STEM Education on the Go!

Quick and simple STEM activities for 4-H Clubs and afterschool groups

It's a Gas

Materials:

Balloons (12 inch)
Small funnel or a small piece of paper rolled up in a funnel shape
Baking soda
Vinegar
Small bottle (12 or 20 Oz. soda bottle)

Directions:

1. Using the funnel, add 3 teaspoons of baking soda to each balloon.
2. Fill each soda bottle 1/3 full with vinegar.
3. Without dropping in the baking soda, fit the balloon top over the bottle opening.
4. Hold up the balloon and let the baking soda fall into the vinegar.
5. Watch as the baking soda mixes with the vinegar to make carbon dioxide gas and blow up the balloon.

Follow-up:

The vinegar mixes with the baking soda to create a chemical reaction that produces carbon dioxide gas. The gas then blows up the balloon.

Picture for step 3

Electric Gelatin

Materials

Balloon
Unflavored gelatin powder
Paper plate
Wool cloth or sweater

Introduction:

Ask students what they know about static electricity

Directions:

1. Provide each student with a small plate with some gelatin powder and a small balloon.
2. Have the youth blow up the balloon (you can also do this ahead of time).
3. Have the youth rub the balloon on a woolen cloth, sweater or their hair.
4. The youth will hold the "charged-up" balloon above the plate with the gelatin (not touching the gelatin).
5. Have the youth raise and lower the balloon and watch the gelatin powder.

Follow-up:

Have a class discussion on what the students saw and why they think it happened.
Explain that the balloon was charged after rubbing it with the wool; it had static electricity.
The balloon then attracted the gelatin.
What other examples of static electricity?
Brain-pop video!: http://www.brainpop.com/science/energy/staticelectricity/
Source: http://pbskids.org/zoom/activities/sci/electricgelatin.html

Invisible Ink

Materials:

Baking Soda
Blank white paper
Water
Paintbrush or cotton swab
Measuring cup
Purple grape juice concentrate

Introduction:

Our vision is often described as a **molecular switch**. The word switch probably makes you think of a light switch. In our eyes, the switch is much smaller than a light switch; however, there is a reaction in our eyes that works as a switch to turn "on" and "off" our vision. To begin this explanation, we will talk about the source of this switch, a molecule called **retinal** which is in all of our eyes. The retinal molecule responds to light. As the light hits our eyes, retinal "switches on" our vision. When we close our eyes or are in a very dark room with no light at all, we are no longer able to see. However, the objects in the room are still there even though we cannot see them. We will simulate this by using invisible ink.

Making the invisible ink:

1. Mix equal parts water and baking soda.
2. Use a cotton swab, toothpick, or paintbrush to write a message onto white paper, using the baking soda solution as 'ink'.
3. Allow the ink to dry. This will take about 10 minutes.
4. Use a different paint brush or cotton swab to paint over the paper with purple grape juice. The message will appear in a different color.

Follow-up:

Baking soda and grape juice react with each other in an acid-base reaction, producing a color change in the paper. The baking soda is a base or is said to have a basic pH and the grape juice is an acid.

Milk Fireworks

Do:

1. Have campers make hypothesis in Journals of what they think will happen
2. Split campers into groups of 2-4. Each group needs an aluminum pie plate, a plate with cotton swabs, a plate with dish soap (1 Tablespoon is plenty) and an empty plate.
3. Have them pour enough milk in their pie plate to just cover the bottom of the tin
4. Near the outside of the plate, place a drop of each color of food coloring into the milk. Colors should be spread out a bit on the outside of the plate. Also place a drop of food coloring (Any color) in the middle of the plate.
5. Using a clean cotton swab touch the tip of the cotton swab into the center of any drop of food coloring then draw the cotton swab to the center. Do with all 4 outside drops of food coloring. It's important not to stir the mix just touch it with the tip of the cotton swab. Record what happens in their journal (the color follows the swab).
6. Now dip the cotton swab into the dish soap, and again place in the center of the drop of food coloring. Repeat a few more times with a new cotton swab. Place dirty swabs on the empty plate at their station.
7. After each group has done 3 swabs total have a discussion of what they saw. (Color explodes like a firework)

Reflect:

- (Journal) What happened when a clean cotton swab was placed in the food coloring?
- What happened when you added dish soap?
- Why do you think this happened?

Apply:

- Milk is mostly water but it also contains vitamins, minerals, proteins, and tiny droplets of fat. Fats and proteins are sensitive to changes in the milk.
- When you add soap, the weak chemical bonds that hold the proteins in solution are changed. The molecules of protein and fat bend, roll, twist, and move in all directions. The food color molecules are bumped and shoved everywhere, providing an easy way to observe all the invisible activity.

Adapted from: Utah State University Cooperative Extension
Aggie Adventures for Kids, Magicians Laboratory (June 2010)

TIME: 30 minutes

GRADE LEVEL: 2 & up

OBJECTIVE:
Campers will explore how molecules change in milk

MATERIALS:

- Milk (Whole or 2%)
- Aluminum Pie Plate
- Food Coloring
- Dish Soap (Dawn works best)
- Cotton swabs
- Paper Plates

Notes:

Adapted from Dusek, Heidi. Magic of Hogwarts. Outagamie County, 2010.

DANCING RAISINS (optional if time)

Do:

1. Have campers make hypothesis in Journals of what they think will happen
2. Pour the club soda into a glass about ¾ full
3. Drop half a raisin into the club soda and wait 20-30 seconds (the raisin should rise and fall)
4. Repeat with a whole raisin

Reflect:

- What happened to the raisin?

Apply:

- The reason why the raisin floats to the top is because the bubbles stick to the sides of the raisin and make the raisin more buoyant.
- Buoyant means that something floats more easily. The bubbles make the raisin float the way a life jacket makes a person float.

Adapted from: Utah State University Cooperative Extension
Aggie Adventures for Kids, Magicians Laboratory (June 2010)

TIME: 10 minutes

GRADE LEVEL: 2 & up

OBJECTIVE:
Campers discover how to make things float

MATERIALS:

- Tall clear glass
- Raisins
- Club Soda (with lots of bubbles, won't work if it's flat)

Notes:

Adapted from Dusek, Heidi. Magic of Hogwarts. Outagamie County, 2010.

DIG ART!
CULTIVATING CREATIVITY IN THE GARDEN

Printmaking: Chlorophyll Prints

Overview Students will extract chlorophyll from a plant part and create a beautiful chlorophyll print.

Objectives Students will:
- engage in the science concepts behind photosynthesis and chlorophyll
- extract the chlorophyll from a plant and create a print with it

Time 1-1.5 hours

Materials
- green leaves (vegetables like kale and spinach, herbs like basil and mint, green leaves from trees and shrubs)
- pieces of white fabric or watercolor paper
- metal spoons
- masking tape

Instructions

1. Review concepts of photosynthesis and chlorophyll with your students. Light is a form of energy. Plants need energy to develop and grow. Humans and animals get their energy from plants. Plants get their energy from the sun, which works to combine water and carbon dioxide to produce sugar. Plants contain chlorophyll, a green pigment that traps the sun's energy. Plants use the sun's energy to combine water and carbon dioxide together to make sugar. Every green part of a plant has chlorophyll and makes sugar.

2. Fold a piece of paper or fabric in half and open it up again. Place a leaf face down on half of the paper/fabric, and fold the other half over it. Tape the paper/fabric to the table so that it stays in one place.

3. Use the bottom of a spoon to press firmly and rub it across the paper/fabric.

4. Rub the spoon over the entire leaf area so that all of the leaf's chlorophyll will be transferred to paper or fabric. The chlorophyll print will be more prominent on the paper because it is thinner and will absorb the chlorophyll more easily than fabric.

5. Repeat this process as many times as you like, trying different leaves and paper or fabric materials.

Taking it Further

Bind the finished prints together in a garden journal or class book, laminate and frame, or hang them as special flags around the classroom.

Resources

How to Paint with Chlorophyll from Leaves:
http://www.ehow.com/how_4535975_paint-chlorophyll-from-leaves.html

Vietnamese artist Binh Danh has developed a process for printing photographs on leaves through using the natural process of photosynthesis. Check out his chlorophyll leaf prints here:
http://neaat.wordpress.com/category/photographer-binh-danh/

Taken from Dig Art! Cornell University: http://blogs.cornell.edu/garden/get-activities/signature-projects/dig-art/activities/

Don’t Blow it!

Materials:

Balloons

20 oz. soda bottle or water bottle

Nail

Directions:

1. Slip the balloon inside the neck of the bottle and stretch the mouth of the balloon over the bottle top.
2. Take a deep breath and try to blow up the balloon inside the bottle. Good luck!
3. Ask an adult to punch a small hole with a nail in the side of the bottle, close to the base.
4. Remove the nail.
5. Again, try to blow up the balloon. Quite a difference! Blow hard until the balloon fills most of the bottle.
6. Place a finger (or thumb) over the nail hole when you stop blowing. Now, move your finger.

Follow-up:

The balloon won't inflate much the first time because the bottle is already filled with air. There's no room for the balloon to expand inside the bottle. However, when you punch a hole in the bottle, the air molecules in the bottle have an exit. They're pushed out as the balloon fills the space inside. As long as you plug the hole, the balloon stays inflated. When you take your thumb off the hole, outside air flows back into the bottle as the balloon collapses. Because of the elasticity of the rubber or latex, the balloon shrinks to its original size as the air rushes out the top of the bottle.

Suppose your thumb gets tired while the balloon is inflated. Put a cap tightly on the bottle and remove your thumb. For the air to flow, both holes have to be

open. How would more holes or even one large hole change the speed of inflating and deflating the balloon? What would more or bigger holes do to the stream flowing from the water-balloon-bottle? Try it out!

The Floating Golf Ball

An activity from Kim Giesting (Connersville, IN)
This activity is an intro to a discussion on density.
Materials:
Clear plastic container
Pickling salt or sea salt
Golf ball
Water

Directions:
1. Fill container 1/2 full of tap water.
2. Add salt until no more salt dissolves. Mixing will help the salt dissolve faster.
3. Add golf ball to the salt solution (it should float!).
4. Gently add fresh water on top of the salt water solution.

Follow-up:
Many students mistakenly believe that they are diluting the solution of salt water to the "perfect" concentration when adding the fresh water. I add a few drops of food coloring and gently stir to show them that the fresh water is less dense and is actually sitting on top of the more dense salt water. The golf ball is actually floating on the salt water and sinking through the fresh water.

Oobleck

Materials:
1.5- 2 cups corn starch
1 cup water
Large dish, bowl or tub
Food coloring (optional)

Directions:

1. Place the water into the bowl or dish
2. Slowly add the corn starch to the water and stir. You can use a spoon at first, but pretty quickly you'll be moving on to using your hand to stir it up.
3. As you approach the addition of about 1.5 cups of the corn starch, start adding it in more slowly and mixing it in with your hand. The goal is to get a consistency where the Oobleck reaches a state that is the liquid and yet solid.
4. Sometimes you will need more corn starch. If so, keep adding more than the initial 1.5 cups. If you add too much, just add some water back into it. You will have to play with it to see what feels appropriately weird.
5. Add a few drops of food coloring, if you wish.
6. Play with the Oobleck:
   - Grab a handful, squeeze it, and let it ooze out your fingers.
   - Make a puddle and quickly drag your fingers through it.
   - Put it into a plastic container and shake it or quickly bump it against a table.
   - Jab and punch at the Oobleck and then slowly let your finger sink in.

Follow-up:
Oobleck is a classic science experiment that's perfect for entertaining both kids and adults. If you haven't seen it in action it's very fascinating stuff and before too long you'll have your hands covered with it, happily making a mess that can be washed away with water.

Oobleck is a non-newtonian fluid. That is, it acts like a liquid when being poured, but like a solid when a force is acting on it. You can grab it and then it will ooze out of your hands. Make enough Oobleck and you can even walk on it!

Oobleck gets its name from the Dr. Seuss book *Bartholomew and the Oobleck* where a gooey green substance, Oobleck, fell from the sky and wreaked havoc in the kingdom. Here the Oobleck will be made in a bowl and will likely make a mess, but only because you can get carried away playing with it.

Fun videos: **http://www.youtube.com/watch?v=f2XQ97XHjVw**
http://www.youtube.com/watch?v=Yp1wUodQgqQ

Make more Slime!

How it works:

The slime recipe is nearly identical to the silly putty recipe except for one ingredient- the type of glue used. The polymer that makes up clear gel glue is slightly different than the polymer that makes up white glue- instead of polyvinyl acetate, it is made up of polyvinyl alcohol. This gives the polymer different properties than the Silly Putty when cross-linked by the borax.

Here is a recipe to make more slime at home.

Materials:

2 tablespoons clear gel glue (NOT Super Glue!- we used Elmer's gel glue)
2 tablespoons water
1 drop food coloring
1 teaspoon borax
1 cup warm water
Glass cup
Measuring spoons
Spoon
Ziplock bag

Procedure:

1. Mix the glue and water in the glass cup. Stir with a spoon until they are completely mixed.
2. Add one drop of food coloring to the mixture from Step 1.
3. Make a borax solution by mixing 1 teaspoon of borax into 1 cup warm water until dissolved completely.
4. Add 2 teaspoons of the borax solution from Step 3 into the glue-water solution from Step 2. The mixture should start to form a blob. Keep stirring! If some of the glue-water liquid does not clump together with the rest of the blob, add a little more borax solution and stir some more.
5. Pour out the excess liquid and put the blob in the Ziplock bag. Knead the bag for a couple of minutes.
6. Remove the blob and you've got homemade slime!

Tips:

- Add glitter after Step 1 for glittery slime.
- The food coloring may stain fabrics, so be careful not to get it on clothing, furniture, or carpet.
- Your slime may get dirty or moldy after a few days. If this happens, discard the slime and make a new batch.
- Do not put your slime down the drain!

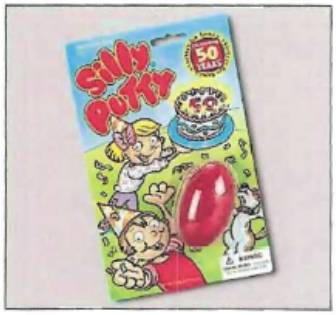
Make more Silly Putty!

How it works:

White glue is made up of a polymer called polyvinyl acetate. When borax is added to the glue and water solution, the borate ion crosslinks the polymer chains, causing bridges between the polymer chains to form. This creates a material that is rubbery like silly putty.

Here's a recipe to make more Silly Putty at home.

Materials:



2 tablespoons white glue
2 tablespoons water
1 drop food coloring
1 teaspoon borax (we used 20 Mule Team Borax, which is available in most grocery stores)
1 cup warm water
Glass cup
Measuring spoons
Spoon
Ziplock bag

Procedure:

1. Mix the glue and water in the glass cup. Stir with a spoon until they are completely mixed.
2. Add one drop of food coloring to the mixture from Step 1. Stir well to mix.
3. Make a borax solution by mixing 1 teaspoon borax into 1 cup warm water until dissolved completely.
4. Add 2 teaspoons of the borax solution from Step 3 into the glue-water solution from Step 2. The mixture should start to form a blob. Keep stirring! If some of the glue-water liquid does not clump together with the rest of the blob, add a little more borax solution and stir some more.
5. Pour out the excess liquid and put the blob in a Ziplock bag. Knead the bag for a couple of minutes.
6. Remove the blob and you've got homemade Silly Putty!

Tips:

- Add glitter after Step 1 for Silly Putty with sparkles.
- The food coloring may stain fabrics, so be careful not to get it on clothing, furniture, or carpet.
- Silly Putty may get dirty or moldy after a few days. If this happens, discard the Silly Putty and make a new batch.
- Do not put your Silly Putty down the drain!

ACTas115

ROCKETS AWAY!

4-H Aerospace Lesson

CONSTRUCT AND TEST FLY A DRINKING STRAW ROCKET

Project Skills:
Building straw rocket models

Life Skills:
Teaching others
WI Academic Standards:
Science C.4. Inquiry

Time:
20-30 minutes

Supplies:
- 6 1" x 2 1/2" adhesive labels (per team)
- 2 Sweetheart (smaller) drinking straws (per team)
- 3 Carnival (larger) milkshake straws (per team)
- Pair of scissors (per team)
- Rockets Away! Flight Chart worksheet
- Roll of masking tape
- Tape measure

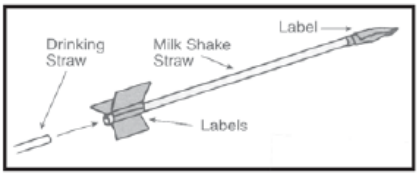
Getting Ready:
- Locate a space that is at least 20 feet long. Use masking tape to mark off a launch line.
- Make a copy of the Flight Chart sheet.
- Make and launch a straw rocket.

Adapted from 4HCCS Aerospace project series Stage 2, Lift–Off (BU-6843), pages 6-7.

WHAT TO DO

Make drinking straw rockets

1. Pair up youth. Give each team the following supplies: six 1" x 2 1/2" adhesive labels, pair of scissors, two drinking straws (launchers), and three milk shake straws (rockets).
2. Have each team work together to make one straw rocket:
   - Cut two labels in half the short way to make four 1" x 1 1/4" labels.
   - Wrap one label around the end of the larger milk shake straw; seal completely to make a rocket nose cone.
   - Attach both ends of the three remaining labels at the opposite end of the same straw. Stick the adhesive together and crease to make three rocket fins. Add team initials to fins.
   - Test fire the rocket by inserting a drinking straw inside of the larger milk shake straw rocket. Aim the rocket into the air, away from anyone else and launch by blowing hard.



3. Emphasize health and safety issues by telling youth to discard their smaller straws after using them and only launch rockets in an orderly fashion at the official launch line one at a time.

Teach others how to make a straw rocket

1. Ask individuals to practice teaching each other how to make a drinking straw rocket. Encourage youth to teach in a way that lets others learn by doing before being told or shown how. Make sure everyone has a chance to be in a teaching role with another person.
2. For each flight round, experiment with each straw rocket by changing the fins. Use larger labels, different numbers of fins, or cut, bend or twist the fins.

Conduct a Rocket Blast-Off Contest

1. Have youth stand behind the launch line and launch their rocket.
2. Use the Flight Chart sheet to record the length of each rocket flight. Measure from launch line to exact point where rockets hit the ground.
3. Announce distance for each rocket's flight. Congratulate the winning team.

TALK IT OVER

Try to get each youth to express his or her feelings and experiences.

Reflect:
- What happened when you made changes to the fins of your rocket?
- How did these changes affect your straw rocket's flight?

Apply:
- Do you like teaching or learning better? Why?
- What do you like others to do when they are teaching you something new?
- Next time you are teaching a friend something new , how would you go about it?

Flight Chart

ROCKETS AWAY!

	1st Flight	2nd Flight	3rd Flight	4th Flight	5th Flight
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance
Name:	Distance	Distance	Distance	Distance	Distance

Food Science

Let's Make Cottage Cheese

Science

Grade Level: 3-4

Time: 45 minutes

Standards:
Science

Materials

- 1 pint 2% Milk
- 1 tablet rennet – found in the pudding/pie aisle of grocery Store
- Strong rubberband
- Clear gallon jar or Container
- Lemon juice or vinegar
- Glass measuring cup
- Hot plate
- Thermometer
- Cheesecloth
- Spoon
- Small bowl
- Small Dixie cups or spoons

Optional items

- Flavorings for cottage cheese: salt, chives, garlic, ranch dressing powder
- Wafer crackers

Overview

This lesson is designed for students to understand the connection between food and themselves. Where does cheese and butter come from? What is the scientific process for creating cheese? A further discussion of jobs linked to agriculture can be a part of this lesson.

Objective

1. Students will watch the action of a catalyst (rennet) on milk during the cheese-making process.

Background Information

Cottage cheese is a fresh cheese with a mild, slightly acidic flavor and small curds. Cottage cheese is part of the family of fresh cheeses that are rindless and not intended to be ripened or aged in order to develop flavor.

Cottage cheese is thought to be the first cheese made in America. For centuries, farmers in Europe made fresh farmhouse cheeses with naturally soured milk, after separating the curds from the whey. Immigrants to America brought the tradition of fresh cheese-making with them and by the mid-1800s the term cottage cheese entered the American vocabulary. Cottage cheese is sold both plain and with added flavorings such as fruit and herbs.

Cottage cheese is made by adding an acid to pasteurized milk which causes a separation of the milk solids from the whey. This can be done by adding a bacterial culture that produces lactic acid or a food-grade acid such as vinegar. After the curd is formed, it is gently cut into pieces

that allow additional whey to drain from the curds. The curds are further cooked and pressed gently to expel more whey. The curds are rinsed and salt is added.

Cottage cheese is high in protein and is a good source of riboflavin. Although it contains calcium, much of it is lost in the separation of whey. Some cottage cheese products are fortified with calcium.

Information from the California Milk Advisory Board (2009). Cottage cheese. http://californiadairypressroom.com/Products/Cottage_Cheese

Vocabulary
Animal rennin is the coagulating enzyme (rennin or chymosin) that is harvested from the stomachs of calves.

Curds are the thickened or large solid parts that form in soured milk. They are the foundation or beginning of the cheese.

Enzyme is a catalyst that speeds up the digestive process.

Whey is the watery part of milk that separates after the milk has soured and thickened, and it is a by-product of the cheese-making process.

Preparation
Plug in hot plate prior to starting the lesson so that it is hot.

Instructional Format
1. Share background information and vocabulary words with students.
2. This lesson will be a class demonstration with student participation.
3. Upon completing the lesson, students will answer conclusion questions and discuss the activity.

Procedures
1. Heat 1 quart of 2% milk in the glass measuring cup on the hot plate. Heat to 32 degrees C (90 degrees F), and then remove milk from the heat.
2. Crush a rennet tablet and dissolve it in 1/3 cup of lukewarm water in the measuring cup.
3. Sir the rennet and water solution into the warmed milk using a spoon. Add lemon juice or vinegar 1 Tablespoon at a time until you clearly see the fat (curd) separating from the whey. Make sure the students look at the changes they can observe before and after adding the vinegar or lemon juice. *Do not add more than 3 tablespoons of lemon juice or vinegar.*
4. Prepare a large clear container by placing one piece of fine cheesecloth over the container and securing it with a rubberband. The cheesecloth should be shaped like a funnel – not stretched tight.
5. Have an extra person hold the cheesecloth in place. Pour the milk mixture through the cheesecloth. Drain it thoroughly. Hold the cheese in the cheesecloth and rinse with fresh water,

several times. Squeeze the cheese curds dry.
6. Place the curds in a bowl and cut them if necessary.
7. Season to taste with salt, dill, chives, garlic, ranch dressing powder, etc.
8. Students can taste the cottage cheese they made by putting cheese in Dixie cups or by spreading it on crackers.

Conclusion Questions (Assessments)

1. What is an enzyme?
   A catalyst that speeds up the digestive process.

2. What is the difference between curds and whey?
   Curds are the thickened or large solid parts that form in soured milk, and they are the foundation or beginning of the cheese. Whey is the watery part of milk that separates after the milk has soured and thickened. It is a by-product of the cheese-making process.

3. What did the milk look like before the lemon juice or vinegar was added? How about after?
   Before: the milk was a smooth, easy-to-stir liquid. After: the milk curdled and became chunky and thick.

Resource

California Milk Advisory Board (2009). Cottage cheese. http://californiadairypressroom.com/Products/Cottage_Cheese

Want More? Extensions

What to do with the whey? Whey is highly nutritious due to its protein content. If you don't want this liquid to go to waste, do the following:

Make ricotta cheese – ricotta means "re-cooked." You'll need leftover whey, a large bowl, fine cheesecloth or reusable coffee filter, a large strainer, and a small bowl. Pour the whey back into your pot and heat it to boiling. The temperature here is not critical, and you don't have to do it slow. Just be VERY careful. Once the whey has cooled down to 140 degrees or less, either use a ladle or pour your whey through the coffee filter. Once you pour it all back into the filter, let it drain for a while until all the liquid is removed. This may take a while depending on the size of the holes in the filter. *http://www.instructables.com/id/Great-Ricotta-Cheese-From-Whey/*

Save it and use it to "water" the classroom plants. Leftover whey can be nutrient-rich plant food. You may to check whether the plant can tolerate acidic solutions since vinegar was used in the whey-making process. Roses do well with acidic solutions.

To further make the connection between agriculture and food on the table, plan a visit to a local dairy farm, where the farmer can show students the dairy operation, explain how milk is transported, and answer any questions students may have.