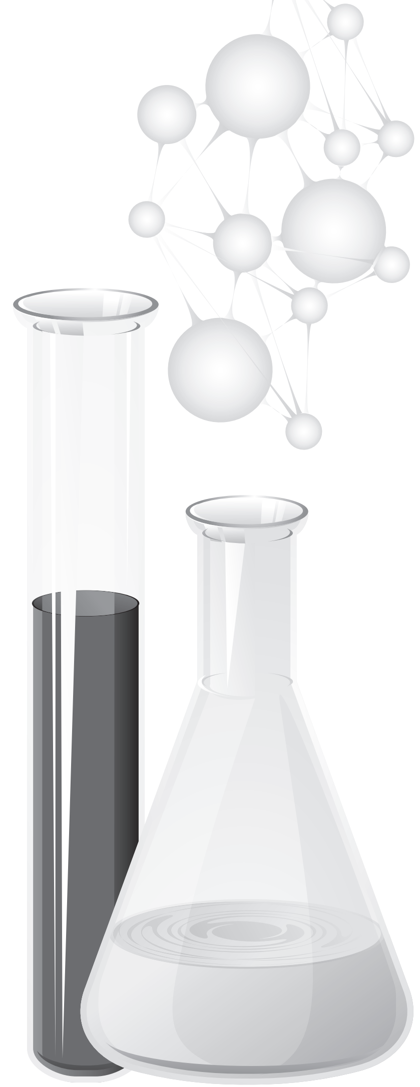


TAKE-HOME CHEMISTRY: 50 Low-Cost Activities to Extend Classroom Learning

Michael Horton

Hawker Brownlow
EDUCATION

TABLE OF CONTENTS

INTRODUCTION

SECTION 1: Science Process Skills, Measurement and Scientific Inquiry

SECTION 2: Chemical and Physical Properties

SECTION 4: Gas Laws, pH and Kinetic Molecular Theory

INTRODUCTION

Research has shown that homework can be an effective and meaningful learning tool for high school students if it is relevant, engaging and hands-on. These take-home chemistry activities are designed to match those criteria. The activities also cost far less than $10 per student the first year, and only a small amount each year after to refill the consumables. Educational writer Alfie Kohn said in a 2006 interview that there are only two ways that homework is effective for high school students. One way is using "activities that have to be done at home, such as … a science experiment in the kitchen" (Oleck 2006). This book is a collection of such activities.

This book is a collection of chemistry labs that lend themselves to being performed at home with simple materials. It is not intended to be a chemistry textbook or to cover every topic encountered in high school chemistry. Most of the labs are written as structured or Level 2 inquiry (see Inquiry in Chemistry, page xi), and some include instructions to raise the level of inquiry if the teacher feels comfortable doing so. A few activities just are not compatible with inquiry at home and are written as Level 1 labs but are still important because they introduce topics critical for other experiments or topics that have common misconceptions. Most of the activities involve measuring, graphing, calculating, extrapolating graphs and performing other science-process skills.

Because this is one piece of a complete chemistry curriculum, it is assumed that traditional learning and hands-on activities in the classroom will fill in where take-home labs are not practical. Teachers may choose to eliminate some of the labs and substitute others without breaking the flow of the labs.

Used in this way, the hands-on activities can be a powerful tool for learning chemistry concepts and preparing students for chemistry standardised assessments that are highly dependent on charts, graphs and conceptual questions. These activities have been piloted in schools across the United States and used by teachers who received the material during conference presentations. The success that these teachers have had with the labs helps refute the common misconception among teachers and students that lectures are for learning and labs are for fun. Students *can* learn chemistry from labs.

Although the labs are written as take-home activities for high school students, many of the activities in the book are well suited for homeschooled students as well as those who take online courses. These activities would also be appropriate for family science nights and museum outreach programs. If a teacher does not have sufficient materials to send an activity home with every student, the lab could be performed in class as an alternative. One teacher used the activities in after-school intervention programs for students who were not proficient after being exposed to the concepts in the classroom.

Why Take-Home Labs?

These take-home labs, if implemented effectively, can address most or all of the following problems, which are common with chemistry labs and homework.

Students will not do homework. This sentiment could be rephrased as, *students will not do busy work at home*. When presented with fun and challenging assignments that open doors to understanding the physical world around them, students will rise to the occasion. Throughout four years of implementing these activities, I found that the homework completion rate improved greatly, and test scores indicate that student achievement increased as well (see Evidence of Success below).

Students do poorly on standardised tests. Most standardised science tests are weighted toward science-process skills. These skills include drawing and interpreting charts and graphs, finding patterns, interpreting diagrams and analysing experimental data. The take-home labs in this book support each of these skills.

There is not enough class time to cover all the standards. A great deal of class time is used on simple labs that students could do at home. These labs are important, but they consume valuable class time. By having students perform these labs at home, teachers recover days of class time in which new concepts can be taught or reinforced.

Students do not experience enough labs. By assigning take-home lab work, teachers can increase the number of labs students complete over the course of the year. This will lead to a more engaging, fulfilling learning experience for students, which will lead to deeper, longer-lasting learning.

Chemistry labs are expensive. There are 50 labs in this book, and the collection of materials needed to complete the labs costs $10 or less, or approximately 20¢ per lab per student the first year. After the first year, only breakages and consumables need to be replaced, at a cost of less than a dollar per kit.

Chemistry students lack basic skills when they get to my class. Some of the take-home labs teach about background information and skills that students are supposed to remember from middle school but rarely do. These labs are a good refresher that you can refer back to throughout the year. As mentioned earlier, it can also buy you extra days of class time to teach the chemistry curriculum for your grade level.

ACTIVITY 2: BUILDING YOUR BALANCE

SCiLINKS THE WORLD'S A CLICK AWAY

Topic: Density of Water
Go to: *www.scilinks.org*
Code: THC02

Objective

Students learn how to use a single-beam balance to determine the masses of objects. Students use the density of water to determine the mass needed to balance the objects.

Purpose

Students will practice using their balances to hone their skills for future labs.

Materials

Two small cups (takeaway cups for sauces are ideal), plastic ruler, pencil, four coins of differing values

Notes

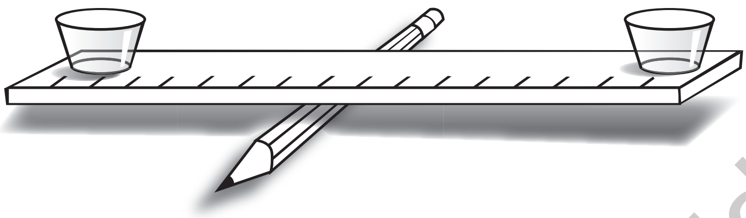
These balances are surprisingly accurate when used properly. Students should be given the accepted masses of the coins after the lab to determine if they measured properly. They should also be instructed to read the syringe to at least one decimal place. Using a hexagonal pencil will hurt their accuracy a bit, but using a round pencil makes it difficult to get stable balance. There are numerous designs for homemade single-beam balances; feel free to substitute another design if you prefer.

- Five cents: 2.8 g
- Ten cents: 5.6 g
- Twenty cents: 11.2 g
- Fifty cents: 15.5 g
- One dollar: 8.9 g
- Two dollars: 6.5 g

Post-Lab Questions

1. Answers vary.
2. Answers vary but should include suggestions such as the balance shifting, the apparatus not balancing completely, etc.
3. Theoretically, one drop of water; realistically, around the mass of the five-cent piece.

ACTIVITY 2: BUILDING YOUR BALANCE



QUESTION

How does a single-beam balance work?

SAFETY

Use only clean water in your syringe. Slowly push the plunger to avoid splashing the water. Never work near an electrical outlet or source. Clean up any spills when finished to avoid slips and falls.

MATERIALS

Two small containers (preferably plastic), plastic ruler, pencil, four coins of differing value

PROCEDURE

You will need a simple balance for many of the activities in this book. To build your balance, you will put a cup on each end of the ruler and balance the ruler on a pencil or pen placed under the middle of the ruler. Attach the cups with tape or glue, then make adjustments in the balance point by adding small extra pieces of tape or clay until the ruler is balanced. When balanced, the ruler may not be perfectly level, but you will be able to tell that tapping it can cause it to sway to either side. When the ruler is not balanced, it will only sway to one side. You should check the empty balance point before each time you use it and make adjustments as necessary. The object that you want to find the mass of should be put in one cup, then you can use the syringe to fill the other cup with water until you have a balance, recording in your lab notebook the beginning and ending volumes in the syringe. Make sure that your balance is on a flat table with both cups over the table. If one side gets too heavy, you do not want the whole balance to fall on the floor.

Remember that the density of water is 1.0 g/ml. That means that 1 ml of water has a mass of 1 g. If it takes 27 ml of water to balance out the sample, then the mass of the sample is 27 g.

This is just one type of simple balance. Other balances might hang from a string or involve other methods. If this one does not work well for you, investigate other methods online and build another type of balance. As long as the balance has a beam that can be balanced with water, it will be fine for all of these activities.

Testing Your Balance

Test your balance by finding the masses of four different coins, and record those masses below. The accepted masses will be given to you by your teacher to ensure that you use the balance correctly.

Data

Value of coin ___________
Mass __________ g

Value of coin ___________
Mass __________ g

Value of coin ___________
Mass __________ g

Value of coin ___________
Mass __________ g

Post-Lab Questions

1. What was the percentage difference between your measurement and the accepted mass (as provided by your teacher)? Percent difference = ([difference between the two answers] ÷ [accepted answer]) × 100
2. What do you think was the biggest contributor to that difference?
3. What do you think is the lightest mass that you could find using this balance?

NST4797 • 9781760014797 • © 2017 Hawker Brownlow Education