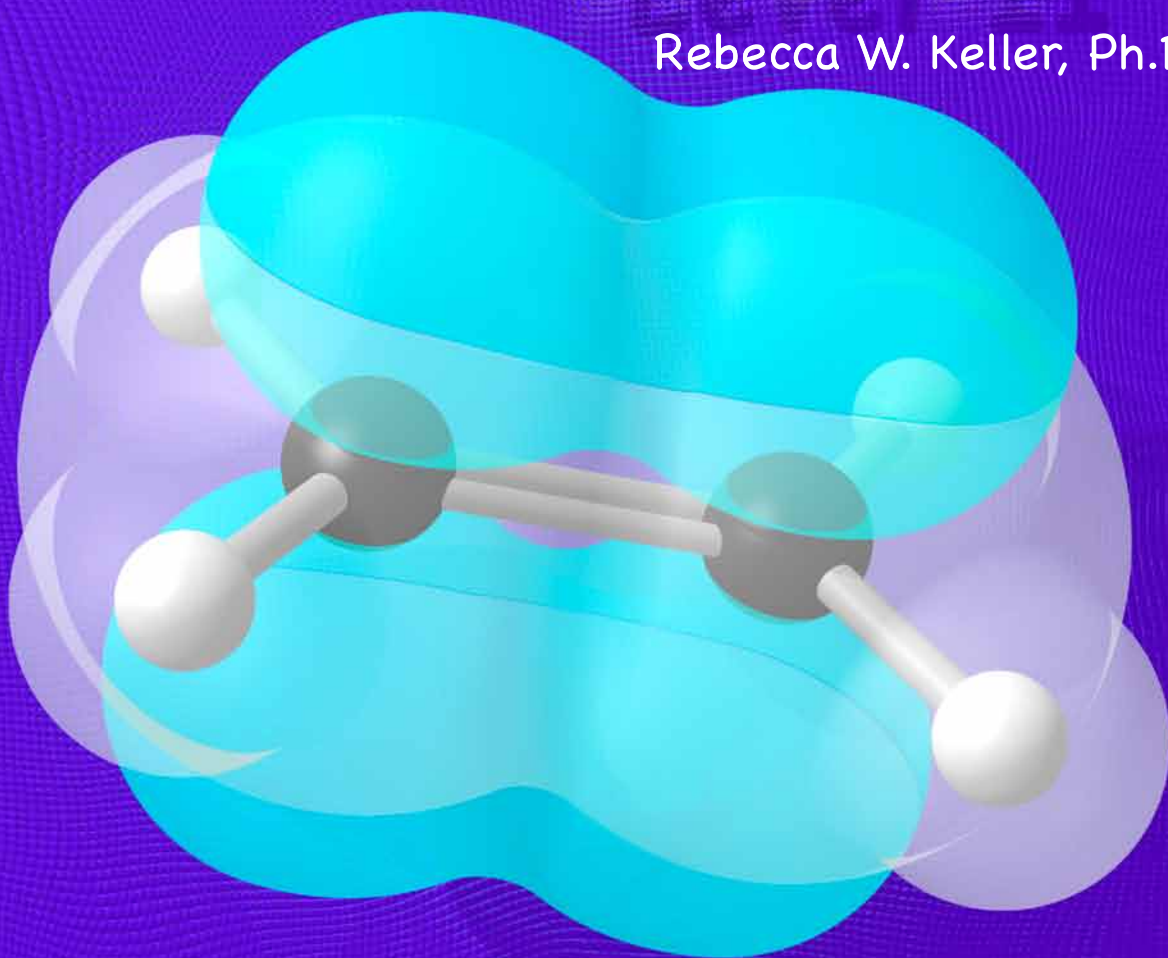
Real Science-4-Kids

Chemistry

Level II

Rebecca W. Keller, Ph.D.



Teacher's Manual

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To the Teacher

In this teacher's manual you will find all of the answers to the Study Questions and Practice Problems in the Chemistry Level II Student Textbook. You will also find a "Suggested Experiment" for each chapter.

In the student laboratory workbook, I encourage the students to design their own experiments. I want students to learn how to create new scientific ideas, and the only way to get them to do that is to encourage them to try. Anyone can find a number of science "experiments" or recipes to follow in a variety of science lab textbooks and on the internet. But the point of scientific investigation is to discover what is not yet known, and some of the most exciting science is discovered by scientists creating new ways to do new things that no one has tried before.

It is important for teachers to give students the freedom to think for themselves and, within reason, to experiment with ideas that you, the teacher, may know won't work. If your student decides to use bubble gum instead of masking tape to attach a test tube to a jar, let them try. It may work beautifully or it may fail and ruin the whole experiment, but at least they tried and in the end they may know quite a lot more about bubble gum than they would have without trying. It is fine to guide them in order to help them find better ways to conduct scientific experiments, such as the use of controls, but don't get overly concerned that they do the experiment "right." The process of learning through *experimentation* is the most important aspect of these experiments.

Also, as much as possible, answer their questions with more questions. Use lots of "How," "Why," and "What" questions.

Student: "How do I get the test tube to stick to the inside of the jar containing water?"

Teacher: "How could you do it?"

Student: "I think I'd like to use bubble gum."

Teacher: "Why do you think that will work?"

Student: "Well, because bubble gum is still sticky inside my mouth and my mouth has water in it, so it should stick in water."

Their answers may surprise you.

Most importantly — be safe and have fun!

Rebecca W. Keller, Ph.D.

Laboratory Safety

Most of these experiments use household items. However, some items, such as iodine, are extremely poisonous. Extra care should be taken while working with all chemicals in this series of experiments. The following are some general laboratory precautions that should be applied to the home laboratory:

> Never put things in your mouth without explicit instructions to do so. This means that food items should not be eaten unless tasting or eating is part of the experiment.
>
> Use safety glasses while using glass objects or strong chemicals such as bleach.
>
> Wash hands before and after handling chemicals.
>
> Use adult supervision while working with iodine and while conducting any step requiring a stove.

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Answers to Study Questions *2*

Instructions for Experiment 1:
Low Sodium *3*

Text reading time .... 2 hours

Experiment time .... 2-3 hours

Suggested Materials :

any packaged materials that have the salt content listed on the side of the box in milligrams (mg)

Answers to Study Questions

1. protons, neutrons, and electrons. Protons have a positive (+) charge and electrons have a negative (-) charge. Neutrons have no charge.

2. 150

3. 54 amu

4. a. chlorine Cl
   b. carbon C
   c. lithium Li
   d. nitrogen N
   e. mercury Hg

5 atomic number 9, fluorine; atomic number 17, chlorine; atomic number 35, bromine

6. atomic number 10, neon; atomic number 36, krypton; atomic number 2, helium; atomic number 18, argon

7 atomic number 3, lithium; atomic number 11, sodium; atomic number 19, potassium; atomic number 37, rubidium.

8. one mole

9. One mole weighs 10.81 grams, so 3 moles would be: 3 x 10.81 = 32.43 grams.

10. To find how much one mole of ammonia weighs, first look on the periodic table and find the atomic weight for each atom in the ammonia molecule.

    one mole of nitrogen weighs 14.01 grams
    one mole of hydrogen weighs 1.00 gram

    Next, write down how many of each kind of atom ammonia has.

    ammonia has one (1) nitrogen atom and three (3) hydrogen atoms:

    Now, plug these numbers into an equation where the number of each atom is multiplied by its atomic weight.

    One (1) nitrogen atom times (x) 14.01 grams, plus (+) three (3) hydrogen atoms times (x) 1.001 equals (=) 17.01 grams.

    [(1 N) x (14.01 grams)] + [(3 H) x (1.00 gram)] = 14.01 grams + 3 grams = 17.01 grams

    one mole of ammonia weighs 17.01 grams.

Instructions for Experiment 1: Low Sodium

In this chapter students learned about matter, mass, and moles. The experiment outlined below will help students further explore these concepts.

The student will need to learn dimensional analysis to perform this experiment. A full discussion of dimensional analysis is given in Appendix D. Have the student read Appendix D before doing the experiment.

In this experiment, the student is given a hypothetical request by their family doctor to limit their sodium intake. The limit is expressed in moles. They will discover that all of the food products list the sodium amount in milligrams (mg). Help the student think about how to solve this dilemma.

A "hint" is provided to help the student get started.

If your student gets stuck or frustrated, help them think through the experiment by asking the following questions:

1. What can you call your experiment? What are you trying to find out with this experiment?

2. What is an "objective?" Specifically, what is your objective with this experiment? What did the doctor request?

3. What is a "hypothesis?" What foods do you think you may or may not be able to eat?

4. How would you write the steps for the experiment? What do you think you should do first?

5. How could you organize the information from the food labels? Can you put the information in a table or a graph? Which information do you think you should look for? What is the "daily recommended allowance?" What is the serving size for each item?

6. How many food items do you think you should check?

7. What if all of the food items have too much sodium? Should you look for other food items? Do you think you could eat less of each?

8. What is a "conclusion?" Did you prove or disprove your hypothesis? How can you tell?

EXPERIMENT 1: LOW SODIUM

You go to the family doctor, and he decides to put you on a special diet. He tells you that you have been eating too much sodium. He is an old chemist, and he tells you not to eat more than 0.01 mole of sodium per day. This sounds pretty easy until you go home and find out that all of the food items list the amount of sodium in mg (milligrams). How do you follow the doctor's orders? Which foods can you eat?

HINTS:

First determine the atomic weight of sodium. It is on the periodic table and the quantity is given as grams per mole (grams/mole). Record this quantity here *22.99 grams/mole*

Remember that the atomic weight tells you how many grams of an element are in one mole. But you need to find out how many milligrams are in 0.01 mole. To find out how many milligrams of sodium are in 0.01 mole, first convert grams of sodium in one mole to milligrams of sodium (1000 milligram = 1 gram) in one mole, and then multiply by 0.01 mole. This will give you milligrams of sodium in 0.01 mole.

Do your calculation here:

There are 22.99 grams of sodium in one mole.

22.99 grams (in one mole) x 1000 milligrams/gram = 22990 milligrams (in one mole)

$$\boxed{(22.99\ \text{gr}\cancel{\text{am}}\text{s}) \times \left(\frac{1000\ \text{milligrams}}{\text{gr}\cancel{\text{am}}}\right) = 22990\ \text{milligrams}}$$

22990 milligrams/mole x 0.01 mole = 229.9 milligrams

$$\boxed{\left(\frac{22990\ \text{mg}}{\cancel{\text{mole}}}\right) \times (0.01\ \cancel{\text{mole}}) = 229.9\ \text{mg (milligrams)}}$$

milligrams (mg) of sodium in 0.01 mole = *229.9 mg sodium*

Now set up your experiment.

Experiment 1: *What can I eat?* Date: ____________

Objective: *To determine which foods contain less than 0.01 mole of sodium per serving*

Hypothesis: *I will be able to eat cereal, but not peanut butter.*

I. List the materials you need:

MATERIALS

1. Calculation from page 1 of this experiment
2. Several food item package containers
3. Pen

II. Write out the steps of your experiment in as much detail as possible.

EXPERIMENT

1. *First I will record how much sodium is in 0.01 mole.*
2. *Next, I will make a list of several items and record the amount of sodium in each.*
3. *I will then compare the amount of sodium in each food item with the limit.*
4. *I will determine the food items below the limit and list these as permissible foods.*
5. ____________

III. Record your results.

RESULTS

Food Item	Serving size	Sodium (in milligrams)
Raisin Bran cereal	*1 cup*	*350 mg*
Nature Valley Granola Bars	*2 bars*	*160 mg*
Jiff Peanut Butter	*2 Tbsp.*	*150 mg*
Chicken of the Sea tuna	*2 oz.*	*250 mg*
Baked Beans	*1/2 cup*	*550 mg*

Foods that are below 229 mg sodium:

Granola bars - 2 bars, 160 mg sodium

Peanut butter - 2 Tbsp, 150 mg sodium

IV. Discuss your results and write your conclusions.

CONCLUSIONS

If I follow the serving size suggestions for each food item, I will only be allowed to eat the peanut butter and granola bars.

My hypothesis was incorrect. I am not able to eat the cereal at the suggested serving size.

I can reduce the serving size for the food items with high sodium and still be within the 0.01 mole limit.

I can eat less than 1/4 cup of baked beans or 1 oz. of tuna or 1/2 cup of bran cereal.