PHARMACY Is Right For Me

STEM Activities List

Engage budding scientists and future pharmacists with this comprehensive list of STEM activities designed to introduce them to the fascinating world of pharmacy. From basic concepts to advanced experiments, these activities cater to various age ranges, time commitments, and material availability. Each activity is accompanied by pharmacy-related talking points, detailed instructions, and a complete list of required materials.

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Make Lip Balm

Audience Size: 5 - 30
Age: Grade 7 +
Time: 20 minutes +
Type: Demo or Interactive

Did you know that making your own lip balm is fairly simple with just a few ingredients? This guide will walk you through the entire process of making your very own lip balm in less than 10 steps. This activity is a great opportunity to talk about chemical processes used often by pharmacists such as compounding.

This activity requires the use of a hot plate. It's recommended adults always be present. Also, some essential oil flavors, such as peppermint oil, can be a skin irritant for some.

You will need:

Ingredient	Quantity: 2	Quantity: 10	Quantity: 20
Anhydrous Base	4 grams	20 grams	40 grams
Beeswax	2 grams	10 grams	20 grams
Lanolin Oil	1.2mL	6mL	12mL
Almond Oil	3.4mL	17mL	34mL
Aloe Vera Powder	0.05 grams	0.5 grams	1.0 grams
Flavored Oil	A few drops	10 drops	20 drops

- Lip Balm Tubes
- Hot plate
- Beakers
- Graduated Cylinder
- Scale
- Stirring Rod
- Spatula

All of the ingredients are USP grade and 100% pure. They are easily found on Amazon or Bulk Apothecary! This recipe makes around 20 tubes of lip balm.

Make Lip Balm

Instructions:

1	Place beaker containing anhydrous base and beeswax onto a hot plate. Melt the base on a hot plate (using setting 3). Be careful not to touch the hot plate.
2	While the base and beeswax are melting add the lanolin and almond oils.
3	Add a spin bar to the beaker and set the stirring speed on low to help disperse the beeswax pellets in the oil mixture. Continue stirring on low until the base and beeswax are fully melted.
4	Using sifter and rubber spatula, carefully sift the aloe vera into the beaker and stir until evenly smooth.
5	Add flavor and mix well.
6	Carefully remove the beaker from the hot plate, remove the spin bar, and allow the mixture to cool on the counter for a few minutes.
7	Turn the bottom dial of the lap balm applicator 2 full turns.
8	Pour melted lip balm into the tubes until full. Allow to cool at room temperature.

Pharmacy Connection Talking Points:

Highlight how a compounding pharmacist can customize medications to meet a patient's needs such as adjusting strength or dosage, flavoring medication, taking out unwanted ingredients, or changing the form of the medication.

Make the connection between flavoring a medication and the flavored oils that will be used in this activity. Ask participants what their favorite flavor lip balm is. Then make the point that, for example, a medication may need to be flavored to help a child take it.

Although the lip balms being compounded during this activity are not medicated, pharmacists have the ability to add medication to it. Lip balms can contain camphor, phenol or menthol to help relieve pain of severely chapped lips.

Build a Functioning Heart Model

Audience Size: 5 - 30
Age: Elementary +
Time: 60 minutes +
Type: Demonstration or Interactive

In this activity, participants build a functioning heart model out of items found around the house. It is a great lesson to talk about the heart, heart health and the role of cardiology pharmacists.

This activity involves food coloring, which may stain clothing. It also requires the use of a drill, which should be handled by an adult.

You will need:

- 3 Empty bottles with caps
- 4 Bendy straws
- Tape
- Drill
- Red food coloring
- 3 cups of water
- Clay

Remove the labels from the bottles so that participants can see the contents easily.

Instructions:

1	The first bottle represents the atrium, the second the ventricle and the third the lungs. Drill one straw-sized and one smaller hole in the cap of the first bottle. For the second, drill two straw-sized holes that are the same size. Leave the third bottle without a cap.
2	Mix water and red food coloring in a pitcher to create the "blood". Fill the first two bottles with the "blood" to 80% capacity. Leave the third empty.
3	Bend and connect the straws using tape, then place them through the bottle caps. Seal around the straws with clay.
4	Squeeze the middle bottle to move the "blood" through the model.
5	Use your fingers to pinch the straws between the atrium (1st bottle) and ventricle (2nd) bottle), and control the one-way flow.
6	Add more "blood" to the atrium when it gets low.

Build a Functioning Heart Model

Pharmacy Connection Talking Points:

- Cardiology pharmacists focus on the heart and are part of a team that includes doctors and nurses. They work together to help patients with heart problems.
- Cardiology pharmacists can work in different places, like emergency rooms, intensive care units, and clinics that focus on heart problems.
- Cardiology pharmacists take care of patients with heart transplants, high blood pressure, uneven heart beats, hearts that don't pump well, and prevent blood clots.
- Pharmacists need to know about blood flow through the heart because it helps them understand how certain medications can affect the heart and blood vessels

Build Candy DNA

Audience Size: 5 - 30
Age: Elementary +
Time: 60 minutes +
Type: Interactive

There are several ways you can make a DNA model project for kids of all ages. Learn about the structure of DNA, and find out how to make your own candy DNA model. This is fun candy science you can eat too!

Some candy may be allergens for some children. It is recommended to check for food allergies before starting this activity.

You will need:

- Twizzlers
- Toothpicks
- Soft candy
- 4 cups

Choose a soft candy that comes in 4 colors but is all the same type of candy to represent the A, T, C, G nucleotides.

Instructions:

1	Sort the soft candy by color into separate cups.
2	Assign each color of the soft candy a nucleotide - Adenine, Thymine, Cytosine and Guanine.
3	Place 2 nucleotides of the same color onto a toothpick and stick it between two Twizzlers. Repeat this process.
4	Twist Twizzlers into a double helix.

Build Candy DNA

Pharmacy Connection Talking Points:

A pharmacogenomics pharmacist studies how genes affect a person's response to medications. They use this knowledge to help doctors and patients choose the right medications based on a person's genetic makeup.

By analyzing a patient's genes, the pharmacogenomics pharmacist can predict how the body might react to certain drugs, and recommend personalized treatments that are more effective and safer.

By analyzing DNA, pharmacists can identify genetic markers that influence drug metabolism, efficacy, and potential adverse reactions. This enables them to make informed decisions regarding drug selection, dosing, and helps prevent medication-related complications.

DNA testing also plays a crucial role in identifying genetic predispositions to certain diseases, allowing pharmacists to implement preventive measures and provide appropriate counseling on lifestyle modifications and medication adherence.

Drug Emulsion

Audience Size: 10 - 30
Age: Elementary +
Time: 30 minutes +
Type: Interactive

Students mix polar and nonpolar substances, adding emulsifiers to promote mixing, using salad dressing ingredients to connect science to real life. They test common household items to find the best emulsifier for salad dressing.

Honey is a potential allergen. Dry mustard and vinegar can cause respiratory irritation. Oil may stain clothes. Please wash hands after handling.

You will need:

- Vegetable or Olive Oil - 8mL
- Vinegar - 8mL
- At least 3 of the following: Honey, dry mustard, garlic paste, tomato paste; - 2 grams
- Stopwatch
- 2 10-mL graduated cylinder
- Scoop
- Scale with weighing trays
- 4 20-mL test tubes
- Test tube rack

Students can repeat the procedure with different herbs, spices, oils, or vinegars, or explore how temperature affects separation time.

Instructions:

1	Prepare four clean 20-mL test tubes in a rack. Label three with the emulsifiers being tested and one as "control."
2	Weigh 2 g of each emulsifier and add them to the corresponding test tubes, leaving the control empty. Label the data sheet with the emulsifiers being tested.
3	Add 8 mL of vinegar to each test tube and swirl to mix.
4	Add 8 mL of oil to each test tube and observe the oil and vinegar layers.
5	Shake the control test tube for 30 seconds, then place it in the rack. Time and record how long it takes for the oil and vinegar to separate.
6	Repeat step 5 for each emulsifier test tube, avoiding cross-contamination. Record separation times or note "> 5 mins" if no separation occurs within 5 minutes.
7	Recheck test tubes later for delayed separation and update your observations in the data table.

Drug Emulsion

Data Table

Emulsifier	Separation Time (min:sec)	Observations
Control (no emulsifier)		

Pharmacy Connection Talking Points:

Drug emulsion refers to a formulation in which one or more drugs are dispersed in a liquid medium, resulting in a stable mixture. Emulsions are commonly used in pharmaceuticals to enhance drug solubility, improve absorption, and provide controlled release. Pharmacists play a vital role in the development, preparation, and dispensing of drug emulsions.

Explain pharmacists' understanding of drug properties: Polar molecules are hydrophilic. Hydrophilic molecules have a tendency to dissolve in water. Polar molecules are generally attracted to polar molecules. Nonpolar molecules are hydrophobic. Hydrophobic means a tendency to be repelled by water. Nonpolar molecules are attracted to other nonpolar molecules.

Some medications are nonpolar but our body is roughly 50-65% water. This means that in order for the drug to be effective, it must be able to be dissolved in an aqueous environment. How can we accomplish this? By adding a surfactant/emulsifier. Emulsifiers help bring together polar and nonpolar molecules. Soap is a surfactant!

Demonstrate drug emulsion and understand polarity: Vinegar contains water making it a more polar compound. Oil is a nonpolar substance. Shake the test tube for 30 seconds. No matter what, the polar and nonpolar substances will eventually separate.

How Pills Dissolve in the Body

Audience Size: 5 - 30
Age: Grade 9 +
Time: 30 minutes +
Type: Demonstration

In a class demonstration, the teacher places different pill types into separate glass beakers of vinegar, representing human stomach acid. After 20-30 minutes, the pills dissolve. Students observe which dissolve the fastest, and discuss the remnants of the various pills.

Ingredients may stain clothing.

You will need:

- 2 cups of Vinegar
- Time-release capsule
- Chalk tablet
- Gel capsule
- Solid capsule
- 3 Glass beakers

Instructions:

1	Arrange materials on a table visible to the class.
2	Pour about ¼ cup of vinegar (or half-fill) into each beaker.
3	Drop one pill into each beaker and note the start time.
4	After a few minutes, examine the vinegar for color changes and observe the pills for dissolution or physical changes.
5	Consider a pill fully dissolved when the vinegar is clear, excluding any outer coverings.
6	Facilitate a class discussion to review observations and answer discussion questions.

Discussion Questions

1. What changes did you observe in the vinegar and the pills over time?
2. How do different types of pills dissolve in vinegar?
3. What factors might influence how quickly a pill dissolves?
4. Which form of medicine do you think works fastest, and why?
5. How could you modify the pill or the environment to speed up dissolution?

How Pills Dissolve in the Body

Pharmacy Connection Talking Points:

Pharmacology serves as the gateway to understanding how drugs and chemicals interact with the human body, offering insights into the science of healing and disease management.

Pharmacology plays a pivotal role in developing new medications by examining how drugs are absorbed, distributed, metabolized, and eliminated within the body.

Pharmacology takes into account individual variability in drug responses due to genetics, age, gender, and other factors, contributing to personalized medicine approaches.

Pharmacology uncovers the underlying biochemical and physiological mechanisms through which drugs exert their effects, aiding in the understanding of diseases.

Extract DNA from a Strawberry

Audience Size: 5 - 30
Age: Elementary +
Time: 30 minutes +
Type: Interactive

Cells are the basic unit of life. DNA contains instructions that direct the activities of cells and ultimately, the body. This activity will demonstrate how DNA can be isolated from a strawberry using common household items

Strawberries are a potential allergen and may stain clothing.

You will need:

- A resealable plastic bag
- 2 strawberries (fresh or frozen, remove the green leaves)
- 2 teaspoon dish detergent
- 1 teaspoon salt
- ½ cup water
- 2 plastic cups
- 1 coffee filter
- ½ cup cold rubbing alcohol
- 1 coffee stirrer

Instructions:

1	Place strawberries in a sealed plastic bag and mash them thoroughly for about 2 minutes until fully smashed.
2	In a plastic cup, mix: ◦ 2 teaspoons dish detergent ◦ 1 teaspoon salt ◦ ½ cup water ◦ Stir gently until the salt dissolves
3	Pour the mixture into the bag of smashed strawberries. Reseal the bag and gently massage the mixture for 1 minute, making sure not to make too many soap bubbles.
4	Put a coffee filter over another cup. Carefully pour the strawberry mix into the filter. Let the liquid drip into the cup, leaving the strawberry bits behind.
5	Pour cold rubbing alcohol into the cup with the liquid. Add about the same amount as the liquid you have.
6	Gently swirl the cup in circles. Look for the whitish, gooey stuff forming at the top. That's the strawberry's DNA!
7	Use a coffee stirrer or a toothpick to lift the strawberry DNA out of the cup.

Extract DNA from a Strawberry

Pharmacy Connection Talking Points:

A pharmacogenomics pharmacist is a healthcare professional who studies how genes affect a person's response to medications. They use this knowledge to help doctors and patients choose the right medications based on a person's genetic makeup.

By analyzing a patient's genes, the pharmacogenomics pharmacist can predict how their body might react to certain drugs, and recommend personalized treatments that are more effective and safer. Their goal is to improve patient care by tailoring medications to individual genetic characteristics.

By analyzing DNA, pharmacists can identify genetic markers that influence drug metabolism, efficacy, and potential adverse reactions. This knowledge enables them to make informed decisions regarding drug selection, dosing adjustments, and the prevention of medication-related complications.

DNA analysis empowers pharmacists to deliver personalized and precise pharmaceutical care, leading to improved patient outcomes and a more targeted approach to medication management.

Protect that Pill

Audience Size: 5 - 30
Age: Grade 7+
Time: 1 hour +
Type: Interactive

Students reinforce their knowledge of the different parts of the digestive system and explore the concept of simulation by developing a pill coating that can withstand the churning actions and acidic environment found in the stomach. Teams test the coating durability by using a clear soda to simulate stomach acid.

The activity materials have the potential to be extremely messy, so emphasize cleanliness and keep cleaning materials nearby.

You will need:

- ¼ cup of flour
- 1/8 cup of cornstarch
- ¼ cup of sugar
- 1/8 cup of vegetable oil
- 1 paper plate
- 4 small paper or plastic bowls or cups
- 1 clear plastic cup
- 1 cup clear diet soda
- 1 small plastic spoon
- 2 pieces of color-coated candy per group- Skittles work well!

Instructions:

1	Begin by discussing the ingredients. Talk about how oil, flour, cornstarch, and sugar contribute to the coating's properties. • Oil: Helps dry ingredients stick together, reduces stickiness, and makes the coating less soluble. • Flour/Cornstarch: Thickens the mixture and improves its workability. • Sugar: Adds thickness, creates a grainy texture, and reduces solubility when used in the right amount.
2	Student teams decide their ingredient amounts and document their recipes.
3	Teams mix ingredients on paper plates, adjusting as needed and updating recipes.
4	Each team coats a candy, aiming for a thin, smooth layer.
5	Each team places their coated candy in a cup of soda, with one uncoated candy as a control.
6	Let candies sit for 10 minutes, stirring if necessary. Discuss how this simulates the stomach environment and why testing this way is safer than on humans.

Protect That Pill

7	After 10 minutes, observe which coatings protected the candy best. Compare recipes and discuss what worked and why.
8	Calculate ingredient proportions and discuss how they relate to performance.
9	Each team creates a new recipe based on observations and tests it again.

Pharmacy Connection Talking Points:

It is important for a pharmacist to have knowledge about the different parts of the digestive system and medication coatings because it helps them understand how medications interact with and are absorbed by the body. Medication coatings are special coverings that are applied to medications. These coatings serve different purposes and can affect how the medication works in the body.

Protective Coatings: Some medications have coatings that protect them from being damaged by stomach acid or other substances in the digestive system. These coatings ensure that the medication remains intact until it reaches the part of the body where it is supposed to have an effect.

Delayed-Release Coatings: Certain medications have coatings that control when and where the medication is released in the body. These coatings are designed to withstand the acidic environment of the stomach and dissolve in the intestines.

Extended-Release Coatings: Some medications have coatings that allow for a slow and gradual release of the active ingredient over an extended period. This helps maintain a steady level of medication in the body and may be used for medications that need to be taken less frequently.

Taste-Masking Coatings: Certain medications, especially those for children, may have coatings to make them taste better or mask their unpleasant taste. This can make it easier for patients, especially young ones, to take their medication.

By understanding the different parts of the digestive system and how medication coatings work, pharmacists can ensure that medications are prescribed and dispensed appropriately, taking into account factors such as absorption, drug interactions, and individual needs.

Make Hand Sanitizer

Audience Size: 5 - 30
Age: Grade 9+
Time: 30 minutes +
Type: Interactive

When it comes to preventing the spread of infectious diseases like COVID-19, nothing beats good old-fashioned handwashing. But if water and soap aren't available, your next best option, is to use an alcohol-based hand sanitizer that contains at least 60% alcohol. All it takes is three ingredients to make your own!

Don't use homemade hand sanitizers on children's skin as they may be more prone to use them improperly, leading to a greater risk of injury.

You will need:

- 2 parts Isopropyl alcohol or ethanol (91–99% alcohol
- 1 part Aloe Vera Gel
- A few drops of essential oils such as clove, eucalyptus, or peppermint
- Spoon
- Whisk
- Container

Instructions:

1	Make the hand sanitizer in a clean space. Wipe down countertops with a diluted bleach solution beforehand.
2	Wash your hands thoroughly before making the hand sanitizer.
3	To mix, use a clean spoon and whisk. Wash these items thoroughly before using them.
4	Make sure the alcohol used for the hand sanitizer is not diluted.
5	Mix all the ingredients thoroughly until they're well blended.
6	Don't touch the mixture with your hands until it's ready for use.

Make Hand Sanitizer

Pharmacy Connection Talking Points:

Pharmacists play a vital and multifaceted role in public health, serving as crucial healthcare providers at the intersection of medicine and community well-being. Beyond dispensing medications, they contribute significantly to disease prevention, health education, and patient care.

Hand sanitizer plays a crucial role in maintaining personal and public health by providing a convenient and effective way to disinfect hands. In a world where we constantly interact with surfaces and objects that can harbor harmful pathogens, hand hygiene has gained paramount significance.

Hand sanitizers offer a rapid and accessible means of killing or inactivating a wide range of microorganisms, including bacteria and viruses. Hospital pharmacies are well equipped to compound hand sanitizer to prevent the spread of disease in health care settings (Hansen & Boiallis, 2020).

The main active ingredient in hand sanitizer is alcohol. “Its antimicrobial activity results from alcohol’s ability to denature proteins. Solutions must contain at least a final concentration of 60% alcohol to be effective. Higher concentrations are less effective, as proteins are not denatured easily in the absence of water.” (Hansen & Boiallis, 2020).

How to Read a Prescription Drug Label

Audience Size: **1** - 30
Age: Grade 9+
Time: 30 minutes +
Type: Interactive

Each time you receive a prescription, it's crucial to read and adhere to the details provided in the medication's "label." This step is essential to guarantee your well-being. Acquaint yourself with the various components of your prescription drug labels through this illustrative example.

You will need:

- Sample Prescription Drug Label Worksheet

Instructions:

1	Discuss the importance of responsible medicine use.
2	Explain survey findings from the Partnership for Drug-Free Kids, which show that one in four teens has misused or abused a prescription drug at least once in their lifetime.
3	Explain the various components of the prescription label.
4	Have students look at the sample and fill out the worksheet

Pharmacy Connection Talking Points:

Reading a prescription label is key to taking medication correctly and avoiding issues with other drugs, foods, or drinks. Pharmacists ensure the label is accurate and help patients understand it for safe use.

Pharmacists label medication before giving it to the patient. A prescription label displays important information including the patient's name, the pharmacy's information, the prescription number, medication name, instructions for use, potential side effects, any warnings or precautions, and refill information.

Pharmacists review prescriptions, check for allergies and interactions, ensure safety, dispense medication, and explain its use to patients.

Pokémon or Drug

Audience Size: 1 - 30
Age: Grade 6+
Time: 30 minutes +
Type: Interactive

Participants guess if they think the name on the screen is a Pokémon or drug name. Correct answers are displayed after a response is selected.

You will need:

- Drug or Pokémon Quiz

Instructions:

1	There are lots of different ways to conduct this quiz.
2	The audience can be split into teams or play individually.
3	It is up to the presenter and depends on the size of the audience that determines the best format.

Pharmacy Connection Talking Points:

Pharmacists rely on the accurate identification and understanding of drug names to ensure the safe and effective use of medications. The precise spelling and pronunciation of drug names are crucial to prevent errors in dispensing, counseling patients, and communicating with other healthcare professionals.

Medications generally have two names - a brand name and a generic name. For example you may blow your nose with a Kleenex - brand name- or a tissue - generic name-. A similar naming system applies to medications.

New medications are frequently developed which means pharmacists are continually learning new names and continually learning about new medications.

It would be impossible to know everything about every medication so pharmacists frequently use their resources to look up information.

Sources

Make Lip Balm

American Pharmacist Association. (n.d.). Frequently Asked Questions About Pharmaceutical Compounding. Compounding Faqs. Retrieved March 10, 2023, from https://www.pharmacist.com/Practice/Patient-Care-Services/Compounding/Compounding-FAQs#:~:text=The%20U.S.%20Pharmacopeia%20Convention%20(USP,based%20on%20the%20practitioner%2Fpatient%2F

Garza, A. (Ed.). (n.d.). Prescription compounding - CDS #10 pharmacy: Bowling Green Pharmacy. CDS #10 Pharmacy. Retrieved March 10, 2023, from https://www.cds10.com/prescription-compounding

Additional Contributor: Kristen Ahlschwede, PhD, Rosalind Franklin University of Medicine and Science

Build a Functioning Heart Model

Brewer, S. (2023, February 9). Build a functioning heart model - genius heart STEM activity & printable. STEAM Powered Family. https://www.steampoweredfamily.com/heart-model-heart-stem/

Additional Contributor: Lisa Richter, PharmD, BCPS, BCCCP. North Dakota State University School of Pharmacy

Build Candy DNA

McClelland, S. (2023, April 22). Candy DNA model for Edible science. Little Bins for Little Hands. https://littlebinsforlittlehands.com/candy-dna-model-edible-science-activitiy/

Sources

Drug Emulsion

American Chemical Society. (2021, July 21). Classroom resources: Salad dressing science: Emulsions. AACT.

Additional Contributor: Kristen Ahlschwede, PhD, Rosalind Franklin University of Medicine and Science

How Pills Dissolve in the Body

The University of Queensland. (2020, August 10). Strawberry DNA extraction activity. Institute for Molecular Bioscience - University of Queensland. https://imb.uq.edu.au/strawberry-dna-extraction-activity

Additional Contributor: Lisa Richter, PharmD, BCPS, BCCCP, North Dakota State University School of Pharmacy

Sources

Protect That Pill

Crosby, J., Curtis, T., Zarske, M., & Carlson, D. (2023, March 1). Protect That Pill. TeachEngineering.org. https://www.teachengineering.org/activities/view/cub_biomed_lesson05_activity1

Additional Contributor: Jeanne Frenzel, PharmD, PhD, BCSCP, North Dakota State University School of Pharmacy

Extracting DNA From a Strawberry

The University of Queensland. (2020, August 10). Strawberry DNA extraction activity. Institute for Molecular Bioscience - University of Queensland. https://imb.uq.edu.au/strawberry-dna-extraction-activity

Additional Contributor: Lisa Richter, PharmD, BCPS, BCCCP, North Dakota State University School of Pharmacy

Making Hand Sanitizer

Hansen, K., & Boiallis, C. (2020, April). Step-by-Step Instructions for Compounding Hand Sanitizer During COVID-19. Pharmacy Purchasing & Products. https://www.pppmag.com/article/2568

Lindberg, S. (2022, August 8). How to make your own hand sanitizer. Healthline. https://www.healthline.com/health/how-to-make-hand-sanitizer

How to Read a Prescription Drug Label

Manitoba. (n.d.). Manitoba education and early childhood learning. Physical Education/Health Education | Manitoba Education and Early Childhood Learning. https://www.edu.gov.mb.ca/k12/cur/physhlth/supporting/gr11_e.html

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