CHAPTER 4

ACTIVITY IDEA 4A EXPERIMENT: TESTING BANANAS FOR STARCH (See idea 5F, which also uses bananas.)

You will need:
- four (or more) bananas, ranging from very green to very ripe
- Lugol's solution (iodine)
- eye dropper

What to tell the students:

In this experiment we will see how the chemical composition of a banana changes as it becomes ripe. You know that very ripe bananas are much sweeter than green ones. This test will prove that starch is converted to sugar as a banana ripens. Can you name the agent of this change?

What to do:
1) Cut a slice of each type of banana.
2) Put a few drops of Lugol's solution on each slice.
3) Observe any darkening. Iodine stains starch molecules but not sugar molecules. Which bananas has the most starch?
4) Can you think of an explanation for the chemical change that is going on? What is starch made of? What type of molecule is able to tear starch molecules apart?

EXPECTED RESULT: The green banana will stain black, or very dark. The riper the banana, the less darkening you will see. This is because plants always contain the enzymes needed to break down the starches in their fruits. The fruit is supposed to be nourishment for the seeds inside the fruit. The sugars can provide the growing plant with energy. The bananas must contain amylase or a very similar enzyme that is able to break the starch into individual glucose molecules.

ACTIVITY IDEA 4B EXPERIMENT: CAN WE PREVENT APPLE SLICES FROM TURNING BROWN?

This activity requires only a short time to get started, then it will need to sit for a few hours.

You will need:
- an apple
- small bowl of water
- small bowl of lemon juice
- small bowl of vinegar
- small bowl of salt water
- small bowl of milk
- tongs
- paper towels or paper napkins
- marker or pen

What to tell the students:

We've all seen apple slices go brown. This process is called "enzymatic browning." The enzyme that does this is called "polyphenol oxidase." When this enzyme combines with oxygen in the air, it creates a brown molecule called melanin. In this experiment we will find out what type of substance can prevent, or slow down, the browning process.

What to do:
1) Cut 6 pieces of paper towel or napkin and write one of these words on each: CONTROL, WATER, LEMON JUICE, VINEGAR, SALT WATER, MILK
2) Cut the apple into slices.
3) Put a slice on the paper that says CONTROL. This will let us see what happens if a slice is not dipped into a solution.
4) Use the tongs to dip an apple slice into the water. Hold it under the water for about 30 seconds. Then pull it out and set it on the paper that says WATER.
5) Use the tongs to dip an apple slice into the lemon juice; hold for 30 seconds, then place on the paper that says LEMON JUICE.
6) Rinse the tongs, then use them to dip an apple slice into the VINEGAR. Place onto the labeled paper.
7) Use this process for the rest of the solutions.
8) Let the slices sit for at least an hour, then observe. Feel the slices. Are the textures different?

9) Let the slices sit for a few more hours, then observe again.
10) Discuss the results. Which solution prevented browning? Was there a difference between the slice that was not dipped at all and the slice that was dipped in water? What did vinegar do? Is the milk-dipped slice harder than the rest? What happened to the salt water slice? Did any of your results surprise you?

EXPECTED RESULT: The undipped slice will turn brown. The water-dipped slice will show some browning but not as much as the control slice. The slice dipped in lemon juice will show much less browning. (The action of the polyphenol oxidase enzyme is blocked by acid.) Some people who have done this experiment reported that their salt water slice had less browning than their lemon juice slice. It has also been reported that the milk slice felt harder than the others, and that the vinegar slice turned completely brown and went mushy. Another possible surprise is that the vinegar slice may turn brown even though vinegar is acidic like lemon juice is.

Your results might or might not match these reported results, but you should definitely see less browning on the lemon juice slice than the control.

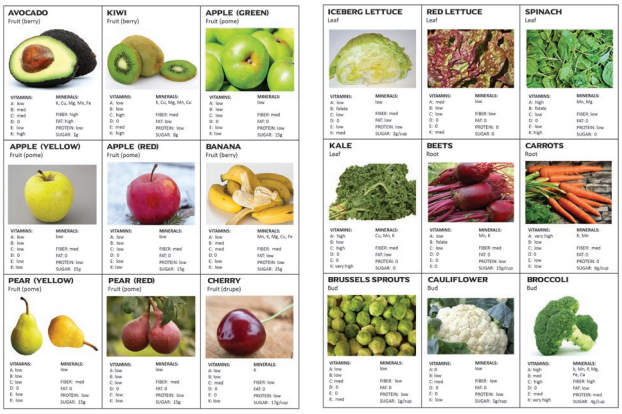
INTERESTING FACT: Commercial apple growers are able to keep apples in good condition for a long time by putting them in a special cooler that not only keeps the temperature low but also takes the oxygen out of the air so the apples are in a pure nitrogen atmosphere. (Normal air is about 80 percent nitrogen, 20 percent oxygen.)

ACTIVITY IDEA 4C FRUIT AND VEGETABLE CARD GAMES

This activity requires you to access the pattern pages via my website. (Go to www.ellenjmchenry.com, click on FREE DOWNLOADS, then click on PLANTS.) This is necessary because of possible copyright issues. The photographs on the cards are from a wide variety of sources and are fine for educational use on a free download, but could potentially create issues in a copyrighted book that is being sold for profit.

As you can see, the cards are high quality and are definitely worth printing on heavy card stock paper. You can use them for reference, not just for games. There are 6 other pages, besides the ones shown here, for a total of 8 pages.

The download also has suggestions for games you can play with the cards. **Choose one or two activities to do with the cards after this chapter, and save a few for the next chapter. This activity will be listed again for chapter 5.**



ACTIVITY IDEA 4D SNACK: MAKE HOMEMADE MAYONNAISE (You can easily find alternative recipes online.)

You will need:

- one large egg (You will use it raw. If you are worried about safety, buy a pasteurized egg.)
- 1 tablespoon Dijon mustard
- 1 tablespoon vinegar
- 1/4 teaspoon salt
- 1 cup vegetable oil (don't use extra virgin olive oil)
- optional: 1 teaspoon lemon juice
- a food processor or stick blender (something with blades that go really fast)

What to do:

1) Put egg in food processor, or in bowl if you are using a stick blender. Process for 20-30 second.
2) Add mustard, vinegar and salt. Process for another 20-30 seconds.
3) Begin to add oil slowly, a few drops at a time. This is necessary for the emulsion to happen. The mixture should begin to thicken at this point.
4) After about 1/4 of the oil has been added, you can being to added it a little faster. Scrape the sides and bottom of the bowl to be sure all ingredients have been blended.
5) Optional: When mixture is thick, you can add some lemon juice or some more vinegar to adjust the flavor.
6) If the mixture seems too thin, turn the processor or stick blender back on and slowly add a tiny bit more oil until it thickens.

ACTIVITY IDEA 4E EXPERIMENT: USE ANTHOCYANIN AS pH INDICATOR

This is a classic science activity, so you, or some of your students, may have worked with cabbage water already. If so, try to find some unusual substances to test—substances that are unlikely to have been included in any previous experiments.

You will need:

- a head of purple cabbage
- a pot of water in which to boil the cabbage leaves
- eye droppers
- copy (or copies) of the following pattern page with the numbered colored dots
- a variety of substances to test

SUGGESTIONS (choose the ones that are best for your situation): water. salt water, sugar water, vinegar, lemon juice, apple juice, orange juice, baking soda in water, cola, seltzer water, flavored seltzer (example: LeCroix® brand), milk, laundry detergent, shampoo, mouthwash, hand soap, toothpaste, window cleaning fluid, ammonia, bleach. (If you want an extremely alkaline substance, use liquid drain cleaner, but be sure to supervise it carefully as it can cause injury to skin. Perhaps give them only a few drops to test.) **Make sure to include water** (distilled if possible) as a neutral 7.0 to which the other samples can be compared.

- You will also need one of the following set-ups for your substances. Choose the option that works best for your situation.

1) Use a foam or clear plastic egg carton, which gives you 12 cups for 12 substances. The downside with this method is that it is hard to label the compartments. You could tape little paper slips to the compartments, or you could use a permanent marker to write on the inside of the top of each compartment.

2) Use a plastic or foam plate and write the labels around the outside of the plate (where the numbers on a clock would be) and then use a dropper to squeeze out a small puddle of the substance close to its label. Put the water (control) in the center.

3) Write the labels on a sheet of paper then put a piece of plastic wrap on top of the paper, and squeeze out small puddle of each substance right near each label.

4) If you want the students to be able to arrange all their substances in order, from acidic to basic, you will need to provide individual small cups for each substance. Clear plastic condiment cups are about the right size. Or, you could cut apart the compartments of foam or plastic egg cartons. Disposable 4-oz plastic (bathroom size) cups also work.

Preparation ahead of time:

1) Chop your purple cabbage (if it is a large head you can use just half of it) and put it into a pot with enough water to cover the cabbage. Boil for a few minutes, until the water in the pot is dark purple. Turn off the heat and let it cool to room temperature. Pour off the purple liquid and save it in a jar or container with a lid. It will keep in the refrigerator for a few days if necessary.

2) Make a copy (or copies) of the pattern page with all the colored dots. Cut it into strips so each student can have a numbered strip. They will compare their colored solutions to the strip to determine the solution's number on the pH scale.

3) Round up the materials for the option you chose (1 - 4) above.

What to tell the students:

In this experiment you will see how anthocyanin pigment taken from purple cabbage can be used as a pH indicator to test how acidic or alkaline a substance is. (Remember that the word "alkaline" means the same as "base" or "basic.") Anthocyanin will turn pink or red in the presence of an acid. (Think of sour, unripe raspberries, which are red.) In a neutral environment (like a ripe berry) anthocyanin will be blue or purple. In an alkaline (basic) environment, anthocyanin will turn green or greenish-yellow. You will be given a strip of paper with colored dots that display the range of colors you may see. Each dot as a number that represent a number on the pH scale. With this color scale you can figure out an approximate pH number for each substance you test.

IN CLASS:
1) Give each student, or pair of students, a set-up for testing. Make sure they understand what to do **before** any substances are given to them.
2) Distribute the samples of substances to be tested. This might require several adults with bottles and eye droppers going around and putting the test substance right next to its label. Unless you are working with very mature students, If you don't have enough adult help to do this, the other option is to WAIT to give out the purple cabbage water, and first send around labeled containers with a dropper in each one, and tell the student they are to squeeze out a small sample of each, putting it in the proper place, and to make sure to keep each dropper with its container. If the eye droppers get mixed up, your samples will be contaminated and this will effect your results.
3) Give each student, or pair of students, a cup of purple cabbage water and an eye dropper. Students should add a dropper of purple anthocyanin water to each substance and see what happens to the color.

NOTE: There isn't an exact amount of purple solution that must be added. Tell them to add drops slowly and just watch until the color stays about the same even after adding a few more drops. When the color is stable, stop adding drops. Fortunately, there is a wide tolerance for error. The experiment will still work even if they add too much, or too little, purple cabbage solution.

ACTIVITY IDEA 4F EXPERIMENT: RIPENING FRUIT USING A NATURAL GAS

You will need:
- four green bananas (make sure that all four bananas are at the same stage of ripening)
- one ripe banana
- one piece of ripe fruit that isn't a banana
- four large plastic bags
- optional: a few small paper bags

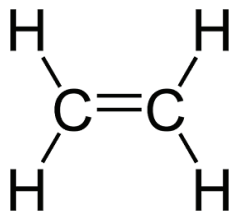
What to tell the students:

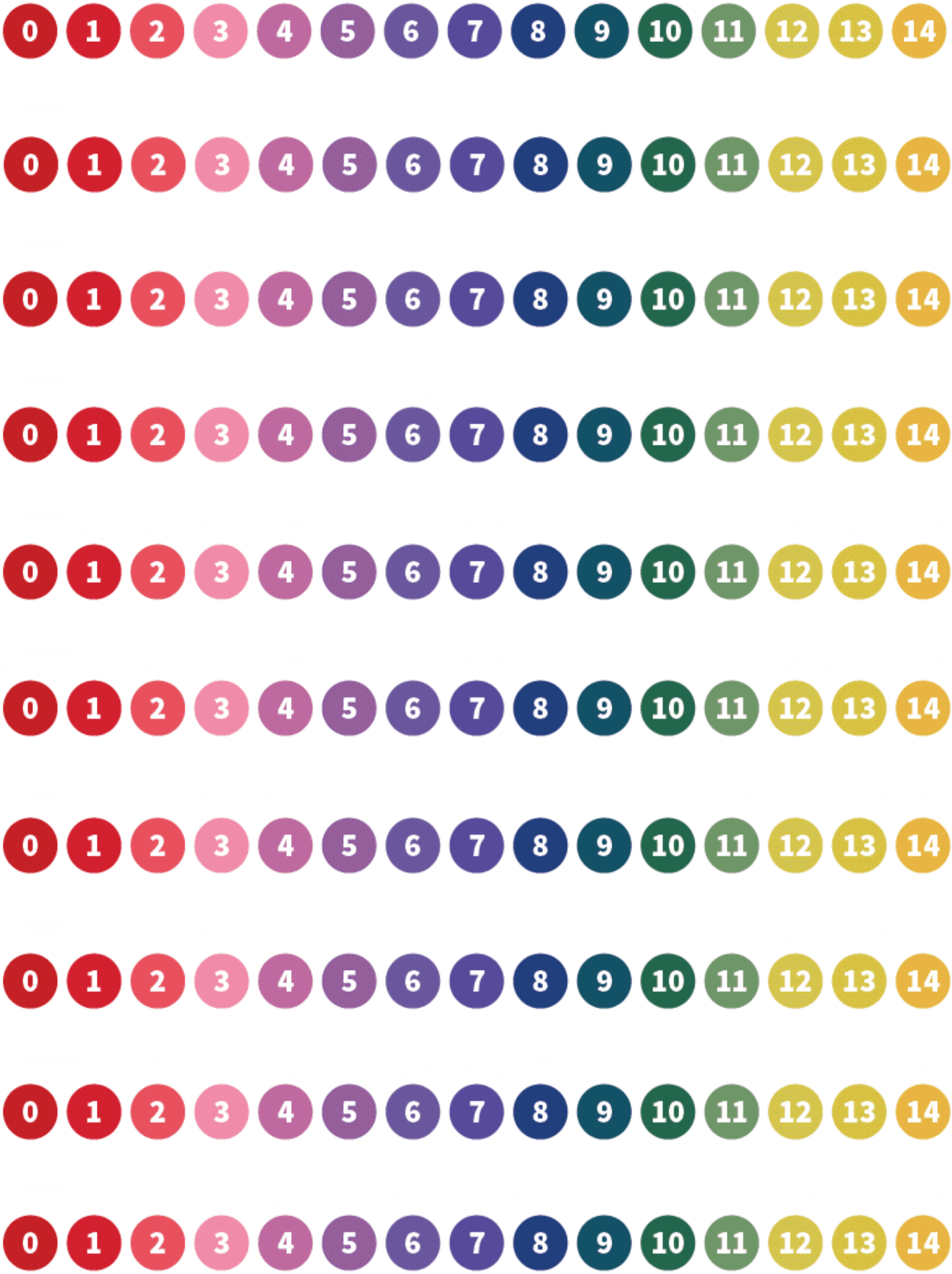
In this experiment we will see how ethylene gas speeds up the ripening process in fruit. This gas is produced by fruit as one of the mechanisms that controls ripening. Commercial fruit growers can produce ethylene artificially and apply it to fruit that was picked unripe and therefore needs to ripen a bit before being sold to customers.

What to do:
1) One of your green bananas will be the "control" to show us how fast ripening occurs if we simply let the banana sit. Do not put this banana into a bag.
2) Put a green banana into a plastic bag and seal it shut.
3) Put the third green banana into a bag and add a ripe banana to the bag. Seal shut.
4) Put the fourth green banana into a bag with a piece of ripe fruit (apple, pear, etc.).
5) If you are using paper bags (to see if paper give a different result from plastic) repeat steps 2, 3 and 4 with paper bags.
6) Set all these bananas on a tray or in a box and put it in a place where it can sit undisturbed for a week.
7) Check the progress of the bananas each day. Record your findings so you don't forget!
8) As soon as all the green bananas have turned ripe, end the experiment.

Which banana was the slowest to ripen? Can you think of a reason? Did the plastic bags catch and hold ethylene and cause those fruits to ripen faster? Did the paper bags hold as much ethylene as the plastic bags?

"Ethylene" is one of the simplest hydrocarbon molecules.

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ACTIVITY IDEA 4G SNACK: TRY SOME TEAS

Tea is the most consumed beverage in the world (not counting water). All types of tea (green, black, white) are from the same tea plant, *Camellia sinensis*. It is the processing that gives various types of tea. Green tea is less processed than black tea. **Check out the tea growing videos on the youtube playlist**. You will find that there's more than one way to process tea. They do it differently in each video.

If this idea works in your situation, you might even want to use fancy tea cups and saucers and do a little education about etiquette, or about tea customs in various countries.

If you want to try decaffeinated teas, there is also a short video explaining the ways of decaffeinating tea and coffee.

If you want to add a food to eat with the tea, consider providing some berries that are high in the phytochemicals we read about—flavonoids, anthocyanin and resveratrol.

ACTIVITY IDEA 4H SNACK: TRY SOME SALAD GREENS

There are many types of salad greens, including many varities of lettuce, plus leaves from spinach, kale, and beets, as well as collard and mustard greens. Your geographical area may have unique greens not available in other places. Provide a selection of samples for students to try. You might also want to provide a small amount of a few varities of dressings for dipping the leaves. After all the taste tests, take a vote to see which green is the favorite and which is the least favorite.

ACTIVITY IDEA 4I EXPERIMENT: REGROW A HEAD OF LEAF LETTUCE

You will need:

- a head of lettuce that is long and straight (such as Romaine)
- a saucer or small bowl
- fresh water each day

What to do:

1) After you've cut off the leaves, don't throw away the stump! Put it into a saucer or bowl and add enough water to cover the bottom of the stump.
2) Change the water each day, and see what happens over the course of a week.
3) Hopefully, new leaves will grow and you'll be able to harvest them for your salad or sandwich. Look at the base of the lettuce. You will see tiny roots growing. These roots aren't quite the same as the original roots, but they take in enough water for a few new leaves to grow.

ACTIVITY IDEA 4J MOLECULE MAT for chapter 4

You will need:

- a copy of the following pattern page for each student
- toothpicks
- the materials for the atoms

What to do:

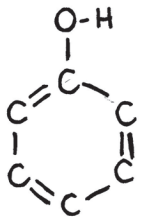
1) Put your chosen materials inside the boxes on the left side of the page (or in small dishes if they won't fit inside the boxes). Toothpicks can be set in a dish, or simply in a pile, within the student's reach.
2) Let the students work on their own as much as possible.
3) The molecules are likely to be large enough that all four will not fit onto the page. You can tell your student to build two then recycle the items, or give them an extra blank sheet and have them build several molecule on it.
4) For students who are keeping a portfolio of their work, take a photo of their paper with all the finished molecules on it.

H - hydrogen

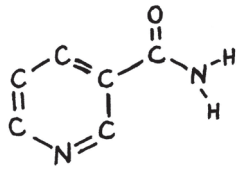
O - oxygen

C - carbon

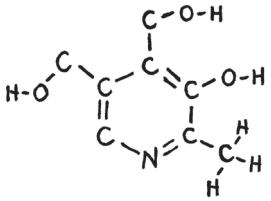
N - nitrogen



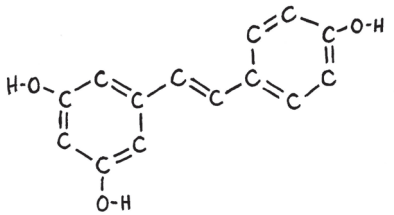
phenol



nicotaminide, a form of vitamin B3



pyridoxine, vitamin B6



resveratrol

MOLECULE MAT Chapter 4