometimes uses hazardous materials, excess amounts of energy, and non-renewable resources. By considering glue from a green chemistry perspective, and thinking about the safer adhesives used by nature, students can think critically about how products are made and the impact they have on people and the environment.

This lesson wraps up the unit by having students create an advertisement for their homemade glue from Lesson 3. Students will work in groups and present their projects to the class.

**Additional Resources:**

*How Bad Are Solvent-Based Adhesives for the Environment?* <https://suretacksystems.com/2016/11/are-solvent-based-adhesives-bad-for-environment/>

*Assessing the Environmental Impact of Adhesives*

<http://www.adhesives.org/adhesives-sealants/adhesives-sealants-overview/health-safety/environmental-protection>

*Adhesives & “Green”*

<https://www.cpadhesives.com/green-adhesives>

*Adhesives*

<http://www.sda-uk.org/materials/adhesives/Adhesives_all.htm>

**Time:**

Multi-day project:

Approximately 5x 30-minute periods

45–75 minutes for presentations

**Learning Objectives:** Students will…

* Report on their opinion of why their glue is green, using facts and descriptive detail.
* Present a technological solution to a problem.
* Use informational text to explore and discuss innovations.
* Present marketing material using multimedia components.

**Standards:**

***NGSS***

**5-ESS3-1**Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

**3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

***Massachusetts Standards***

*STE*

**5.3-5-ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.

**5.3-5-ETS3-1(MA)** Use informational text to provide examples of improvements to existing technologies (innovations) and the development of new technologies (inventions). Recognize that technology is any modification of the natural or designed world done to fulfill human needs or wants.

**5-ESS3-1** Obtain and combine information about ways communities reduce human impact on the Earth’s resources and environment by changing an agricultural, industrial, or community practice or process.

*ELA & Literacy*

**RSIT.5.2** Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

**RSIT.5.3** Explain the relationships or interactions of two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.

**WS.5.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**SL.5.4** Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

**SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

**Materials:**

* Cut-up sentence strips from the article
* Art supplies

**Teacher Preparation:**

* Cut article into strips by paragraph.

**Keys to Success:**

* This lesson can substitute for an ELA Speaking & Listening presentation.
* This project can be worked on over multiple days when other work has been completed or when there is down time.
* In-class presentation time can be reduced by assigning groups of 2–4 students for the advertisement project.
* Presentations should fall between 2–4 minutes in length.
* A sample rubric is provided. You may wish to use a rubric for individual students or for teams as a whole.

**Extension:**

* Read the article *Post-it Notes Were Invented By Accident*: <http://www.todayifoundout.com/index.php/2011/11/post-it-notes-were-invented-by-accident/>

**Procedure:**

1. Read aloud to the class the article about adhesives and the environment.
2. Divide the class into teams of 3 students.
3. Hand out sentence strips from the article.
4. Challenge the students to tape the sentences in chronological order on a wall or whiteboard in the classroom.
5. Have students review the order of the sentence strips and check for accuracy as a class.
6. Transition to discussing the student project. Explain that the class will be split into groups to create an advertisement for their homemade glues from Lesson 3.
7. Groups have the option of creating one of the following types of advertisement (they will later share this with the class in a 2–4 minute presentation):
   1. Packaging: After considering various examples of packaging, students may create an eye-catching package design and include standard components of packaging, such as ingredients, instructions for use, and product claims.
   2. Print Advertisement: After examining several examples of print advertisements in newspapers, magazines, phone books, and online, assign students the task of creating a print advertisement for their product, including a tagline, product claims, and persuasive statements.
   3. Commercial: After examining examples of radio and/or television commercials, students will create a commercial for their product. Their script could include components such as a jingle or slogan, product claims, anecdotes, and persuasive claims.

**Wrap-Up/Assessment:**

1. Final group work will be shared with the class in a 2–4 minute presentation.
2. Students’ green glue advertisements will be evaluated based on the attached rubric, or on a similar rubric of your choosing. Students’ presentations must refer to the problems associated with glue (hazardous materials, non-renewable resources used for starting materials, energy-intensive manufacturing process, etc.). The advertisement of their green glue will address how it solves the problems and benefits people and the natural environment.

**Just Glue It!: Sample Rubric**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Category | 4 | 3 | 2 | 1 |
| Eye Contact | Always has eye contact with audience | Most of the time has eye contact with the audience | Sometimes has eye contact with the audience | Does not have eye contact with the audience |
| Enthusiasm/  Clarity | Speaks clearly and is very enthusiastic about the topic during the presentation | Most of the time is enthusiastic about the topic during the presentation | Sometimes is enthusiastic  about the topic during the presentation | Does not appear enthusiastic and audience has difficulty understanding |
| Preparedness and Organization | Very prepared and organized during the presentation | Most of the time prepared and organized during the presentation | Somewhat prepared and organized for the presentation | Does not appear to have prepared for the presentation |
| Content Knowledge (green chemistry criteria, problem, and solution of glue) | Student shows full understanding and includes green chemistry criteria, explains the problems with glue, and fully describes solutions | Knowledge is clear most of the time during the presentation but green chemistry criteria, problems with glue, and solutions are incomplete | Knowledge is sometimes evident during the presentation but green chemistry criteria, problems with glue, and solutions are incomplete | Knowledge is not clear. Student does not include mention of green chemistry criteria, problems with glue, or solutions |
| Time Requirement | Presentation falls within time guidelines (2–4 minutes) | Presentation is within 1 minute above/below time guidelines | Presentation is within 2 minutes above/below time guidelines | Presentation is more than 2 minutes above/below time guidelines |

*Optional Reading:* <http://www.todayifoundout.com/index.php/2011/11/post-it-notes-were-invented-by-accident/>

## **POST-IT NOTES WERE INVENTED BY ACCIDENT**

[November 9, 2011](http://www.todayifoundout.com/index.php/2011/11/post-it-notes-were-invented-by-accident/) [Daven Hiskey](http://www.todayifoundout.com/index.php/author/daven/)



[http://www.todayifoundout.com/index.php/2011/11/post-it-notes-were-invented-by-accident/ - disqus\_thread](http://www.todayifoundout.com/index.php/2011/11/post-it-notes-were-invented-by-accident/#disqus_thread)

[Today I found out](http://www.todayifoundout.com/) Post-It Notes were invented by accident.

There were actually two accidents that lead to the invention of the Post-It note. The first was by Spencer Silver. According to the former Vice President of Technical Operations for 3M Geoff Nicholson (now retired), in 1968, Silver was working at 3M trying to create super strong adhesives for use in the aerospace industry in building planes. Instead of a super strong adhesive, though, he accidentally managed to create an incredibly weak, pressure sensitive adhesive agent called Acrylate Copolymer Microspheres.

This adhesive did not interest 3M management as it was seen as too weak to be useful. It did have two interesting features, though. The first is that, when stuck to a surface, it can be peeled away without leaving any residue. Specifically, the acrylic spheres only stick well to surfaces where they are tangent to the surface, thus allowing weak enough adhesion to be able to be peeled easily. The second big feature is that the adhesive is re-usable, thanks to the fact that the spheres are incredibly strong and resist breaking, dissolving, or melting. Despite these two notable features, no one, not even Silver himself, could think up a good marketable use for it. Thus, even with Silver promoting it for five years straight to various 3M employees, the adhesive was more or less shelved.

Finally, in 1973, when Geoff Nicholson was made products laboratory manager at 3M, Silver approached him immediately with the adhesive and gave him samples to play with. Silver also suggested what he saw as his best idea for what to use the adhesive for, making a bulletin board with the adhesive sprayed on it. One could then stick pieces of paper to the bulletin board without tacks, tape, or the like. The paper could subsequently be easily removed without any residue being left on the sheets. While this was a decent idea, it wasn’t seen as potentially profitable enough as annual bulletin board sales are fairly low.

Now enter the second accident by chemical engineer Art Fry. Besides working at 3M as a Product Development Engineer and being familiar with Silver’s adhesive thanks to attending one of Silver’s seminars on the low-tack adhesive, he also sung in a church choir in St. Paul, Minnesota. One little problem he continually had to deal with was accidentally losing his song page markers in his hymn book while singing, with them falling out of the hymnal. From this, he eventually had the stroke of genius to use some of Silver’s adhesive to help keep the slips of paper in the hymnal. Fry then suggested to Nicholson and Silver that they were using the adhesive backwards. Instead of sticking the adhesive to the bulletin board, they should “put it on a piece of paper and then we can stick it to anything.”

This initially proved easier said than done, in terms of practical application. It was easy enough to get the adhesive on the paper, but the early prototypes had the problem that the adhesive would often detach from the paper and stay on the object the paper was stuck to, or, at least, leave some of the adhesive behind in this way. There was no such problem with the bulletin boards Silver had made because he had specifically made them so that the adhesive would bond better with the board than the paper. Two other 3M employees now entered the scene, Roger Merrill and Henry Courtney. The two were tasked with coming up with a coating that could be put on the paper to make the adhesive stay bonded to it and not be left behind on whatever the paper was stuck to when it was removed, a task at which they were ultimately successful at achieving.

Interestingly, because management at 3M still didn’t think the product would be commercially successful, they more or less shelved it for three years, even though the Post-It notes were extremely popular internally at 3M labs during that span. Finally, in 1977, 3M began running test sale runs of the Post-It note, then called “Press ‘n Peel”, in a certain areas in four different cities to see if people would buy and use the product. It turned out, no one much did, which confirmed in the minds of the executives that it wasn’t a good commercial product.

Luckily for offices the world over, Nicholson and Joe Ramey, Nicholson’s boss, didn’t feel like giving up yet. They felt the marketing department had dropped the ball in that they hadn’t given businesses and people samples of the product to use to let them see for themselves how useful the notes could be. So a year after the initial flop, 3M tried again to introduce the Post-It note to the world, this time giving huge amounts of free sample Post-It note pads away in Boise, Idaho, with the campaign deemed “The Boise Blitz”. This time, the re-order rate went from almost nothing, in the previous attempt, to 90% of the people and businesses that had received the free samples. For reference, this was double the best initial rate 3M had ever seen for any other product they’d introduced. Two years later, the Post-It note was released throughout the United States.

So after 5 years of constant rejection for the adhesive and another seven years in development and initial rejection, Post-It notes were finally a hit and have since become a mainstay in offices the world over, today being one of the top five best selling office supply products in the world.

Extended Reading \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Bonus Facts:

* Ever wonder why the standard color for Post-It notes is yellow? It turns out this was kind of an accident as well. The official story from some at 3M is that it was because it created a “good emotional connection with users” and that it would “contrast well stuck to white paper”. However, according to Geoff Nicholson there was no such thought given to the color. The real reason Post-It notes were yellow was simply because the lab next door to where they were working on the Post-It note “had some scrap yellow paper – that’s why they were yellow; and when we went back and said ‘hey guys, you got any more scrap yellow paper?’ they said ‘you want any more go buy it yourself’, and that’s what we did, and that’s why they were yellow. To me it was another one of those incredible accidents. It was not thought out; nobody said they’d better be yellow rather than white because they would blend in – it was a pure accident.”
* Another obstacle in the initial launch of Post-It notes was that, because it was a completely new type of product, it required the construction of new machinery to mass produce the Post-It note pads, which was initially prohibitively expensive for a product seen by many within 3M as destined for commercial failure.
* While most Post-It notes only have a thin strip of adhesive, you can buy Post-It notes that are completely covered in the back with the adhesive. One example of a place this type of note is used is at the U.S. postal service. These full adhesive backed notes are used there on forwarded mail.
* Post-It notes received an upgrade in 2003 when 3M launched a new version of the Post-It note with super sticky glue that has better adhesion to vertical surfaces.
* Spencer Silver holds a total of 22 patents, including the patent for the “low-tack, reusable, pressure sensitive adhesive” used in Post-It notes (Patent#: 3,691,140). Silver is still working at 3M today in their special adhesives department. He also has a doctorate in organic chemistry, which he received two years before inventing the adhesive used in Post-It notes. On the side, his favorite past time is painting using pastels and oils, which he apparently is extremely accomplished at.
* Post-It notes are occasionally used in art-work. One such famous example was in 2008 when Shay Hovell used 12,000 Post-It notes to create a replica of the Mona Lisa. The most expensive Post-It note art piece was done by R.B. Kitaj and sold for £640 (about $1000) in 2000.
* Art Fry received his early education in a one room schoolhouse. He studied chemistry at the University of Minnesota and was hired while still in school at the “Minnesota Mining and Manufacturing Company”, which later was re-named 3M. He retired from 3M in the early 1990s.

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