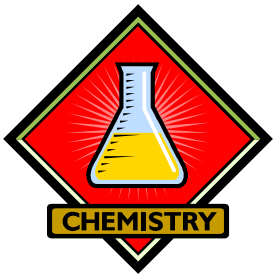
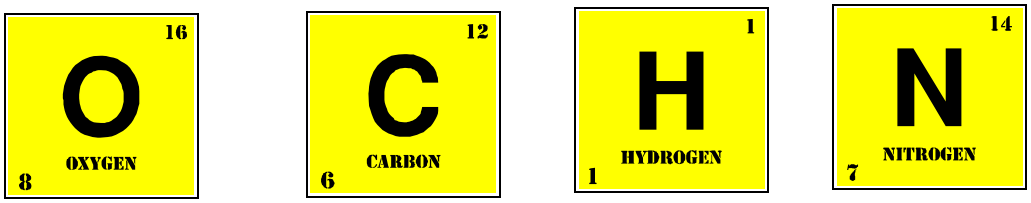


Speeding up the Fizz

Teacher's Notes

Chemicals are everywhere. A chemical is a substance that has mass and takes up space. The simplest substance is an *element*. You may have seen a periodic table before. The periodic table lists all the elements presently known. Some common elements are:



An *atom* is the simplest particle that describes an element. The center of an atom is called the *nucleus* and contains both *neutrons* and *protons*. The *electrons* orbit around the nucleus. What makes each element unique is the number of electrons, protons, and neutrons it has. The number in the lower left-hand corner of the periodic table is the number of electrons that element has in its most stable form.

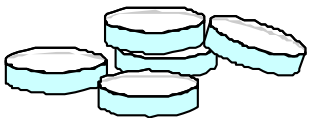
A *molecule* is just a group of bonded atoms that exist as a separate entity. Can you think of any molecule that is made up of the elements shown above? Chemists have developed a shorthand notation for molecules by combining the letter for each element that is contained in the molecule. If an element is contained twice then a subscript 2 is written next to that element's letter. This

shorthand is called an *empirical formula*. Can you give the common name for the following empirical formulas?

H_2O _____water_____ CO_2 __carbon dioxide___

O_2 _____oxygen_____ CH_4 ____methane_____

A *chemical reaction* is when two molecules come together and undergo chemical change to form new substances with new properties. Chemical changes are indicated when any of the following occur: formation of a gas (bubbles present), formation of a new solid, a color change, or a gain or loss of heat. In addition many factors can affect a chemical reaction — changing how fast the reaction proceeds or even if the reaction happens. An example is temperature. Some reactions need to be heated in order for the reaction to occur. In other cases, some other molecule (called a *catalyst*) needs to be present for the reaction to happen. In this lab you get the chance to explore the effect of temperature and particle size has on the rate of a simple chemical reaction.



Part A: Effect of Particle Size

These labs illustrate that various experimental conditions can affect the rate of a chemical reaction. Here the chemical reaction is that between an effervescent tablet and water. When an effervescent tablet is placed in water, a reaction takes place in which CO_2 is released (bubbles).

This reaction will continue until one reactant, the effervescent tablet, is consumed. This simply means that the bubbles will continue until the tablet is completely gone. Thus, it is very easy to measure the rate of this simple chemical reaction. The girls must just measure the time that it takes the tablet to dissolve. It is then possible to vary the conditions of the reaction and see their effect on the rate.

Part A of this lab has the girls examine the effect of the size of the tablets on the reaction rate. The girls will discover that the reaction will go faster (i.e. the tablet will dissolve quicker) if the tablet is broken into pieces than if it is whole. It is important that the girls understand this conclusion. In Part B they will look at the effect of the temperature on the reaction rate and they will need to always use whole tablets.

 To do part A of the lab, get a partner and gather the following supplies for a class of 30 students. They will work with a partner.

Equipment needed:

- ❑ 15 Thermometers
- ❑ 15 Graduated cylinders (100 ml)
- ❑ 45 clear plastic cups (7 oz)
- ❑ 45 effervescent antacid tablets
- ❑ 15 Stopwatches
- ❑ 30 Pencils
- ❑ 15 pieces of filter paper
- ❑ Water (room temperature)

Procedure:

1. Before beginning, have your teacher show you how to use the stopwatch.
2. Using a graduated cylinder, fill 3 plastic cups each with 100 ml of room temperature water.

3. Measure the temperature of the water and record below:

Temperature = _____**26**_____ ˚C

4. Working with a partner: place one full tablet in one of the glasses of water and time how long it takes for the tablet to dissolve. One person should place the tablet into the water and the second should start the stopwatch. Stop the stopwatch when you do not see any more of the tablet.
5. *Record* the time in the table below
6. Set this cup of water aside
7. Break a second effervescent tablet into 4 pieces.
8. Place all 4 pieces into a new glass of water and time how long it takes for all 4 to dissolve.
9. *Record* the time in the table below
10. Set this second cup of water aside
11. Take the third effervescent tablet and crumble it into many pieces. Do this on the filter paper so that you do not loose any pieces.
12. Place the entire crumbled tablet into the third glass and time how long it takes all the pieces to dissolve.
13. *Record* the time in the table below.
14. Empty and rinse out all three glasses

Sample Results

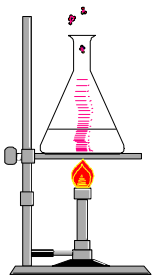
	Time (seconds)
Full tablet (step 5)	**36.13**

Broken Tablet (step 9)	**30.22**
Crumbled tablet (step 13)	**22.31**

Discussion:

What tablet dissolved fastest? The crumbled tablet dissolves faster.

Why? The surface area for the crumbled tablet is larger than that on the whole tablet. Thus, there is more area to react at a given time and the reaction goes faster.



Part B: Effect of Temperature

To do part B of the lab, gather these additional supplies for a class of 30 students.

- ❑ 75 effervescent antacid tablets
- ❑ Jug of hot water
- ❑ Jug of ice

Procedure:

1. Using a graduated cylinder, fill 1 plastic cup with 100 ml of room temperature water.
2. Measure the temperature of the water and *record* in table below
3. Measure how long it takes for one whole tablet (do not crush or break) to dissolve
4. Record the time in the table below
5. Set this cup of water aside
6. Fill a graduated cylinder with 50 ml of room temperature water
7. Add ice to give a total volume of 100 ml
8. Pour the ice/water mixture into a plastic cup and stir. *Record* the temperature when it has reached a constant value.
9. Measure how long it takes for one whole tablet (do not crush or break) to dissolve in the ice water.
10. *Record* the time in the table below
11. Set this cup of water aside

12. Using a graduated cylinder, fill 1 plastic cup with 100 ml of hot water.
13. Measure the temperature of the water and *record* in table below
14. Measure how long it takes for one whole tablet (do not crush or break) to dissolve in the hot water.
15. *Record* the time in the table below
16. Set this cup of water aside
17. Repeat this procedure using different temperatures of water, *record* your results in the table below

Sample Results

Temperature (˚C)	Time (seconds)
26	36.13
38	26.56
2	145.71
47	17.36
13	65.01

Discussion:

1. Did the tablet dissolve faster in hot water or cold? _____cold_____

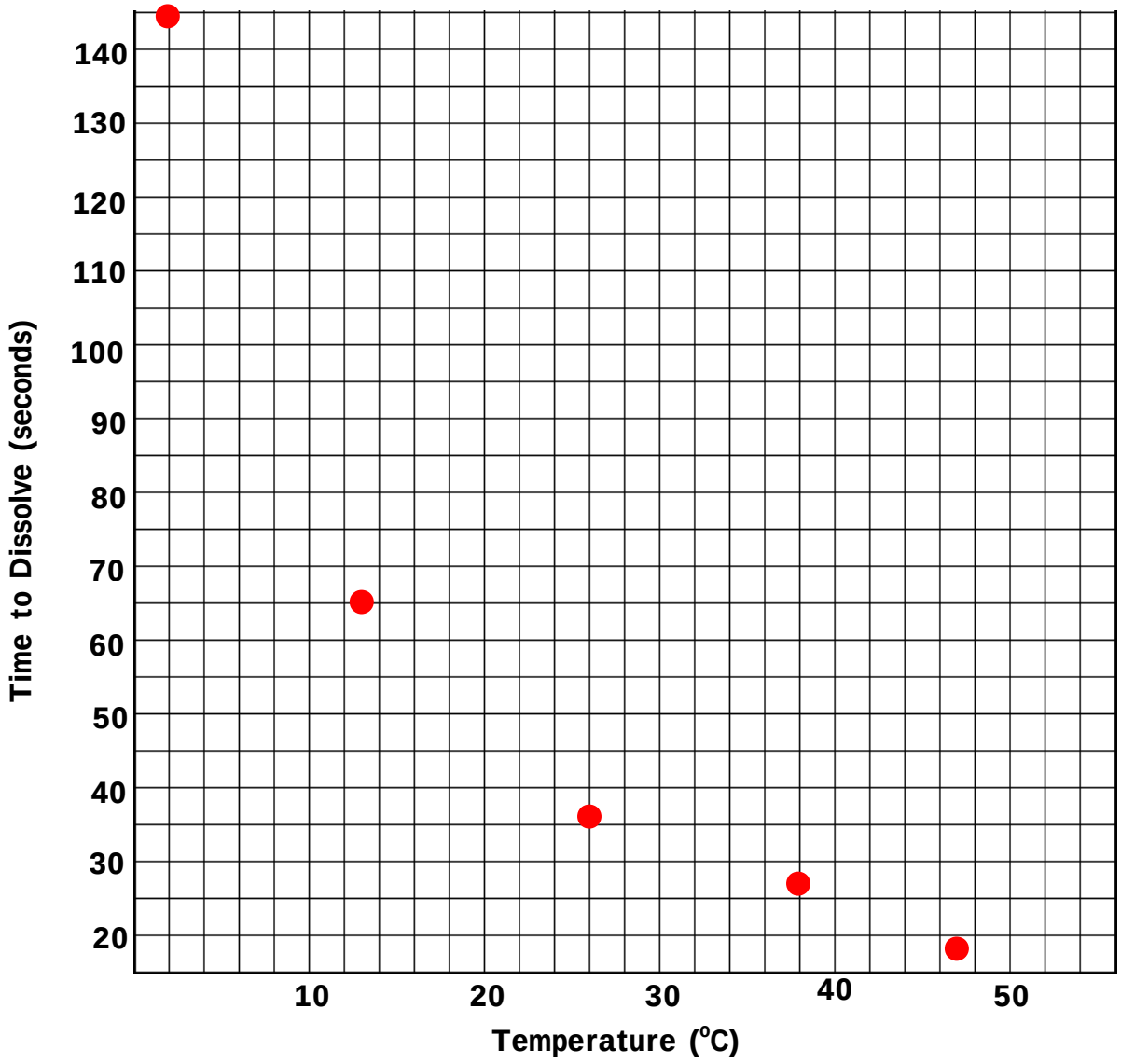
2. Why? _The increase in temperature causes the number of collisions to_____

_____increase and thus the reaction proceeds faster._____

3. Why was it important to use a whole table each time? As was seen in the Part of the lab, a broken tablet will dissolve faster than a whole tablet. If we want to measure the change caused by heat, we need to keep the other

Analysis of the results obtained in Part B:

Plot temperature (x-axis) vs. time (y-axis) on the graph below using your results from part B.



Discussion:

1. Does your data lie in a straight line? _____

2. Draw a smooth curve through your points. Pick a temperature that lies between temperatures you have already measured. Using the graph, predict how many seconds it will take the tablet to dissolve. Try the experiment. Does your prediction agree with your measurement? _____