

Even Soap is Science: Lesson Guide

Background:

Most people know that keeping themselves and their environment clean is important, but have you ever wondered how soap works? Did you know that scientists carefully develop soap in order for it to work properly? The soap you use today to wash your clothes and clean your hands is the result of many years of research in chemistry. It takes the right mix of ingredients in order to create a product that will work properly. Soap has changed a lot over the years, as scientists have learned new and better ways to clean. Many different soap products are available because those who create them want you to have a choice and to use the ones that you like best.

The American Cleaning Institute has created an activity to showcase the chemistry of cleaning products by introducing students to how soap is made, while creating sand art. The goal is to encourage students to think about how science impacts their daily lives.

Objective:

During this activity, students will be simulating the creation of a liquid hand soap to learn about the chemistry that goes into their design. While this is a pretend activity, students will be able to understand that a soap product is the result of combining particular ingredients in certain amounts to create a product that works in a specific way.

Key Points:

- Soap can be complex.
- Scientists help ensure cleaning products work properly.
- In a cleaning product, different ingredients have different functions. They all work together to deliver results consumers expect.
- Creative scientists are working to improve soap every day and there are great careers in the world of soap and cleaning products.

Materials:

1 per student – Small, clear containers or test tubes (0.5 mL works well) with a lid or cap

6 - Colors of sand

6 - Containers to hold the sand

6 - Small spoons or scoops

6 – Funnels (consider using funnel holders)

Set-up:

Space will be needed for eight (8) separate stations.

We recommend using the print-outs available for [download](#) to label each station.

Students will move in order from Station 1 to Station 8. At each station they will learn about a specific group of ingredients that serve a common purpose. The students will create their own “soap product” by adding colored sand into their container in proportions they think represents the content of a hand soap.

The ingredients for a general liquid hand soap are as follows:

Product: Liquid Hand Soap

Please note, this is an example formulation; actual formulations will vary.

Table 1. Definitions of each functional group as depicted on the downloadable posters:

Chemical Type	Color	Percent	Function
Solvent	Blue	71%	Solvents help to blend the ingredients and give soap the right consistency so it's easy to use.
Surfactant	Orange	20%	Surfactants are the chemicals in soap that remove germs and dirt. These chemicals hold onto the germs and dirt as the water washes them away.
Fragrance	Pink	1%	Fragrances add a pleasant, sweet smell to the soap.
Preservative	Green	1%	Preservatives protect the product by keeping microscopic bugs from growing in it, eating the soap ingredients, and preventing the soap from doing its job.
pH Adjuster	Purple	2%	The pH adjusters raise or lower the pH of a solution making it either more basic or acidic. The pH level affects how well the soap does its job.
Other	Yellow	5%	Other ingredients in a soap may include: Dye—Gives soap a color Thickener—Gives soap the proper consistency to flow out of a bottle Moisturizer—Provides hydration and moisture to the skin Foam Enhancer—Helps create suds or bubbles. Builder/Chelating Agent—Provides extra cleaning power Antimicrobial—Kills germs on your hands or body

Procedure:

Station 1: Introduction

At Station 1, students will take a container and view the directions for the activity.

Directions for students:

- 1) Take a small, clear container
- 2) Visit each station

At each station, add to your bottle the amount of colored sand you think is needed of this ingredient for a liquid hand soap. You will be adding 6 colors of sand, so remember to leave some room as you add sand in the first few stations.

- 3) Check your results

Compare the colored bands in your bottle to the diagram at Station 8.

Station 2: Solvent

Definition: Solvents help to blend the ingredients and give soap the right consistency so it's easy for you to use.

Student Hint: The solvent is needed to dissolve all the other ingredients; you are going to need the greatest amount compared to the other ingredients.

Station 3: Surfactant

Definition:

These are the chemicals in soap that remove germs and dirt. Surfactants attach to germs, dirt, and to water. Surfactants hold onto the germs and dirt as the water washes them away.

Student Hint: Surfactants are the most important element of the soap, but are not used in the greatest amount.

Station 4: Fragrance

Definition: Fragrance is added to cover the odors of ingredients that might not smell so great, or add a pleasant scent.

Student Hint: Fragrances are optional in soap, some have them and some do not. And they are very powerful, a little can go a long way.

Station 5: Preservative

Definition: Preservatives are added to keep microscopic bugs from growing and eating the soap ingredients.

Student Hint: Preservatives help the soap remain effective while it sits on your counter – but you will barely be able to see this color in the final product.

Station 6: pH Adjuster

Definition: The pH adjusters raise or lower the pH of a solution making it either more acidic or more basic. The pH level affects how well the soap does its job.

Student Hint: Twice as much as preservative – but twice as much of a very little is still a very little!

Station 7: Other

Dye – Gives the soap a bit of color

Thickener –Keeps the soap from running off your hands.

Moisturizer –Softens your skin.

Foam Enhancer – Helps create suds while you lather

Builder/Chelating Agent – Provides the surfactant with extra cleaning power

Antimicrobial - Antimicrobial ingredients kill microorganisms on your skin or body, including the ones that make you sick.

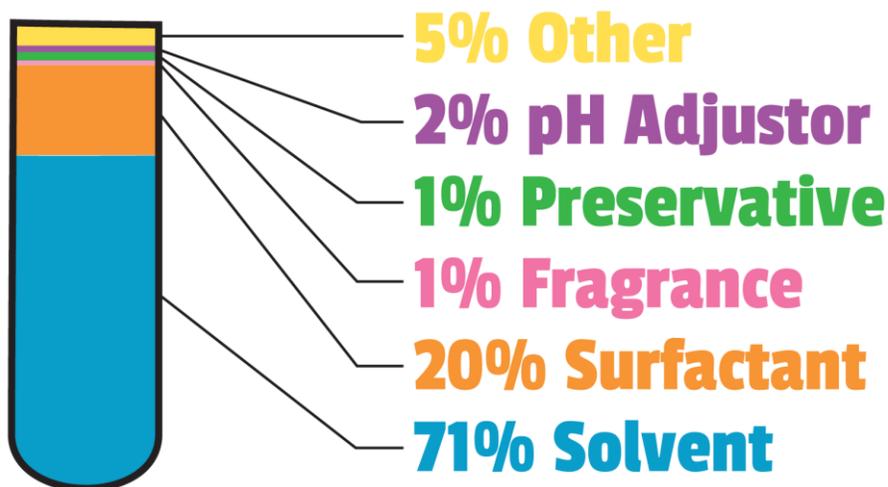
Station 8: Check Results

The final station will include a chart depicting the “preferred” formulation or mixture to prepare a liquid hand soap. The student should compare the size of each layer to the pictures provided.

Preferred Formulation for a typical Liquid Hand Soap:

Note: When you create a soap product, how this products works will depend on what ingredients and how much of each ingredient you use. There can be many different ways to make a liquid hand soap or any cleaning product.

CHECK YOUR RESULTS



WHAT DID YOU MAKE?

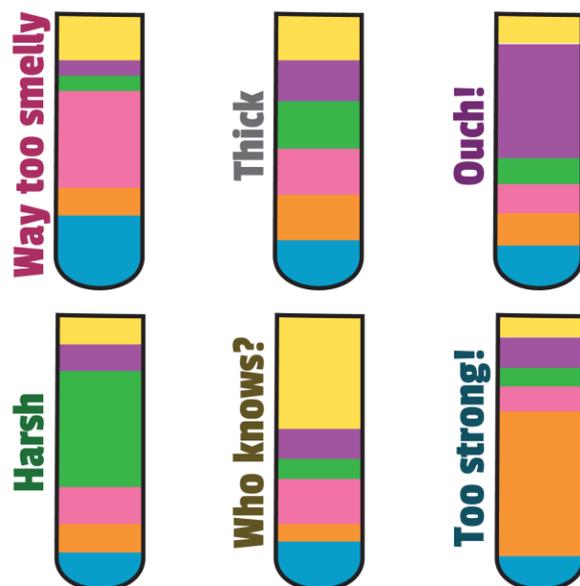


Table 2. Possible experiment outcomes:

Outcome	Look	Result	Description
Way Too Smelly	Mostly Pink	Too much fragrance	Phew, sometimes a lot of a good smell is too much for some people! What you made is closer to an air freshener or perfume.
Thick	Even Bands	Not enough solvent	You may not be able to pump it out of the container as it is more like a bar of (solid) soap. It also has too much fragrance, pH adjuster, and preservative, which means it may be smelly and harsh on the skin.
Ouch!	Mostly Purple	Too much pH adjuster	When the pH of the soap is wrong, the product can be very acidic or basic, which would not be good for your hands. It may sting your skin.
Harsh	Mostly Green	Too much preservative	Preservatives will keep the soap free of bacteria as it gets older. Too much germ killing could harm the good bacteria that live on your skin. The product may also last a lot longer than typically needed.
Who Knows?	Mostly Yellow	Not enough surfactant	The “other” ingredients provide the soap with additional benefits (color, moisturizing, killing germs, or creating bubbles (suds)), but they need to be balanced with enough cleaning power and solvent to be useful.
Too Strong!	Mostly Orange	Too much surfactant	This is too powerful (highly concentrated). This much surfactant will take the good stuff off your skin, like oils that keep your skin soft, leaving your skin dry and irritated.

Resources:

[Even Soap is Science Student Worksheet](#)

[Station Information Printouts](#)

[Science of Soap Video](#)

[Soaps and Detergents Book](#)



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