CHAPTER 1

ACTIVITY IDEA 1A   EXPERIMENT: HOW MANY DROPS OF WATER WILL FIT ON A PENNY?

You will need:
- an eye dropper for each student
- a penny for each student
- cups of water (students can share)

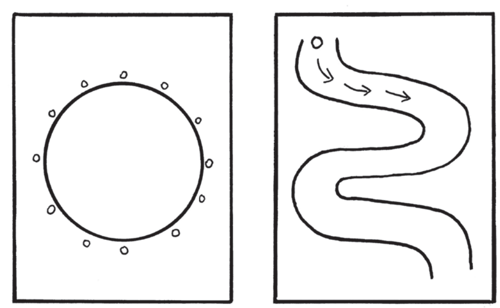
What to tell the students:

In this chapter you read about hydrogen bonding between water molecules. This attraction between water molecules is what allows water to form droplets. In this activity you will observe the shape of a single droplet, then you will see how many drops of water will fit on top of a penny before gravity finally overcomes the strength of the hydrogen bonds.

What to do:
1) Give each student a penny, an eye dropper and access to a cup of water.
2) Tell them to put one single droplet onto the penny. Look at it from the side. How close is it to being a sphere?
3) Then give them the challenge of slowing putting additional droplets onto the penny, carefully counting as they go. Make sure the eye dropper (or the droplet being added) doesn't touch the penny or the droplet on the penny. When the penny is full of water look at it from the side. How tall is the drop?
4) At some point (over 30 drops perhaps) the giant droplet will finally give way and let go, gushing out over the penny and onto the table.
5) The students will likely want to repeat this procedure several times to see if they can add more drops.

ACTIVITY IDEA 1B   GAME: WATER DROP RACES

You will need:
- an eye dropper for each student
- a plastic straw for each student
- waxed paper
- pencil and paper for each student
- round object for tracing a large circle on the paper (small plate, for example)
- tape
- cups of water (students can share)
- for game #2: a tablet or stiff piece of cardboard the size of a sheet of paper



What to tell the students:

In this activity you will play games with water droplets.

What to do for GAME #1:   RACE TO THE CENTER
1) Give each student a piece of paper and a pencil. Pass around the round object and have the students place it in the center of their paper and trace around the edge. (If you have a large group of students, you can either prepare the circle pages yourself ahead of time, or use an object that you have multiples of, such as a set of saucers.)
2) Tell the students to lay the waxed paper on top of their sheet of paper and use a few pieces of tape to secure the waxed paper to the table so it won't slide around.
3) Have the students fill their droppers and place 12 drops of water around the edges of their circle (outside the line). Imagine the circle to be a clock, and put a drop on each "hour."
4) Now they are ready to play the game. The goal is to get all of their water drops together in the center of the circle, forming one large drop. Use the plastic straws to move the water drops around on the waxed paper. Ready, set, go! First person to get all their droplets together in the center wins the game.

What to do for GAME #2:   RACE DOWN THE ROAD
1) Give each student a tablet or piece of cardboard and have them tape a piece of paper to it. Then have them draw a curved "road" down the page. Tape the waxed paper on top of the paper.
2) Put a drop of water at the top of the curved road and then tip and tilt the road, trying to keep the water droplet inside the track while it rolls downward.

<u>ACTIVITY IDEA 1C</u> EXPERIMENT: NO STIRRING ALLOWED!

<u>You will need:</u>
- a cup of water for each pair of students
- food coloring

<u>What to tell the students</u>:

All molecules, including water molecules, are in constant motion. The molecules themselves vibrate internally, and they also wander about, bumping into other molecules. Although we can't see water molecules, we can witness their motion by putting a drop of dye into the water. The dye is also made of molecules that are moving. We can watch as the dye and water molecules move around and get mixed together. This will take some patience, as it is not a fast process.

<u>What to do</u>:
1) Give each pair of students a cup of water to observe.
2) Tell the students that they are NOT to disturb the cup in any way. No touching the cup! Warn the students that they will need to be patient and watch the cup for several minutes.
3) Put a single drop of food coloring into each cup.
4) The drop of food coloring will stay in place for a surprisingly long time. However, it will begin to swirl a bit and flow into other areas of the cup. The students' patience will be the limiting factor in this experiment. You might want to get this experiment started, then take a break and come back to it 5 or 10 minutes later.
5) Eventually, the dye will completely disperse into the water, making the water a homogeneous pale color.

<u>ACTIVITY IDEA 1D</u> EXPERIMENT: OBSERVING CRYSTALS

<u>You will need:</u>
- salt and sugar
- small pieces of black paper
- Optional: Epsom salt crystals, a specialty salt such
- as sea salt or Himalayan salt, or a special type of sugar
- Optional: include some sand, to represent another type
- of tiny crystal that is easily identified
- magnifiers (ideally 20x or higher, but minimum 10x)

<u>What to tell the students</u>:

In this activity, you will see that different types of salt and sugar can be identified by their crystal shapes.

NOTE: If you do not have magnifiers, you can use the following page.

<u>What to do</u>:
1) Give each student a magnifier, a piece of black paper, and access to the crystals you are supplying.
2) Have them take a pinch of each substance and place it on their black paper. Tell them to observe carefully.
3) Extension: After they observe all the crystals, have them clean off their black paper, then give them a pinch of a mystery crystal (don't let them see which container you used) and see if they can correctly identify what it is.

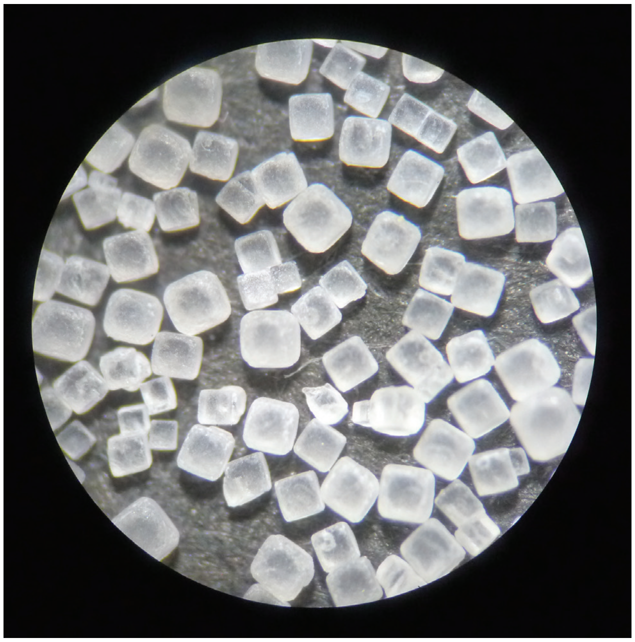
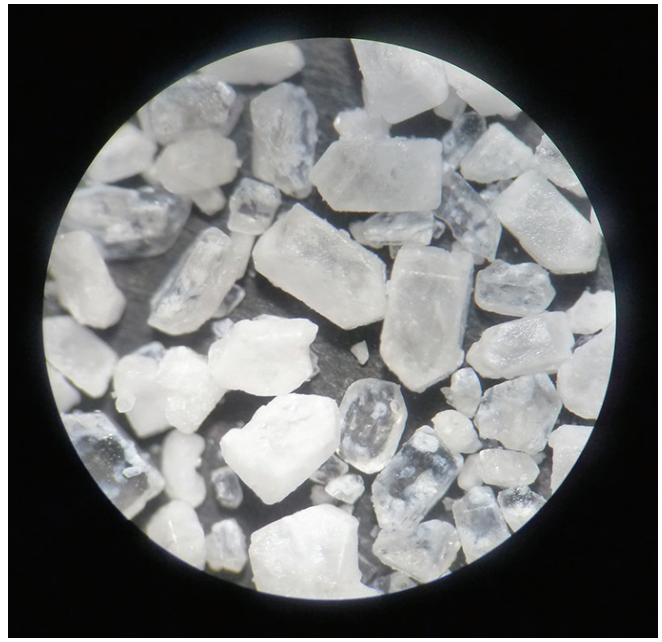
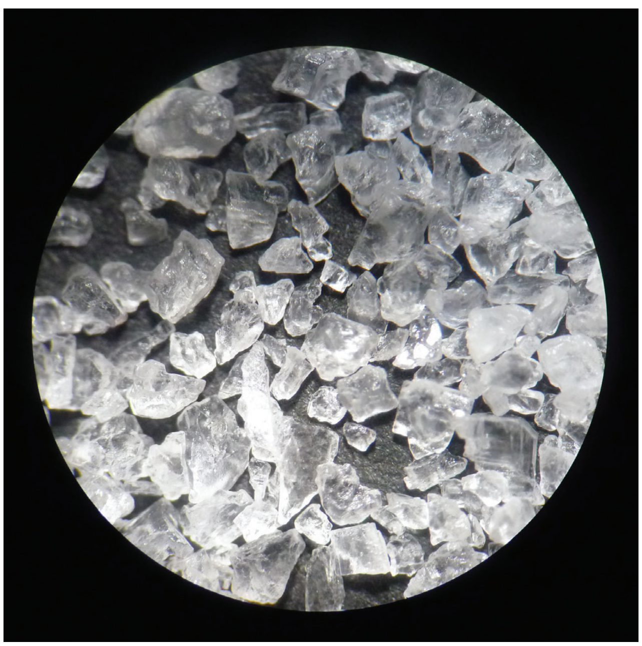


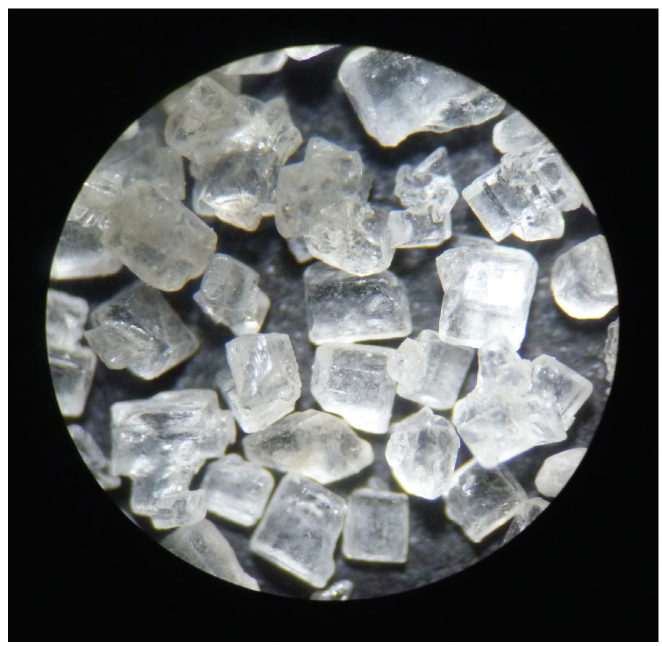
table salt 40x



Epsom salt 20x



Himalayan salt 20x



raw cane sugar 40x

sand 40x

ACTIVITY IDEA 1E EXPERIMENT: USE SALT TO LIFT AN ICE CUBE

You will need:
- salt
- ice cubes
- several short pieces of string
- bowl or glass of water
- Optional: a marker to darken the end of one string

What to tell the students:

In this experiment you will use salt to lift an ice cube with a piece of string. Salt lowers the freezing point of ice by interfering with ice's crystal structure. Salt will cause ice to melt at a temperature less than 0˚ C (32˚ F).

What to do:

1) Give each student, or pair of students, a bowl or glass of water with a few ice cubes floating in it and two pieces of string. (Optional: Use the marker to darken the end of one string so you can keep track of which is which.) Have the students lay a piece of string across two ice cubes.
2) Tell them to shake a little salt on top of one cube but not the other.
3) Let the cubes sit for a few minutes.
4) Lift the strings. If the cubes have been sitting long enough, the string that was salted should be stuck to the ice cube and will be able to lift it. The unsalted string won't be stuck to the cube.
5) Explain that the salt caused enough melting at the surface of the cube to allow the string to sink into the cube just a bit. The cold temperature of the rest of the cube then causes this melted area to quickly refreeze, trapping the string in the ice.

ACTIVITY IDEA 1F EXPERIMENT: GROW LARGE SALT AND/OR SUGAR CRYSTALS

You will need:
- white granulated sugar
- non-iodized salt
- water (distilled if possible, but use tap water if distilled not available)
- pan, stove, stirring spoons
- glass jars
- pieces of string, or wooden sticks such as popsicle sticks or bamboo skewers
- optional: food coloring

Time required: At least a week to grow the crystals

What to tell the students:

In this activity, you will watch the growth of crystals of salt and sugar. We will be using a type of solution called a "super saturated" solution. This means that the solvent (in this case, water) is holding the maximum amount of solute that it possibly can. Our solutions will have a lot of dissolved salt or sugar and some of it will come out of solution and stick to a string or stick you will provide, and will hopefully grow to become a very large crystal.

What to do:

1) Make your super-saturated solutions. The same technique is used for both salt and sugar. You heat water in a pan until it is almost boiling. You don't need a rolling boil, just extremely hot water. You keep adding salt (or sugar) (not both!) until no more will dissolve into the water. Eventually, there will be so much dissolved salt or sugar that what you are adding simply falls to the bottom of the pan.
2) Turn off the heat and let it solution cool. (Add some food coloring if you'd like, but this is not necessary.)
3) Pour only the clear top part of the solution (no solids from the bottom) into your jar or glass.
4) Dip the end of your string or stick into the solution. Let this sit until dry.
5) The bit of dried solute on your string or stick will act as the "seed crystal" that will be the starting point for the larger crystals that will form.
6) Rig a way to dangle the string or stick in the solution so the tip is well into the solution but not touching the bottom or sides.
7) Let this sit for several days, or even several weeks. Watch as the crystal on the end gets larger and larger.

EXTENSION FOR ACTIVITY 1F: While you have this solution available, try this bonus experiment. Put a few drops of each solution onto a smooth surface. Jar lids will work well, or small plates. Allow some drops to air dry. Use a hair dryer or fan to force other drops to dry quickly. Then compare the crystals. Expected result is that the crystals that dried slowly will be larger and have more impressive geometric shapes. Forming nice crystals takes time.

ACTIVITY IDEA 1G EXPERIMENT: PICKING UP SALT WITH A BALLOON

You will need:
- salt (any type)
- small plate
- one balloon per student or pair of students
- Optional: pepper or sugar

What to tell the students:

In this activity you will see that salt crystals carry an electrical charge. Things that carry an electrical charge are attracted to other objects that are electrically charged.

What to do:
1) Put a spoon of salt into the dish or plate. Blow up the balloon.
2) Before rubbing the balloon against anything, hold the balloon over the salt and see what happens. (Expected result is that nothing will happen. If the balloon happens to have an electrical charge already, some salt might jump up onto it.)
3) Rub the balloon against your hair.
4) Hold the balloon over the salt and see what happens. Expected result is that many grains of salt will jump up and stick to the balloon. You are likely to hear a sprinkling sound as they hit the balloon. NOTE: If you are doing this experiment in a room that has a lot of humidity (during hot summer day, for example) you might get less spectacular results. Best results happen with low humidity.
5) Extensions: Have students brush salt off and see if the balloon still has enough static to draw more salt. Try the same thing with pepper or sugar.

ACTIVITY IDEA 1H EXPERIMENT: BREAKING APART WATER MOLECULES

You will need:
- clear glass of water
- 9V battery
- tiny pinch of salt
- two short wires, if possible (and something to strip the plastic off the ends)

What to tell the students:

In this activity you will split water molecules into oxygen gas and hydrogen gas. The gas bubbles will be very small, but they will be visible. Will we see more oxygen bubbles or more hydrogen bubbles, or the same number of each? Think about the chemical formula: H_2O. What does the "2" mean?

What to do:
1) Strip both ends of the wires. If you don't have an actual wire stripper, you can use a pair of scissors or a knife to put a cut in the rubber coating. Once cut, the bit of rubber on the end should slide right off leaving a bit of bare wire.
2) Attach one wire to each terminal on the battery.
3) Put a tiny pinch of salt into the water.
4) Put the wires into the water. If you don't have wires, just turn the 9V battery upside down and submerge just a tiny portion of the end with the terminals. (Warning: The battery could get hot if you keep the terminals wet for several minutes.)
5) Watch for bubbles to form. The wire, or terminal, with more bubbles will be hydrogen because the formula, H_2O, tells us that every time you split a molecule, you get two hydrogens and only one oxygen.

ACTIVITY IDEA 1I   MOLECULE MAT for chapter 1

You can do this activity with a wide variety of materials. You can use edibles such as soft candies or bits of fruit or veggies, or you can use inedibles such as colored play dough or clay. If you happen to have molecule building kits (the sturdy plastic type) you might be able to match enough parts to the molecules listed here, although you might run into problems with the balls not having the correct number of holes or not having enough of some colors.

TIP: If you want to be able to reuse the pattern pages, you can slide them into plastic sleeves ("sheet protectors").

What you will need if you are using toothpicks and small, soft objects:
- toothpicks that are cut in half (or you can try short pieces of uncooked spaghetti) (Play dough shown in photo.)
- a copy of the following pattern page for each student
- small, soft objects to represent each type of element (20 H's, 11 O's, 13 c's, 4 Na's, 4 Cl's)

What to tell the students:

In this activity you will be making some of the molecules you read about in the chapter. The toothpicks will represent the electrical attractions that keep the atoms together. If you are good at making models and would like an extra challenge, make sure that the four sticks coming out of your carbon atoms are as far apart from each other as possible.

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 students' reach.
2) Let the students work on their own as much as possible.
3) For students who are keeping a portfolio of their work, take a photo of their paper with all the finished molecules on it.

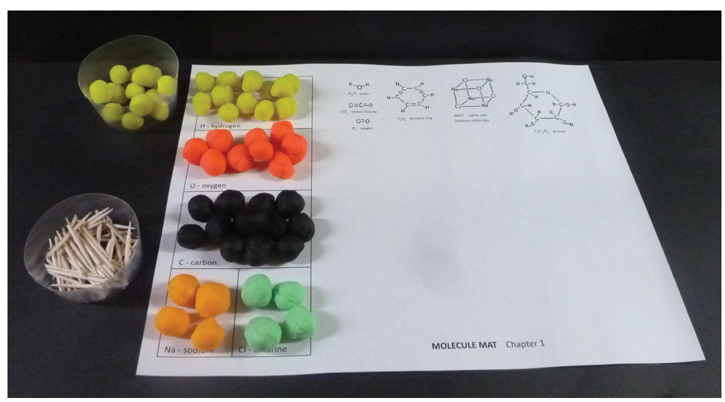
For students who finish early (if you are working with a group), try one of these ideas:
1) Have them use the diagram in their book to make fructose.
2) Have them disassemble their glucose molecule and then see if they can reassemble it from memory. (Make sure they can't see the diagram on the mat!)

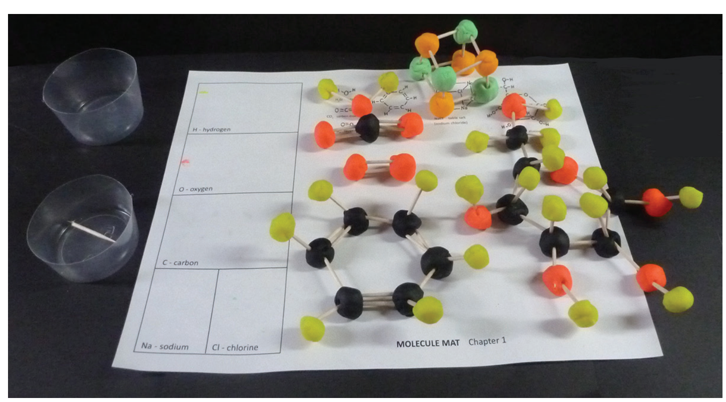
EXTENSION: If you are working with a group, you might want to have the students pick up their finished glucose molecules and place them all side by side in line. Then ask them to create bonds between the molecules. (Remember, an OH comes off one molecule and an H off the other to create an H_2O.)

NOTE ABOUT DOUBLE BONDS IN CARBON RINGS:

You will notice that in many carbon rings, the bonds in the ring alternate between one line and two lines. Carbon always wants to make four bonds, so normally we picture it as having four lines coming out of it. With this single/double line structure, the carbons have only three lines coming out of them, suggesting they are only making three bonds. In reality, what is going on is that these bonds are going back and forth between single and double so fast that is impossible to tell which is which. Therefore, the carbons think they have four bonds enough of the time that they are content and the molecule will be stable. However, because the possibility of adding an atom exists, this opens the possibly of an enzyme being able to add a new part to the molecule by changing those carbon intersections into a standard 4-bond situation.

Remember, if you have this book in paperback form, you can download a digital copy of the Molecule Mat by going to http://ellenjmchenry.com/printable-pages-for-DYD. The mat pattern is included in the printable pages download file.





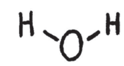
H - hydrogen

O - oxygen

C - carbon

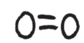
Na - sodium

Cl - chlorine

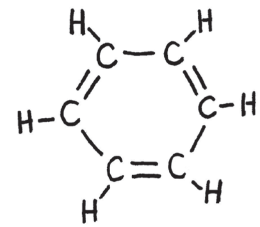


H_2O water

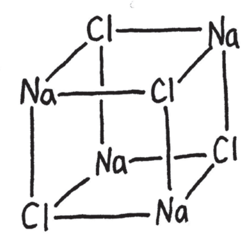
CO_2 carbon dioxide



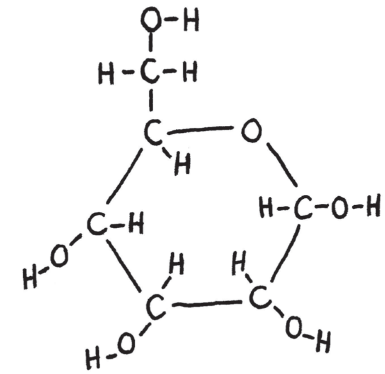
O_2 oxygen



C_6H_6 benzene ring



NaCl table salt (sodium chloride)



$C_6H_{12}O_6$ glucose

MOLECULE MAT Chapter 1

CHAPTER 2

(NOTE: Even though this chapter introduced pH, we are going to wait to do pH experiments until chapter 4 when we read about anthocyanin, which can be used as a pH indicator.)

ACTIVITY IDEA 2A EXPERIMENT: "UNSHAKE" A CAN OF SODA (CARBONATED BEVERAGE)

You will need:
- one or more cans of carbonated beverage (TIP: Cans of seltzer water are often cheaper than flavored sodas.)

What to tell the students:

You know what happens when you shake a can of soda pop and then open it. In this activity you will try to reverse the shaking process so the beverage does not explode out of the can when you open it.

What to do:
1) Shake a beverage can.
2) Tap the top of the can with 5-10 strong, firm taps. If you can't get a firm enough tap using your finger, you can use an object like a spoon.
3) Open the can slowly.

When you shake a can of soda, you are causing many tiny bubbles to form all along the inside of the can. These tiny bubbles will be the gathering point for larger bubbles to form if the pressure inside the can is released. By tapping the can, you are forcing these tiny air bubbles hanging to the inside of the can to float to the surface. Once these tiny air bubbles are gone from the inside of the can, the can has been restored to its original state.

EXTENSION: Try it with both warm and cold cans. (Cold beverages hold dissolved carbon dioxide better than warm ones, and should therefore make less mess.)

ACTIVITY IDEA 2B SNACK: MAKE A CARBONATED DRINK WITH "DRY ICE"

You will need:
- dry ice
- cups
- fruit juice of your choice

What to tell the students:

Dry ice is frozen carbon dioxide gas. If we put a piece of dry ice into a glass of juice, the carbon dioxide should diffuse into the juice, making it fizzy. Dry ice is much colder than regular ice. Be careful not to touch it!

What to do:
1) An adult should break up the dry ice into cube-sized pieces. (Be careful not to touch the dry ice as it is much colder than regular ice and could cause injury to skin.)
2) Let each student hold their cup and watch the dry ice fizz and create lots of vapor. Their drink will look like a magic potion while the dry ice is melting. Tell them not to drink their juice until the piece of dry ice has completely melted.

ACTIVITY IDEA 2C EXPERIMENT: RISING AND FALLING RAISINS (a.k.a. "DANCING" RAISINS)

You will need:
- raisins
- tall, clear glass (so you can see the action going on inside)
- seltzer water

What to tell the students:

In this experiment you will observe the lifting power of carbon dioxide bubbles. Raisins are more dense that water and will naturally sink. When put into carbonated water, the wrinkled skins of the raisins provide lots of places where microscopic "nucleation sites" can form. These sites will attract CO_2 and form bubbles. The bubbles sticking to the raisin will give it enough lift to be able to rise to the surface. At the surface, the bubbles pop and the raisin sinks. Then the cycle repeats.

What to do:
1) Fill the glass with seltzer water and add about two dozens raisins.
2) Observe the raisins becoming covered with bubbles and rising to the surface. Watch as the bubbles pop and thus disappear at the surface, allowing the now bubble-free raisin to sink back to the bottom.

EXTENSION: Try some other objects, such as popcorn kernels, candy sprinkles, dry lentils. Do they form as many bubbles? Why or why not? (Do smooth objects have fewer nucleation sites?) Also, you could try comparing a clear plastic glass to a clear glass made of glass. Which has more bubbles forming on the sides? Might the texture of the plastic (even though it appears to be smooth) be less smooth than glass?

ACTIVITY IDEA 2D FOR AMBITIOUS EXPERIMENTERS: TRY THE "HOT ICE" EXPERIMENT

If you like challenging experiments, try making "hot ice" using baking soda and vinegar. Instead of reading how to do it, it's much better to watch. Check out the video on the playlist, or use a video search engine and the key words "hot ice experiment." If your hot ice doesn't work, at least you have a batch of sodium acetate crystals to look at. Just allow the solution to evaporate completely (and slowly) and you'll have some interesting crystals.
NOTE: Sodium acetate is used in many reusable hand warmers. If someone in your class has them, you could prepare them (they "reset" when boiled) and let the class witness how fast they go from flexible to hard. "Hot ice" forms inside the packet.

ACTIVITY IDEA 2E COOKING ACTIVITY: MAKE "MILK GLUE" (CASEIN GLUE) or MILK "PLASTIC"

In this activity, you will "curdle" milk. We will explain curdling in the next chapter. You can wait to do this activity until after chapter 3, or you can use it now if you need more activities for this chapter.

You will need:
- milk (any type—fat content won't alter results)
- white vinegar
- baking soda
- water
- pan, stirring spoon, strainer (NOTE: Some sources recommend straining using a funnel lined with a coffee filter.)

What to do:
1) Warm 1.5 cups (350 ml) milk in a pan. Once it is warm, add 3 teaspoons (5 ml) vinegar. (Measurements don't have to be exact.)
NOTE: If you are working in a classroom, you can do this process without heating and it should still work reasonably well.
2) Keep heating (if you are heating) and stirring until you see the curds and whey separate.
3) Strain out the curds. (You won't need the watery whey.) The curds will form a lump.
4) Put the lump of curds back into the pan and add a little water and a teaspoon of baking soda.
5) Heat this mixture until it bubbles. Turn off heat and let it cool.
6) Once cool, this mixture should make a stiff paste that can be spread using a brush or craft stick.

EXTENSION: The lump of casein (from step 3) can also be used as "milk plastic." Simply mold the casein into whatever shape you'd like, then let it dry. The dried "plastic" can be painted with acrylic paints.

NOTE: Making casein paint is more difficult than making glue. If you want to try paint, search online for instructions. It is mainly use by people in the antique furniture business.

ACTIVITY IDEA 2F "JUST FOR FUN" ACTIVITY: FOOD COLORING IN MILK

This activity is often done with younger children, but older kids enjoy it, too. Older students will be able to appreciate the chemistry of the materials.

You will need:
- milk (higher fat milk works best)
- food coloring
- plates
- dish soap
- cotton swabs

What to tell the students:

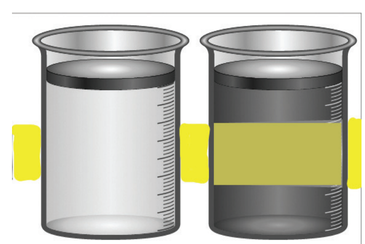
In this activity you will watch interactions between polar and non-polar molecules. Milk is mostly water, which is polar. It has microscopic non-polar fat globules suspended in it. The food coloring you will add to the milk will let you see molecular motion in the milk that would otherwise be impossible to see. Soap molecules have both a polar end and a non-polar end, so they can interact with both water and fat. When you touch a drop of soap to the center of the plate, the soap will begin to disperse in the water because of its polar ends. Then its non-polar ends will begin to be attracted to fat molecules. Further more, the negatively charged end of the soap molecules are attracted to the milk's protein molecules. So there are molecules coming and going all over the place as they chase after molecules that they'd like to be associated with. The food coloring simply goes along for the ride and allows us to see all the motion going on at the molecular level.

What to do:
1) Pour enough milk into the plate to completely cover the bottom.
2) Put a few drops of food coloring into the milk. DO NOT STIR!
3) Touch the tip of a cotton swab to the soap.
4) Touch the soapy end of the swab to the center of the milk.

NOTE: The effect in the milk will "run out" after a few touches of the swab. If they want to see the effect again, you'll need to rinse the plate and put in fresh milk.

EXTENSION: Some online sources suggest laying a piece of paper on top of the swirly designs to "capture" the design. Pull if off carefully and lay it flat to dry.

ACTIVITY IDEA 2G EXPERIMENT: TESTING FOR THE TYNDALL EFFECT (COLLOIDS)



You will need:
- various liquids in clear glasses (For example: water, whole milk skim milk, apple juice, water with food coloring, water with various powders mixed in, such as flour, baking powder, cornstarch, etc.)
- a laser pointer
- a flashlight

What to tell the students:

In this experiment you will test liquids for the Tyndall effect that you read about at the end of this chapter. The Tyndall effect occurs in colloids. Solutions will let light pass right through because the dissolved particles are so small. Colloids have larger particles which will block the light.

What to do:
1) Start with a clear glass of water. Shine the flashlight and the laser pointer through and observed what happens to the light.
2) Mix a little milk into the water and shine the light again. Any change? Add a little more and try it again.
3) Shine the light through a glass of pure milk.
4) Try the light through various other liquids. How many are colloids? Try mixing some powders (powdered fruit juice, jello powder, powdered milk, or whatever you have on hand) into water and see which end up being solutions and which end up being colloids.

ACTIVITY IDEA 2H GAME: "THE GLYCINE GAME" (pattern pages are part of the digital download at http://ellenmchenry.com/printable-pages-for-DYD)

You will need:
- copies of the following pattern pages (see printing directions at the bottom of each page)
  If card stock is not available, use regular paper.
- scissors
- Optional: paper and pencil for each player (for writing down answers to questions)

How to set up:
1) Choose one of the card sets to use in the game. If you want to do review of facts learned in the chapter, print the REVIEW cards. If your students have mastered the basic concepts of the chapter, you can choose BONUS INFO cards. (Or print both of them and play the game twice!)
2) Cut apart the molecule cards and the quiz cards. Trim the playing board.
3) Shuffle the molecule cards and place them face down on the square in the center of the board. Shuffle your chosen set of quiz cards and place them face down on the rectangle in the center of the board.

How to play:
1) The goal of the game is to be the first player to use the molecule cards to build a glycine molecule (as shown on board).

2) Players take turns drawing cards. If the card is a quiz question, the reader of the card will be the one player who is not allowed to benefit from a right answer since, obviously, they are seeing the answer. The other players write down their guess as to the correct answer. When the corrrect answer is read aloud, each player who had written the correct answer gets to take a molecule card. If the card is simply a question about what you ate (from the BONUS INFO card set), then the reader of the card may also give an answer, if applicable, and receive a card.
NOTE: For the BONUS INFO cards, players are not expected to already know the answers. They are supposed to think about any information they might know that would help them to eliminate wrong answers, then take a guess. If they guess wrong, that's okay. They learn when the hear the answer. (If that question comes up again, hopefully they will remember the answer.)

3) The role of the H_2O cards: Water is the "universal solvent," meaning that because it is a strongly polar molecule, it exerts a pull on many types of chemical bonds. When you draw an H_2O card, it will dissolve one of your chemical bonds. This means that you must choose one of your cards and return it to the bottom of the draw pile. You also return the H_2O card to the bottom of the draw pile.

4) The first player to make a complete glycine molecule wins the game.

ACTIVITY IDEA 2I EXPERIMENT: EFFECTIVENESS OF VARIOUS PRESERVATIVES IN BREAD

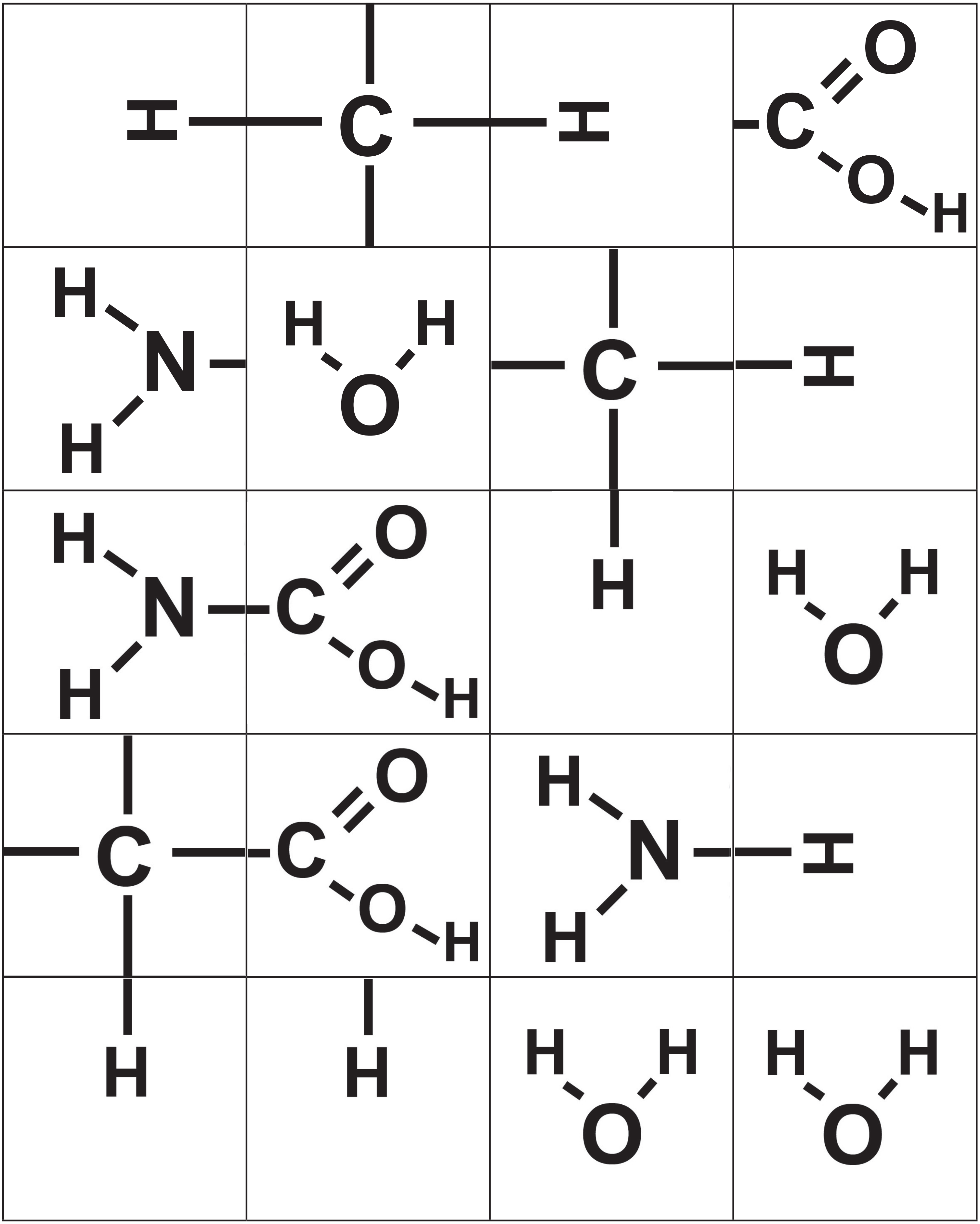
You will need:
- several slices of bread from different sources that use various preservatives, or use no preservatives

(Calcium propionate and sodium proprionate are the most common preservatives. Some natural breads use a chemical derived from cherries. In my class, the cherry preservative worked amazingly well.)
- sandwich-sized plastic bags
- marker to write on the bags

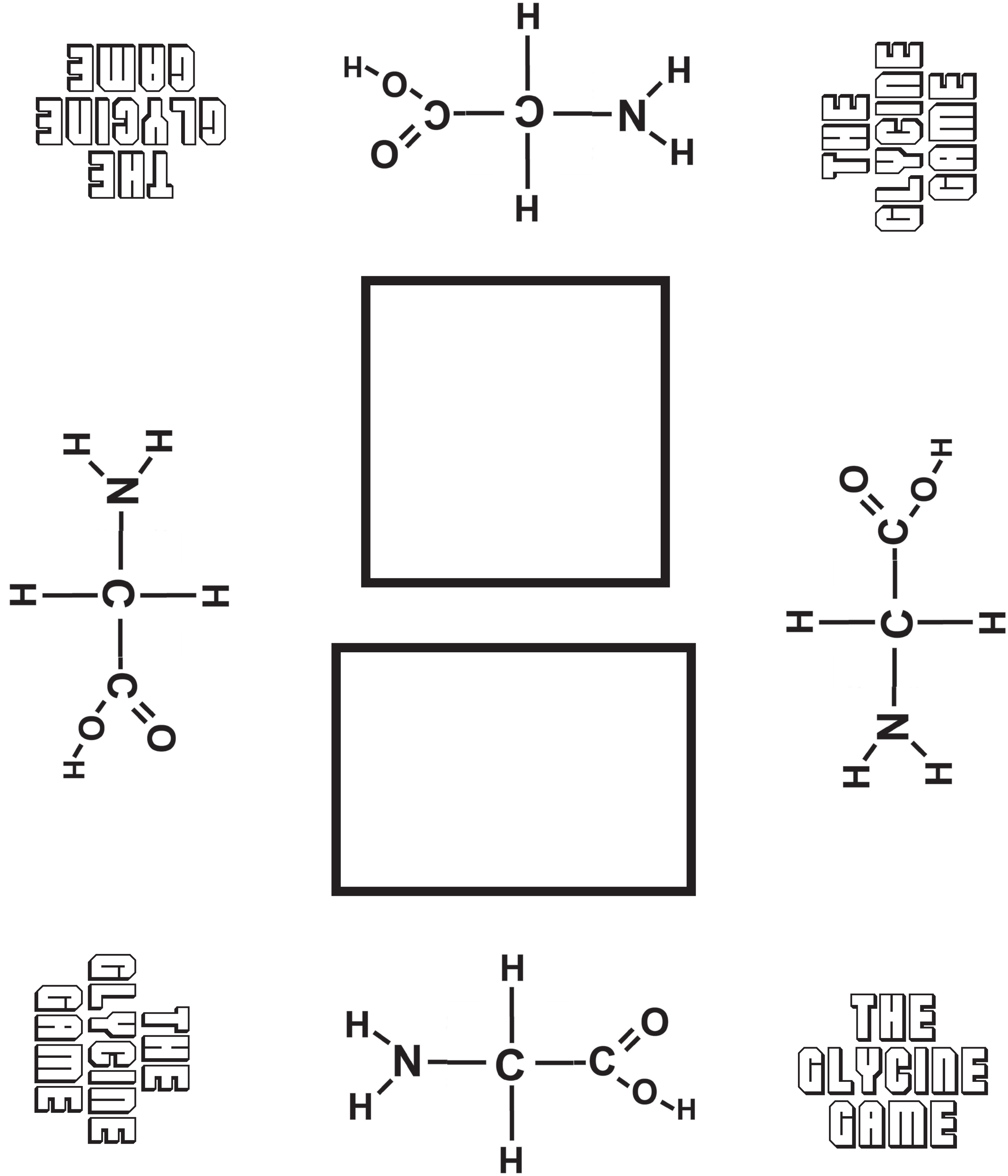
What to tell the students:

In this chapter we met a few preservatives. In this experiment you will find out the names of various preservatives used in commerical bread and you find out which seem to be most effective at preventing mold.

What to do:
1) Place one slice of bread from each loaf into a plastic bag. The bags will keep the bread from drying out and will speed up the molding process.
2) Read the labels on the bread bags and find the names of the preservatives. (When in doubt, type the chemical name into an internet search engine to find out what it does.) Label the bags so you remember which loaf each slice came from. You might also want to write which preservatives were listed on the bread bag.
3) Let the bags sit for at least a week, until obvious mold spots appear. Observe the bags each day and keep a written record of what happens in each bag.
4) Discuss results. Which bread was the most resistant to mold? Think of other factors that might have contributed to the rate of molding. (ex: water content, types of grains used, salt or sugar content)



PRINT ONTO CARD STOCK / PRINT ONE PAGE FOR 2 PLAYERS, PRINT 2 PAGES FOR 3-4 PLAYERS



PRINT ONTO CARD STOCK / ONE COPY (FOR UP TO 4 PLAYERS)
TRIM OFF THIS BOTTOM SECTION

What number is neutral on the pH scale? Answer: 7	What is the special name for the attraction between water molecules? Answer: hydrogen bonding	TRUE or FALSE? What we think of as "taste" comes largely from our sense of smell. Answer: True
TRUE or FALSE? The amount of benzene in a can of soda is dangerous. Answer: False	What is OH- called? a) hydrogen ion b) hydronium ion c) hydroxide ion Answer: C	TRUE or FALSE? A hydrogen ion is the same thing as a proton. Answer: True
TRUE or FALSE? If you let a nail sit in a glass of Coke, the phosphoric acid in the Coke will dissolve the nail. Answer: False	Salt water is a: a) solution c) colloid b) mixture d) compound Answer: A	Milk is a: a) solution c) colloid b) mixture d) compound Answer: C
When a glucose molecule is attached to a fructose molecule, what do you get? Answer: sucrose	What is the name of the enzyme that breaks apart the sucrose molecule? Answer: sucrase	What is the special name for the carbon atom at the center of an amino acid molecule? Answer: alpha carbon
How many fatty acid chains are on a <u>triglyceride</u> molecule? (Hint: Think about the word.) Answer: 3 ("tri" means 3)	What is the name of the enzyme that breaks apart the lactose sugar molecule? Answer: lactase	Peptidase enzymes break apart what type of molecule? a) fats b) proteins c) sugars Answer: B
TRUE or FALSE? Trigylceride fat molecules in milk float around freely Answer: FALSE, they are found inside spherical membranes.	Famous scientist Louis Pasteur discovered this simple sugar. Answer: Galactose	What is casein? a) Glue that is made from milk. b) A protein found in milk. c) A type of paint made from milk. Answer: B

REVIEW CARDS **PRINT ONTO CARD STOCK / ONE COPY PER GAME (up to 4 players)**

Take a card if you have consumed any food or drink today that contains casein. Remember, casein is the protein found in milk. Casein foods include milk, cheese, yogurt, and ice cream. Butter and cream have had most of their casein removed, so they are not really casein foods.	Food allergies are usually not a good thing, but today they will earn you a card. Name your food allergy or allergies and then take a card.	Can you guess which of these plant parts has the highest amount of protein? a) roots b) leaves *c) seeds d) flowers
Everyone (except the card reader) loses a card. Choose one of your cards and return it to the bottom of the draw pile.	If we could gather all the sodium and chlorine atoms in your body, and turn them into salt, can you guess how many shakers they would fill? a) half a shaker b) one shaker *c) three shakers d) ten shakers	Nuts are full of amino acids! Take a card if you have eaten any type of tree nut today or yesterday. Tree nuts include walnuts, almonds, pecans, pistachios, brazil nuts, pine nuts, macadamias. hazelnuts, and cashews. NOTE: Peanuts are NOT tree nuts.
Salt can be extracted from sea water. Can you name the country that has the saltiest sea in the world? a) Turkey b) Lebanon c) Egypt *d) Israel	Time to trade! Each player must choose one of their cards and hand it to the player on their left.	The ancient Romans were famous for the stinky, salty sauce that they used as a condiment (like ketchup). The sauce was left to ferment (rot) for months. Can you guess the main ingredient of their stinky sauce? *a) fish b) beans c) cabbage d) garlic
The healthiest (mineral-rich) drinking water in the world is generally considered to be water that comes from what source? a) lakes *b) glaciers c) the ocean d) underground wells	Beans are a great source of protein. If you have eaten any beans today or yesterday, take a card. Ex: green beans, kidney beans, black beans, canneli bean, Fava beans, Lima beans, refried beans	Can you guess who drinks more milk than anyone else in the world? The citizens of: *a) Norway b) Netherlands c) Germany d) France
Dairy cows produce over 80% of the world's milk. The runner up, with 14% is: a) sheep b) goats *c) buffalo d) camels	Can you guess where the world's largest dairy farm is located? They milk over 90,000 cows every day! *a) Arabia b) Korea c) Russia d) South Africa	Can you guess the most popular dairy cow in the United States? a) the brown and white Guernsey *b) the black and white Holstein c) the tan and white Jersey
Which type of milk will look slightly blue if you shine a light through it? a) raw milk b) whole milk c) 2% fat milk *d) fat-free skim milk	Which of these plant sources is NOT used to make a milk substitute? a) almonds b) oats *c) peanuts c) coconuts	This question is about something you read in the chapter. Which one of these substances do you think has the <u>lowest</u> pH number? a) water b) apple juice c) milk *d) lemon juice

BONUS INFO CARDS

PRINT ONTO CARD STOCK / ONE COPY PER GAME (up to 4 players)

<u>ACTIVITY IDEA 2J</u> "MOLECULE MAT" for chapter 2

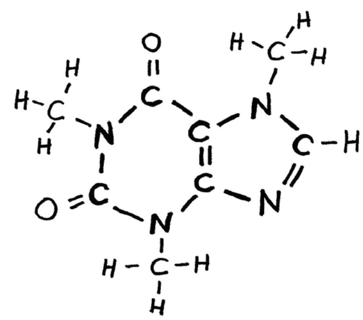
<u>You will need:</u>

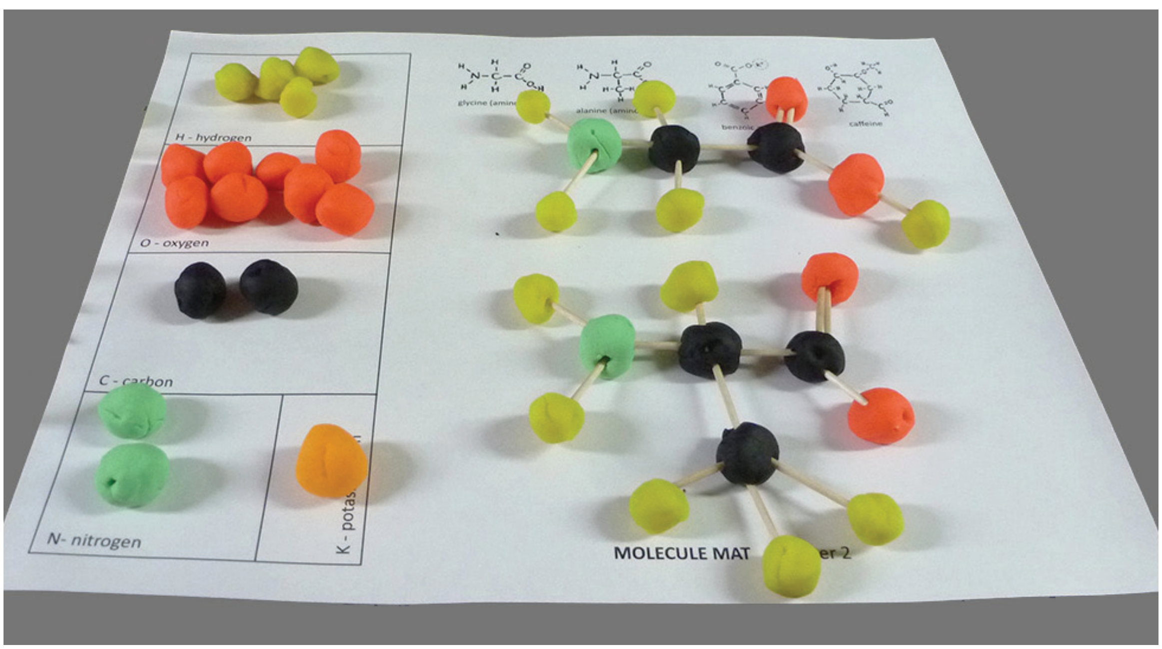
- a copy of the following pattern page for each student
- toothpicks
- the materials you used for the Molecule Mat in chapter 1 (or try something different if you want to)

<u>What to do</u>:

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 students to build two then recycle the items, or give them an extra blank sheet and have them build several molecules 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.

TIP: For students who finish early (if you are working with a group) have them bond their glycine to their alanine. (Remove the OH from the COOH, and one of the H's from the NH_2. The OH and H will form a water molecule.) If they need another challenge, have them build caffeine, shown here on the right.
(We will build this after the last chapter, but doing it twice is fine.)





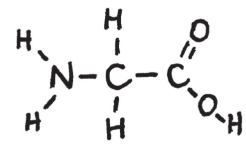
H - hydrogen

O - oxygen

C - carbon

N- nitrogen

K - potassium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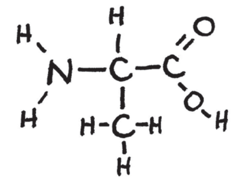
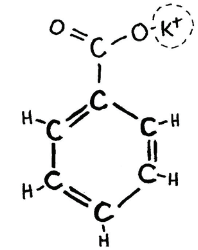
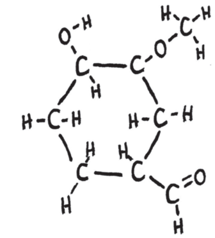

alanine (amino acid)


benzoic acid


vanillin

MOLECULE MAT Chapter 2