

Chemistry for the Logic Stage

Teacher Guide



WELL-TRAINED MIND[®]
TOP RECOMMENDATION

Written by Paige Hudson

Chemistry for the Logic Stage Teacher Guide

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Chemistry for the Logic Stage *Introduction*

In *Success in Science: A Manual for Excellence in Science Education*, we state that the middle school student is “a bucket full of unorganized information that needs to be filed away and stored in a cabinet.”¹ The goals of science instruction at the logic level are to begin to train the students’ brain to think analytically about the facts of science, to familiarize the students with the basics of the scientific method through inquiry-based techniques and to continue to feed the students with information about the world around them. *Chemistry for the Logic Stage* integrates the above goals using the Classic Method of middle school science instruction as suggested in our book. This method is loosely based on the ideas for classical science education that are laid out in *The Well-Trained Mind: A Guide to Classical Education at Home* by Jessie Wise and Susan Wise Bauer.

This guide includes the four basic components of middle school science instruction as explained in *Success in Science*.

1. **Hands-on Inquiry** — Middle school students need to see real-life science, to build their problem solving skills and to practice using the basics of the scientific method. This can be done through experiments or nature studies. In this guide, the weekly experiments fulfill this section of middle school science instruction.
2. **Information** — Middle school students need to continue to build their knowledge base along with learning how to organize and store the information they are studying. The information component is an integral part of this process. In this guide, the reading assignments, vocabulary and sketches contain all of the necessary pieces of this aspect of middle school science instruction.
3. **Writing** — The purpose of the writing component is to teach the students how to process and organize information. You want them to be able to read a passage, pull out the main ideas and communicate them to you in their own words. The assigned outlines or reports in this guide give you the tools you need to teach this basic component to your student.
4. **The Science Project** — Once a year, all middle school student should complete a science project. Their project should work through the scientific method from start to finish on a basic level, meaning that their question should be relatively easy to answer. The science fair project, scheduled as a part of unit seven fulfills the requirements of this component.

Chemistry for the Logic Stage also includes the two optional components of middle school science instruction as explained in *Success in Science*.

1. **Around the Web** — Middle school students should gain some experience with researching on the Internet. So for this optional component, the students should, under your supervision, search the Internet for websites, YouTube videos, virtual tours and activities that relate to what they are studying. In this guide, the Want More lessons recommend specific sites and activities for you to use.
2. **Quizzes or Tests** — During the middle school years it is not absolutely necessary that you give quizzes or tests to the students. However, if you want to familiarize them with

¹Bradley R. Hudson & Paige Hudson, *Success in Science: A Manual for Excellence in Science Education*, (Elemental Science, 2012) 52

test-taking skills, we suggest that you give quizzes or tests that will set the students up for success. With that in mind, we have included optional tests for you to use with each unit.

My goal in writing this curriculum is to provide you with the tools to explore the field of chemistry while teaching the basics of the scientific method. During the years, your students will work on their observation skills, learn to think critically about the information they are studying and practice working independently. *Chemistry for the Logic Stage* is intended to be used with seventh through eighth grade students.

What this guide contains in a nutshell

This guide includes the weekly student assignment sheets, all the sketches pre-labeled for you and discussion questions to help you guide your discussion time. This guide also contains information for each experiment, including the expected results and an explanation of those results. There is a list of additional activities that you can choose to assign for each week. Finally, this guide includes possible schedules for you to use as you guide your students through *Chemistry for the Logic Stage*.

What the Student Guide contains

The Student Guide, which is sold separately, is designed to encourage independence in your students as they complete *Chemistry for the Logic Stage*. The Student Guide contains all the student assignment sheets, pre-drawn sketches ready for labeling, experiment pages and blank report pages. The guide also includes blank date sheets as well as all the sheets they will need for the Science Fair Project. In short, the Student Guide contains all the pages your students will need and it is essential for successfully completing this program.

Student Assignment Sheets

This Teacher Guide contains a copy of each of the student assignment sheets that are in the Student Guide. This way you can stay on top of what your students are studying. Each of the student assignment sheets contains the following:

✓ **Experiment**

Each week will revolve around a weekly topic that it to be studied. Your student will be assigned an experiment that poses a question related to the topic. Each of these experiments will walk your students through the scientific method (see the Appendix pg. 253 for a brief explanation of the scientific method). In a nutshell, the scientific method trains the brain to examine and observe before making a statement of fact. It will teach your student to look at all the facts and results before drawing a conclusion. If this sounds intimidating, it's not. You are simply teaching your students to take the time to discover the answer to a given problem by using the knowledge they have and the things they observe during an experiment.

Each week, the student assignment sheet will contain a list of the materials needed and the instructions to complete the experiment. The student guide contains an experiment sheet for your students to fill out. Each experiment sheet contains an introduction that is followed by a list of materials, a hypothesis, a procedure, an observation and a conclusion section.

The introduction will give your students specific background information for the experiment. In the hypothesis section, they will predict the answer to the question posed in the lab. In the materials listed section, your students will fill out what they will use to complete the experiment. In the procedure section, they will recount step by step what was done during their experiment, so that someone else could read their report and replicate their experiment. In the observation section, your students will write what they saw. Finally, in the conclusion section they will write whether or not their hypothesis was correct and share any additional information they have learned from the experiment. If the students' hypothesis was not correct, discuss why and have them include that on their experiment sheet.

Vocabulary & Memory Work

Throughout the year, the students will be assigned vocabulary for each week. They will need to write out the definitions for each word on the Unit Vocabulary Sheet found in the Student Guide on the week that they are assigned. You may want to have your students also make flash cards to help them work on memorizing the words. This year, the students will memorize the elements of the periodic table along with specific information relating to each unit. There is a complete listing of the vocabulary words and memory work for each unit on the unit overview sheet in this guide along with a glossary and a list of the memory work in the Student Guide.

Sketch

Each week the students will be assigned a sketch to complete and label. The Student Guide contains an unlabeled sketch for them to use. They will color the sketch, label it and give it a title according to the directions on the Student Assignment Sheet. The information they need will be in their reading, but the sketch is not always identical to the pictures found in the encyclopedia. So, these sketch assignments should make the student think. This guide contains a completed sketch for you to use when checking their work.

Writing

Each week the students will be assigned pages to read from the spine text, the *DK's Encyclopedia of Science*. Have them read the assigned pages and discuss what they have read with you. After you have finished reading and discussing the information, you have three options for your students' written assignment:

✦ **Option 1: Have the students write an outline from the spine text**

A typical seventh grader completing this program should be expected to write a two to three level outline for the pages assigned for the week. This outline should include the main point from each paragraph on the page as well as several supporting and sub supporting points;

✦ **Option 2: Have the students write a narrative summary from the spine text**

A typical seventh grader completing this program should be expected to write a three to six paragraph summary (or about a page) about what they have read in the spine text;

✦ **Option 3: Have the students write both an outline and a written report**

First, have the students read the assigned pages in the spine text. Then, have them write a two to three level outline for the assigned pages. Next, have the students do some additional research reading on the topic from one or more of the suggested

reference books listed below. Each topic will have pages assigned from these reference books for their research. The following encyclopedias are scheduled to be used as reference books:

- 📖 *The Kingfisher Science Encyclopedia, 2017 Edition* (KSE): This resource is appropriate for middle school students.
- 📖 *Usborne Illustrated Dictionary of Science, 2012 Edition* (UIDS): This resource is approaching the high school level.
- 📖 *DK Eyewitness Book: Chemistry, 2005 Edition* (DK Chem): This resource also approaching the high school level.

Once the students complete the additional research reading, have them write a report of three to four paragraphs in length, detailing what they have learned from their research reading.

Your writing goal for middle school students is to have them write something (narrative summary, outline or list of facts) every day you do school, either in science or in another subject. So, the writing option you choose for this curriculum will depend on the writing the students are already doing in their other subjects.

When evaluating the students' report, make sure that the information they have shared is accurate and that it has been presented in a grammatically correct form (i.e. look for spelling mistakes, run-on sentences and paragraph form). In the Student Guide, there are two blank lined sheets for the students to use when writing their outlines and/or summaries. If you are having the students type their report, have them glue a copy of it into their Student Guide.

🕒 **Dates**

Each week the dates of important discoveries within the topic and the dates from the readings are given on the student assignment sheet. The students will enter these dates onto one of their date sheets. The date sheets are divided into the four time periods as laid out in *The Well-Trained Mind* by Susan Wise Bauer and Jessie Wise (Ancients, Medieval-Early Renaissance, Late Renaissance-Early Modern, and Modern). Completed date sheets are available for you to use in the appendix of this guide on pg. 249-252.

Schedules

Chemistry for the Logic Stage is designed to take up to 5 hours per week. You and your students can choose whether to complete the work over five days or over two days. Each week I have included two scheduling options for you to use as you lead them through this program. They are meant to be guides, so feel free to change the order to better fit the needs of your students. I also recommend that you begin to let them be in charge of choosing how many days they would like to do science as this will help to begin to foster independence in their school work.

Additional Information Section

The Additional Information Section includes tools that you will find helpful as you guide the students through this study. It is only found in the Teacher Guide, and it contains the following:

🔧 **Experiment Information**

Each week, the Additional Information Section includes the expected experiment results and an explanation of those results for you to use with the students. When possible, you will also find suggestions on how to expand the experiment in the Take it Further section.

🔍 Discussion Questions

Each week the Additional Information Section includes possible discussion questions from the main reading assignment, along with the answers. These are designed to aid you in leading the discussion time with the students. I recommend that you encourage them to answer in complete sentences, as this will help them organize their thoughts for writing their outline or report. I have also included a list of the discussion questions without the answers at the end of each unit's material in this guide. This is so you can give them to your students ahead of time, if you desire, or you can use them to review for the unit test. If they are already writing outlines or lists of facts, you do not need to have them write out the answers to the discussion questions before hand as there is plenty of writing required in this program already.

📖 Want More

Each week, the Additional Information Section includes a list of activities under the Want More section. ***These activities are totally optional.*** The Want More activities are designed to explore the science on a deeper level by researching specific topics or through additional projects to do. The students do not have this information in their guide, so it is up to you whether or not to assign these.

☑ Sketch

Each week, the Additional Information Section includes copies of the sketches that have been labeled. These are included in this guide for you to use as you correct the students' work.

Tests

The students will be completing a lot of work each week that will help you to assess what they are learning, so testing is not absolutely necessary. However, I have included end of unit tests that you can use if you feel the need to do so. The tests and the answers are included after the material for each unit in this guide. You can choose to give the tests orally or copy them for the students to fill out.

What a typical two day schedule looks like

A typical two day schedule will take one and a half to two hours per day. Here's a breakdown of how a normal two day week would work using week three:

🔗 Day 1: ***Define the vocabulary, record the dates, do the experiment and complete the experiment sheet***

Begin day 1 by having the students do the "Can I transfer metal atoms?" experiment. Have them read the introduction and perform the experiment using the directions provided. Next, have them record their observations and results. After they discuss their results with you, have them write a conclusion for their experiment. Finish the day by having them look up and define "metal" using the glossary in the Student Guide and add the dates to their date sheets;

🔗 Day 2: ***Read the assigned pages, discuss together, prepare an outline or narrative summary and complete the sketch***

Begin by having the students read pp. 34-37 in the *DK Encyclopedia of Science*. Then,
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using the questions provided, discuss what they have read. Next, have them complete the sketch using the directions on the Student Assignment Sheet. Finally, have them write an outline or narrative summary. Here is what that could look like:

Alkali, Alkaline Earth and Transition Metals

Alkali metals are the silvery-white metals otherwise known as the Group 1 elements on the periodic table. They all react with water to form alkaline solutions. The reactivity of these metals increases as you go down the group, but all of them have one electron in their outer shell.

Alkali metals are used in a variety of products. Potassium is used in fertilizer. Lithium is used to treat depression. Sodium is used in street lamps. Cesium is used in the atomic clock.

Alkaline earth metals are compounds that commonly occur in nature, also known as the Group 2 elements on the periodic table. They also all react with water to form alkaline solutions. The reactivity of these metals are similar to the chemistry of the alkali metals, except all of these metals have two electrons in their outer shell.

Alkaline earth metals are found in many places. Calcium is found in chalk, milk and bones. Beryllium is found in the semi-precious gem beryl. Magnesium is used in fireworks and alloys. Barium is used to block x-rays for medical tests.

Transition metals include the center block of elements on the periodic table. They are shiny, hard, and strong; they also have high melting points and can conduct heat or electricity. Transition metals have variable valencies. They can be used as catalysts or form alloys with each other, and their compounds are typically colored.

Transition Metals are used in a variety of ways. A car is made out of transition metals. The body shell is made from iron and a trace of manganese, the car itself is painted with a transition metal compound, the headlight casing and light bulb contain the transition metals chromium and tungsten, and other parts of the car contain transition metal alloys. Coin money, batteries, and magnets are also made from several different transition metals.

What a typical five day schedule looks like

A typical five day schedule will take forty-five minutes to one hour per day. Here's a breakdown of how a normal five day week would work using week three...

✦ Day 1: Do the experiment and complete the experiment sheet

Begin day 1 by having the students do the "Can I transfer metal atoms?" experiment. Have them read the introduction and perform the experiment using the directions provided. Next, have them record their observations and results, discuss their results with you and then write a conclusion for their experiment;

✦ Day 2: Read the assigned pages, discuss together and write an outline or list of facts

Begin by having the students read pp. 34-37 in the *DK Encyclopedia of Science* and discuss what they have read using the provided questions. Then, have the students write a two to three level outline, and complete the sketch using the directions on the

Student Assignment Sheet. Here's a sample outline:

Alkali Metals

- I. Alkali metals include the Group 1 elements on the periodic table.
 - A. All react with water to form alkaline solutions.
 - B. Alkali metals are of silvery-white color.
 - C. The reactivity of these metals increases as you go down the group.
 - i. All of these metals have one electron in their outer shell.
- II. Alkali metals are used in a variety of products.
 - A. Potassium is used in fertilizer.
 - B. Lithium is used to treat depression.
 - C. Sodium is used in street lamps.
 - D. Cesium is used in the atomic clock.

Alkaline Earth Metals

- I. Alkaline earth metals include the Group 2 elements on the periodic table.
 - A. All react with water to form alkaline solutions.
 - B. Alkaline earth metals are compounds that commonly occur in nature.
 - C. The reactivity of these metals are similar to the chemistry of the alkali metals.
 - i. All of these metals have two electrons in their outer shell.
- II. Alkaline earth metals are found in many places.
 - A. Calcium is found in chalk, milk and bones.
 - B. Beryllium is found in the semi-precious gem beryl.
 - C. Magnesium is used in fireworks and alloys.
 - D. Barium is used to block x-rays for medical tests.

Transition Metals

- I. Transition metals include the center block of elements on the periodic table.
 - A. They are shiny, hard, and strong.
 - B. They have high melting points and can conduct heat or electricity.
 - C. Transition metals have variable valencies.
 - D. They can be used as catalysts or form alloys with each other.
 - E. Their compounds are typically colored.
- II. Transition Metals are used in a variety of ways.
 - A. A car is made out of transition metals.
 - i. The body shell is made from iron and a trace of manganese.
 - ii. The car is painted with a transition metal compound.
 - iii. The headlight casing and light bulb contain the transition metals chromium and tungsten.
 - iv. Other parts contain transition metal alloys.
 - B. Coin money is made from several different transition metals.
 - C. Batteries and magnets are made from transition metals.

✦ Day 3: Record the dates, define the vocabulary and complete the sketch

Begin by having the students look up and define "metal" using the glossary in the *Chemistry for the Logic Stage ~ Introduction*

Student Guide and add the dates to their date sheets. Then, have them complete the sketch using the directions on the Student Assignment Sheet;

- ✦ **Day 4: Read from the additional reading assignments and prepare a written report**
Begin by having the students read “Metals” from *KSE* pp. 183, “The Alkali Metals” from *UDIS* pp. 168-169, “The Alkaline-earth Metals” from *UDIS* pp. 170-171, “The Transition Metals” from *UDIS* pp. 172-175, or “Looking at Metals” from *DK Chem* pp. 24-25. Then, have the students use their outline along with what they have just read to write a 3 to 5 paragraph summary of what they have learned;
- ✦ **Day 5: Complete one of the Want More activities**
Have the students make several Element Trading Cards or have them watch the video about alkali metals. You could also have them read about a scientist from the field of chemistry.

The Science Fair Project

I have scheduled time for the students to complete a science fair project during unit seven. Janice VanCleave’s *A+ Science Fair Projects* and Janice VanCleave’s *A+ Projects in Chemistry: Winning Experiments for Science Fairs and Extra Credit* are excellent resources for choosing project topics within the field of chemistry. You can call your local school system to see if it allows homeschooled students to participate in the local school science fair or get information on national science fairs from them. Another option would be to have your students present their project in front of a group of friends and family.

How to include your younger students

I recognize that many homeschool families have a range of different student ages. If you wish to have all your students studying the topic of chemistry you have two options for your elementary students when using this program with your middle school students:

- ✦ **Option 1: Have your younger students use *Chemistry for the Grammar Stage***

I recommend this option if your younger students are in the second through fourth grade and/or your older students are ready for some independence. The units in *Chemistry for the Grammar Stage* will not match up with the units in *Chemistry for the Logic Stage*, so you will need to do each program as written;

- ✦ **Option 2: Have your younger students use *Chemistry for the Logic Stage* along with your older students**

I recommend this option if your younger students are in the fourth through sixth grade and/or your older students are not ready to work independently. However, you will need to adjust the work load for your younger students. Here are some suggestions on how to do that:

- ✓ Have them watch and observe the experiments;
- ✓ Add in some picture books from the library for each of the topics;
- ✓ Read the reading assignments to them and have them narrate them back to you;
- ✓ Let them color the sketches and then tell them how to label them.

As for the reading assignments, you may find that the spines scheduled are too much for your younger students. If so, you can read to them out of the *Usborne Science Encyclopedia*. I have included a chart coordinating this resource in the Appendix on pg. 254-256.

Helpful Articles

Our goal is to provide you with the information you need to be successful in your quest to educate your students in the sciences at home. This is the main reason we share tips and tools for homeschool science education on our blogs. As you prepare to guide your students through this program, you may find the following articles from there helpful:

- 📖 *Classical Science Curriculum for the Logic Stage Student* – This article explains the goals of logic stage science and demonstrates how the classical educator can utilize the tools they have at their disposal to reach these goals.
<http://elementalblogging.com/classical-science-curriculum-logic/>
- 📖 *Scientific Demonstrations vs. Experiments* – This article shares information about these two types of scientific tests and points out how to employ scientific demonstrations or experiments in your homeschool.
<https://elementalscience.com/blogs/news/89905795-scientific-demonstrations-or-experiments>
- 📖 *A Simple Explanation of the Scientific Method* – This article details the steps of the scientific method, along with why it is so important to teach.
<https://elementalscience.com/blogs/news/simple-explanation-of-the-scientific-method/>

Additional Resources

The following page contains quick links to the activities suggested in this guide along with several helpful downloads:

<https://elementalscience.com/blogs/resources/cls>

Final Thoughts

If you find that this program contains too much work, please tailor it to the needs of your student. As the author and publisher of this curriculum I encourage you to contact me with any questions or problems that you might have concerning *Chemistry for the Logic Stage* at support@elementalscience.com. I will be more than happy to answer them as soon as I am able. I hope that you and your student enjoy *Chemistry for the Logic Stage*!

Book List

The following books were used when planning this study. (**Note**—*The editions noted here are the most current editions. However, the past two editions of each of these resources will also work.*)


Encyclopedias for Reading Assignments


The following book is the main spine of this program. You will need to purchase it to complete the reading assignments scheduled in this program.


 *The DK Encyclopedia of Science, 2016 Edition* (DK EOS)

References for Reports

The following encyclopedias are scheduled for additional reference reading. They are optional, but I suggest that you purchase one or two to use throughout the year.

 *The Kingfisher Science Encyclopedia, 2017 Edition* (KSE) This resource is appropriate for middle school students.

 *Usborne Illustrated Dictionary of Science, 2012 Edition* (UIDS) – This resource is approaching the high school level.

 *DK Eyewitness Book: Chemistry, 2005 Edition* (DK Chem) This resource is also approaching the high school level.


Experiment Equipment

If you would like to create a more lab-like chemistry experience for the students this year, I suggest using equipment that is more commonly found in the laboratory setting. Here's a list of material that you can substitute:

- ✓ **Jar** — Use a beaker or Erlenmeyer flask that is at between 750 and 1000 mL;
- ✓ **Cup** — Use a beaker or Erlenmeyer flask that is at between 200 and 500 mL;
- ✓ **Bottle** — Use an Erlenmeyer flask that is between 250 and 1000 mL;
- ✓ **Small cup** — Use a small beaker (50 mL) or test tube;
- ✓ **Eye dropper** — Use a pipette.

You can use the glass or plastic version of each of the above.

Safety Advisory

Many of the experiments in this book use boiling water or open flames. We recommend that your students use safety glasses and protective gear with each experiment to prevent accidents. Do not allow your students to perform any of the experiments marked “ **CAUTION**” on their own.

Units of Measurement

What are the two measuring systems?

- ☛ **The Standard or Standard American Engineering (SAE) System** — This system is used mainly in the United States and it uses units like inches, pounds and gallons. It was derived from an early English measuring system that has its roots in the Roman system of measurements.
- ☛ **The Metric System** — This system is used in most of the world and it uses units like meters, grams and liters. The system is base 10 and their names are formed with prefixes. It was derived from one of the early French measuring systems.

In the US, the standard system of units are more widely used on consumer products and in industrial manufacturing, while the metric system is more widely used in science, medicine and government. Since this program has been published in the US, I have used the standard system of measurement throughout for familiarity. However, because I believe that it is important for our students to be familiar with both systems, I have included metric measurements in parentheses.

What about converting units?

Every student should know how to convert measurements inside of a given measuring system, such as knowing how to convert grams to kilograms or ounces to pounds. Normally, these conversion factors are taught as a part of your math program. However, I also recommend that you have your students memorize several basic conversion factors between the two systems. Here is a list of factors that the students should try to memorize:

- ☛ **Pounds to Kilograms:** 1 lb = 2.2 kg
- ☛ **Ounces to Grams:** 1 oz = 28.3 g
- ☛ **Gallons to Liters:** 1 gal = 3.785 L
- ☛ **Cups to Milliliters:** 1 c = 240 mL
- ☛ **Miles to Kilometers:** 1 mi = 1.61 km
- ☛ **Feet to Meters:** 1 ft = 0.305 m
- ☛ **Inches to Centimeters:** 1 in = 2.54 cm

With the global flow of information that occurs these days, it is very important for students to learn these most basic conversion factors. To learn more about the importance of units of measurement in science, read the following blog post:

📖 <https://elementalscience.com/blogs/science-activities/units-of-measurement>

Sequence of Study

Building Blocks of Chemistry (9 weeks)

Unit 1: The Periodic Table (5 Weeks)

- ✓ Elements, Atoms and Ions
- ✓ The Periodic Table
- ✓ Metals
- ✓ Poor Metals and Semimetals
- ✓ Nonmetals

Unit 2: Matter (4 Weeks)

- ✓ States of Matter
- ✓ Properties of Matter
- ✓ Kinetic Theory and Gases
- ✓ Crystals

Principles in Chemistry (14 weeks)

Unit 3: Solutions (4 Weeks)

- ✓ Molecules and Mixtures
- ✓ Solutions
- ✓ Separating Mixtures and Compounds
- ✓ Chemical Analysis

Unit 4: Chemical Reactions (6 Weeks)

- ✓ Chemical Bonding
- ✓ Chemical Reactions
- ✓ Reactivity
- ✓ Catalysts
- ✓ Oxidation and Reduction

Unit 5: Acids and Bases (4 weeks)

- ✓ Acids
- ✓ Bases
- ✓ Measuring Acidity (pH)
- ✓ Neutralization and Salts

Applications for Chemistry (12 weeks)

Unit 6: Chemistry of Life (4 Weeks)

- ✓ Organic Chemistry

- ✓ Chemistry of the Human Body
- ✓ Chemistry of Food
- ✓ Fermentation

Unit 7: Chemistry of Industry (8 weeks)

- ✓ Soaps and Detergents
- ✓ Iron, Steel, and Alloys
- ✓ Chemistry in Farming
- ✓ Coal and Oil Products
- ✓ Polymers and Adhesives
- ✓ Dyes, Pigments, and Cosmetics
- ✓ Fibers and Paper
- ✓ Ceramics and Glass

Note—This unit also contains a science fair project and a scientist biography project for the students to complete.

Materials Listed by Week

Building Blocks of Chemistry

Unit 1: The Periodic Table

Week	Materials
1	<i>No experiment supplies needed</i>
2	Heavy cream, Milk, Sugar, Vanilla, 1 small and 1 large zip-locking plastic bag, Crushed ice, Dish towel or oven mitt, Rock salt
3	Vinegar, Salt, 6 pennies, Glass cup, 2 iron nails
4	Magnet, Light socket, Light bulb, Copper wire, D battery, Magnet, Charcoal, Paperclip, Aluminum foil, CD, Pencil lead, Safety glasses
5	Element cards (homemade or purchased)

Unit 2: Matter

Week	Materials
6	Cup, Ice Cubes, Pot, Thermometer
7	4 clear cups, Eye dropper, Table salt, Food coloring, Water
8	2 cups, Apple juice, Timer, Partner
9	String, Wide mouthed jar, Pencil, Pipe cleaners, Water, Borax, Scissors

Principles in Chemistry

Unit 3: Solutions

Week	Materials
10	Bag of multi-colored marshmallows, Toothpicks
11	5 clear cups (or beakers), 5 plastic spoons, Sugar, Salt, Baking powder, Flour, Cornstarch, Water, Vegetable oil, Tablespoon
12	Distilled water, 2 test tubes, Salt, Glass cup, 2 Alligator clips, Covered copper wire, 6-volt Lantern battery, Permanent marker
13	Coffee filters, Markers, Alcohol, Coffee can or wide-mouthed jar, Rubber bands, Eyedropper

Unit 4: Chemical Reactions

Week	Materials
14	Cake frosting, Red and yellow bite-sized candies
15	Yeast, Hydrogen peroxide, Epsom salts, Water, 2 cups, 2 thermometers
16	Baking soda, Chalk, Iron nail (non-coated), Copper penny, White vinegar, 4 cups

<i>Week</i>	<i>Materials</i>
17	2 potatoes, Pot, Water, Oven mitt, Large Slotted Spoon
18	Carbonated water, Sugar, 2 cups
19	Steel wool, Vinegar, Jar with lid, Ammonia, Hydrogen peroxide, 2 bowls

Unit 5: Acids and Bases

<i>Week</i>	<i>Materials</i>
20	Cranberry juice, Lemon juice, Baking soda, Clear cup
21	6 cups, Red cabbage solution, Water, Vinegar, Baking soda, Sprite, Ammonia, Lemon Juice, Eye dropper
22	Lemon, Tomato, Saliva, Milk, Bleach, Toothpaste, Liquid Dish Soap, pH paper, Gloves
23	Vinegar, Ammonia, Red cabbage solution, Water, Safety glasses

Applications for Chemistry

Unit 6: Chemistry of Life

<i>Week</i>	<i>Materials</i>
24	Sugar, Salt, Candle, 2 metal spoons, Hot mitt
25	2 slices of bread, Water, Saliva, 2 plastic bags
26	Benedict's solution, Iodine solution, Several different types of food for testing (such as a hard-boiled egg, bread, potato, pasta, yogurt, cookies or cheese), Eyedropper, Small plastic cups, Safety glasses
27	Yeast, Water, Sugar, 3 bottles, 3 balloons, Instant read thermometer, Pot, Hot mitt

Unit 7: Chemistry of Industry

<i>Week</i>	<i>Materials</i>
28	Powdered detergent, Liquid soap, 2 large cups, 2 small cups, 2 bowls, pH paper, Vegetable oil, Dirt, Ketchup, Plaster of Paris, Water, Straw, Old t-shirt fabric
29-36	Materials will vary depending on the Science Fair Project that your student has chosen to do.
33-35	<i>No experiment supplies needed</i>

Chemistry:
Unit 3

Solutions

Unit 3: Solutions

Overview of Study

Sequence of Study

Week 10: Molecules and Mixtures

Week 11: Solutions

Week 12: Separating Mixtures

Week 13: Chemical Analysis

Materials by Week

Week	Materials
10	Bag of multi-colored marshmallows, Toothpicks
11	5 clear cups (or beakers), 5 plastic spoons, Sugar, Salt, Baking powder, Flour, Cornstarch, Water, Vegetable oil, Tablespoon
12	Distilled water, 2 test tubes, Salt, Glass cup, 2 Alligator clips, Covered copper wire, 6-volt Lantern battery, Permanent marker
13	Coffee filters, Markers, Alcohol, Coffee can or wide-mouthed jar, Rubber bands, Eyedropper

Vocabulary for the Unit

1. **Molecule** – A substance that is formed when two or more atoms chemically join together.
2. **Mixture** – A combination of two or more elements or compounds that are not chemically combined.
3. **Miscible** – Liquids that can be blended together.
4. **Immiscible** – Liquids that cannot be blended together.
5. **Solution** – A homogenous mixture of two or more substances.
6. **Solubility** – The ability of a solute to be dissolved.
7. **Solute** – The substance that dissolves in the solvent to form a solution.
8. **Solvent** – The substance in which the solute dissolves to form a solution, typically a liquid.
9. **Anode** – The positively charged electrode by which current enters the cell.
10. **Cathode** – The negatively charged electrode by which current leaves the cell.
11. **Electrolyte** – A substance that conducts electricity when it is in solution.
12. **Chromatography** – A method of separating the substances in a mixture by the rate they move through or along a medium, such as filter paper.

Memory Work for the Unit

The Elements of the Periodic Table – The following elements will be memorized in this unit:

- ✓ 37-Rb-Rubidium
- ✓ 38-Sr-Strontium
- ✓ 39-Y-Yttrium
- ✓ 40-Zr-Zirconium
- ✓ 41-Nb-Niobium
- ✓ 42-Mo-Molybdenum
- ✓ 43-Tc-Technetium
- ✓ 44-Ru-Ruthenium
- ✓ 45-Rh-Rhodium
- ✓ 46-Pd-Palladium
- ✓ 47-Ag-Silver
- ✓ 48-Cd-Cadmium
- ✓ 49-In-Indium
- ✓ 50-Sn-Tin
- ✓ 51-Sb-Antimony
- ✓ 52-Te-Tellurium

Law of Constant Composition – A pure compound always contains the same elements in the same proportions.

Notes

Student Assignment Sheet Week 10

Molecules and Mixtures

Experiment: Marshmallow Molecules

Materials:

- ✓ Bag of multi-colored marshmallows
- ✓ Toothpicks

Procedure:

1. Read the introduction to this experiment.
2. Choose a color of marshmallow to represent each of the following atoms: oxygen, nitrogen, hydrogen and carbon. When you make your molecules you must follow these rules:
 - ➔ Oxygen prefers to bond twice, nitrogen prefers to bond three times, hydrogen prefers to only bond once and carbon prefers to bond 4 times;
 - ➔ Each atom must have its preferred number of bonds to form a stable molecule and you must only create stable molecules;
 - ➔ All of nitrogen's bonds should point down and all of carbon's bonds need to be opposite from each other (except in the case of a multiple bond).
3. Make the following molecules from your marshmallows: NH_3 (ammonia), H_2O (water), CH_4 (methane), CO_2 (carbon dioxide), $\text{C}_2\text{H}_5\text{OH}$ (ethanol) (**Hint**—You can make multiple bonds between the atoms.)
4. Draw a quick sketch of each of your molecules after you finish assembling them.
5. Draw conclusions and complete your experiment sheet.

Vocabulary & Memory Work

- Vocabulary: molecule, mixture
- Memory Work—This week, add the following elements to what you are working on memorizing:
 - ✓ 37-Rb-Rubidium, 38-Sr-Strontium, 39-Y-Yttrium, 40-Zr-Zirconium
- Memory Work—Work on memorizing the Law of Constant Composition: A pure compound always contains the same elements in the same proportions.

Sketch

- No sketch this week.

Writing

- 🔗 Reading Assignment: *DK Encyclopedia of Science* pp. 58-59 (Compounds and Molecules)
- 🔗 Additional Research Readings: Chemical Compounds: *KSE* pp. 164-165, Molecules: *UIDS* pg. 125, Atoms and Molecules: *DK Chem* pp. 16-17

Dates

- 🕒 1649 – Pierre Gassendi states that atoms can be joined together to form molecules.
- 🕒 1798-1808 – Joseph-Louis Proust analyzes the different sources of several compounds and finds that their elements always contained the same ratio by weight. This leads to the discovery of the law of constant composition.

Schedules for Week 10

Two Days a Week

<i>Day 1</i>	<i>Day 2</i>
<ul style="list-style-type: none"> <input type="checkbox"/> Do the “Marshmallow Molecules” experiment, then fill out the experiment sheet on SG pp. 77-79 <input type="checkbox"/> Define molecule, chemical compound, mixture on SG pg. 74 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 8-13 	<ul style="list-style-type: none"> <input type="checkbox"/> Read pp. 58-59 from <i>DK EOS</i>, then discuss what was read <input type="checkbox"/> Prepare an outline or narrative summary, write it on SG pp. 80-81
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ Bag of multi-colored marshmallows ✓ Toothpicks 	
<p><i>Things I Need to Prepare</i></p>	

Five Days a Week

<i>Day 1</i>	<i>Day 2</i>	<i>Day 3</i>	<i>Day 4</i>	<i>Day 5</i>
<ul style="list-style-type: none"> <input type="checkbox"/> Do the “Marshmallow Molecules?” experiment, then fill out the experiment sheet on SG pp. 77-79 	<ul style="list-style-type: none"> <input type="checkbox"/> Read pp. 58-59 from <i>DK EOS</i>, then discuss what was read <input type="checkbox"/> Write an outline on SG pg. 80 	<ul style="list-style-type: none"> <input type="checkbox"/> Define molecule, chemical compound, mixture on SG pg. 74 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 8-13 	<ul style="list-style-type: none"> <input type="checkbox"/> Read one or all of the additional reading assignments <input type="checkbox"/> Write a report from what you learned on SG pg. 81 	<ul style="list-style-type: none"> <input type="checkbox"/> Complete one of the Want More Activities listed <li style="text-align: center;">OR <input type="checkbox"/> Study a scientist from the field of Chemistry
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ Bag of multi-colored marshmallows ✓ Toothpicks 				
<p><i>Things I Need to Prepare</i></p>				

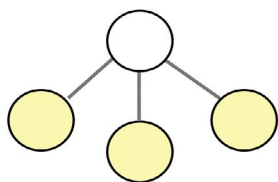
Additional Information Week 10

Notes

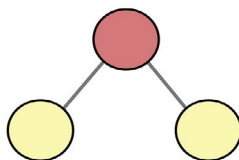
💡 **Molecules vs. Compounds** – Molecules are formed when two or more atoms join together. Compounds are formed when two or more elements join together. For example H_2 (*hydrogen gas*) is a molecule because two atoms of hydrogen are joined together. However, since there is only one type of element present, H_2 is not a compound. On the other hand, H_2O (*water*) is a molecule because the three atoms, one oxygen atom and two hydrogen atoms, have been joined together to form it. It is also a compound because it contains two different elements, hydrogen and oxygen. So, all compounds are molecules, but not all molecules are compounds.

Experiment Information

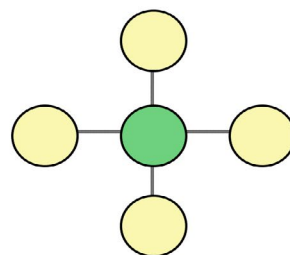
- 👉 **Introduction** – (*from the Student Guide*) Molecules are formed when two or more atoms are held together by a chemical bond. These molecules form the millions of substances that surround us in daily life, such as water and table salt. The atoms tend to follow a set of rules when they form molecules. In this experiment, you are going to make marshmallow representations of several common molecules.
- 👉 **Results** – This experiment is meant to be a demonstration of how molecules are formed so that the concepts will be solidified in your students' mind. The pictures below will give you an idea of what their creations should look like:



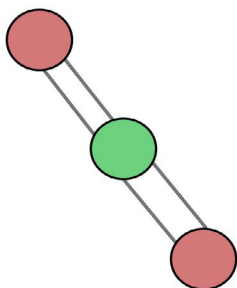
NH_3 (ammonia)



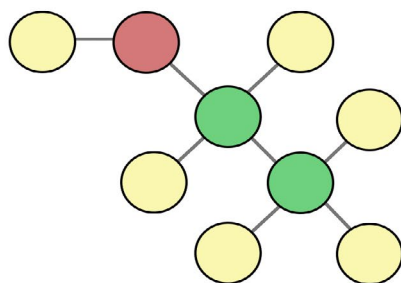
H_2O (water)



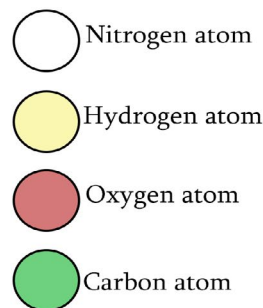
CH_4 (methane)



CO_2 (carbon dioxide)



C_2H_5OH (ethanol)



- ☞ **Take it Further** – For a challenge, see how long of a polyethylene chain you can make, using the marshmallows and rules set forth in the experiment (**Hint**—*Polyethylene is composed of only carbon and hydrogen.*).

Discussion Questions

1. How are compounds and mixtures alike? (*Compounds and mixtures are both a combination of different elements.*) How do they differ? (*The atoms in a compound are chemical bound, while in a mixture no chemical reaction has taken place. Compounds have their own unique chemical properties, while compounds or elements in a mixture still retain their original chemical properties.*)
2. What is the law of constant composition and who discovered it? (*The law of constant composition states that a pure compound always contains the same elements in the same proportions. It was discovered by Joseph-Louis Proust.*)
3. What are three types of liquid mixtures? (*The three types of liquid mixtures are miscible, immiscible and emulsion.*)
4. What is synthesis? (*Synthesis is when chemists build larger and more useful molecules from smaller ones.*)
5. What is an alloy? (*An alloy is created when small amounts of one type of metal are added to another type of metal to give it strength.*)
6. How do chemists define the purity of a substance? (*Chemists say that a substance is pure when it contains only one type of atom or molecule.*)

Want More

- 📖 **Research Report** – Have the students research more about alloys and then write a one to three paragraph report on the topic. Their report should include what an alloy is, why it is used and several examples of alloys that are commonly used. (**Note**—*Alloys will be studied again in week 30.*)
- 📖 **Miscible or Immiscible** – Have the students gather water, oil, juice, alcohol and food coloring from your kitchen pantry or fridge. Then, have them mix each of the liquids with one of the other liquids to determine if they are miscible or immiscible.

Student Assignment Sheet Week 11 Solutions

Experiment: Is it polar or nonpolar?

Materials:

- | | |
|-----------------------------|-------------------|
| ✓ 5 clear cups (or beakers) | ✓ Flour |
| ✓ 5 plastic spoons | ✓ Petroleum jelly |
| ✓ Sugar | ✓ Water |
| ✓ Salt | ✓ Vegetable oil |
| ✓ Baking soda | ✓ Tablespoon |

Procedure:

1. Read the introduction to this experiment and write down which molecules you think are polar and which ones you think are nonpolar.
2. Label the cups #1 through #5. Add $\frac{1}{2}$ cup (120 mL) of room temperature water to each of the five cups.
3. Then stir in 1 TBSP (12.6 g) of sugar to cup #1, 1 TBSP (17.1 g) of salt to cup #2, 1 TBSP (12 g) of baking soda to cup #3, 1 TBSP (5 g) of flour to cup #4 and 1 TBSP (8 g) of petroleum jelly to cup #5.
4. Gently stir each of the cups with a spoon, using a different spoon for each cup. Wait 10 minutes and record your observations and results.
5. Pour out the solutions, rinse well and dry each of the cups. Add $\frac{1}{2}$ cup (120 mL) of room temperature oil to each of the five cups.
6. Repeat steps 3 and 4.
7. Draw conclusions and complete your experiment sheet.

Vocabulary & Memory Work

- Vocabulary: solution, solubility, solute, solvent
- Memory Work—This week, add the following elements to what you are working on memorizing:
 - ✓ 41-Nb-Niobium, 42-Mo-Molybdenum, 43-Tc-Technetium, 44-Ru-Ruthenium
- Memory Work—Continue to work on the Law of Constant Composition

Sketch: Anatomy of a Water Molecule

- ⊕ Label the following: chemical bonds, the symbol for an oxygen atom (O), the symbol for the hydrogen atoms (H), the charges associated with the molecule

Writing

- 🔗 Reading Assignment: *DK Encyclopedia of Science* pg. 60 (Solutions) and pg. 75 (Chemistry of Water)
- 🔗 Additional Research Readings:
 - 📖 Solutions: *KSE* pp. 158-159
 - 📖 Solutions and Solubility: *UIDS* pp. 144-145

Dates

- ⊕ No dates to be entered this week.

Schedules for Week 11

Two Days a Week

Day 1	Day 2
<input type="checkbox"/> Do the “Is it polar or nonpolar?” experiment, then fill out the experiment sheet on SG pp. 84-85 <input type="checkbox"/> Define solution, solubility, solute, solvent on SG pg. 74 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 8-13	<input type="checkbox"/> Read pp. 60 and 75 from <i>DK EOS</i> , then discuss what was read <input type="checkbox"/> Color and label the “Anatomy of a Water Molecule” sketch on SG pg. 83 <input type="checkbox"/> Prepare an outline or narrative summary, write it on SG pp. 86-87
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ 5 clear cups (or beakers), 5 plastic spoons ✓ Sugar, salt, baking soda, flour, petroleum jelly ✓ Water, vegetable oil ✓ Tablespoon 	
<p><i>Things I Need to Prepare</i></p>	

Five Days a Week

Day 1	Day 2	Day 3	Day 4	Day 5
<input type="checkbox"/> Do the “Is it polar or nonpolar?” experiment, then fill out the experiment sheet on SG pp. 84-85 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 8-13	<input type="checkbox"/> Read pp. 60 and 75 from <i>DK EOS</i> , then discuss what was read <input type="checkbox"/> Write an outline on SG pg. 86	<input type="checkbox"/> Define solution, solubility, solute, solvent on SG pg. 74 <input type="checkbox"/> Color and label the “Anatomy of a Water Molecule” sketch on SG pg. 83	<input type="checkbox"/> Read one or all of the additional reading assignments <input type="checkbox"/> Write a report from what you learned on SG pg. 87	<input type="checkbox"/> Complete one of the Want More Activities listed OR <input type="checkbox"/> Study a scientist from the field of Chemistry
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ 5 clear cups (or beakers), 5 plastic spoons ✓ Sugar, salt, baking soda, flour, petroleum jelly ✓ Water, vegetable oil ✓ Tablespoon 				
<p><i>Things I Need to Prepare</i></p>				

Additional Information Week 11

Experiment Information

- ☞ **Introduction** – (from the Student Guide) A solution contains several different types of molecules that have been evenly mixed. Generally, a solution is made when one type of molecule, which we call the solute, is dissolved in another, which we call the solvent. The molecules can be either polar or nonpolar. Polar molecules have a positive and a negative end, while nonpolar molecules do not carry a charge. As a general rule, like dissolves like; this means that solvents with polar molecules dissolve solutes with polar molecules and vice versa. In this experiment, you are going to use a polar solvent, water, and a nonpolar solvent, vegetable oil, to determine if several substances are polar or nonpolar.
- ☞ **Results** – The students should have the following for the results chart:

Solute	Solvent: Water	Solvent: Vegetable Oil
Sugar	SS	NS
Salt	S	NS
Baking Soda	S	NS
Flour	NS	SS
Petroleum Jelly	NS	S

*S = Soluble, SS = Semi-soluble, NS = Not soluble

They should find that salt, baking soda and sugar are polar molecules, and that flour and petroleum jelly are both nonpolar molecules.

- ☞ **Explanation** – Salt and baking soda have ionic bonds, meaning the atoms have exchanged electrons to form a chemical bond that holds the molecule together through the associated charges. These two molecules are very polar substances which can easily dissolve in a polar solvent. Sugar has a long carbon chain that has no associated charge and an OH group that carry a charge. However, it is polar because the pull of the OH group is stronger than the carbon chain, so sugar dissolves better in water than in oil. Flour is composed of thousands of different molecules that come from grinding up grain. Some of these molecules are polar, some are not. On the whole, cooking flour contains more nonpolar molecules, so it distributes more evenly in the oil. Petroleum jelly is a mixture of hydrocarbons, all of which are nonpolar, which is why it dissolves easily in the oil and not in the water.
- ☞ **Take if Further** – Test to see if iodine crystals are polar or nonpolar. (*Note—If you cannot find iodine crystals to purchase, you can make your own by mixing iodine tincture from the pharmacy with hydrogen peroxide. The crystals will fall to the bottom of the glass and then you can just scoop them out.*) Use the crystals to repeat the experiment. (*The students should see that the iodine crystals are soluble in oil because they are nonpolar molecules.*)

Discussion Questions

pg. 60, Solutions

1. What is the difference between concentrated and dilute solutions? (*Concentrated solutions have a large amount of solute in relation to solvent. Dilute solutions have a*

small amount of solute in relation to solvent.)

2. Why is water such a good solvent? (*Water is a good solvent because it has a slight electrical charge that allows it to form weak bonds with other charged particles.*)
3. What is a saturated solution? (*A solution is said to be saturated when it cannot hold any more of the solvent.*)

pg. 75, Chemistry of Water

1. Why is water rarely found in its pure state? (*Water is rarely found in its pure state because it readily dissolves substances.*)
2. What is unique to solid water (a.k.a. ice)? (*Water is one of the few substances that expands when it freezes.*)
3. What is hard water and what causes it to form? (*Hard water is water that does not lather easily with soap. This is caused by the presence of either dissolved magnesium or calcium.*)

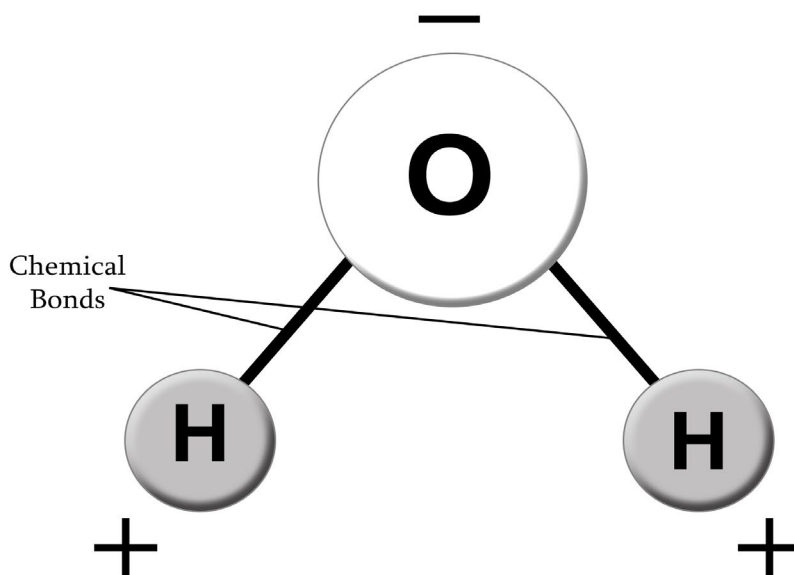
Want More

- ✍ **Research Report** – Have the students research more about polar and nonpolar molecules. Then, have them write a one to three paragraph report sharing what they have found.
- ✍ **Hard Water Test** – Have the students add a cup (240 mL) of tap water to a glass. Then, add a teaspoon (5 mL) of dish liquid and mix well. Next, use a straw to blow into the water. If lots of bubbles form, then the water is not very hard, but if bubbles do not form, you have hard water.

Sketch Week 11

(*Note—The students will need to look at both of the assigned pages to gather the information they need to complete this sketch.*)

Anatomy of a Water Molecule



Student Assignment Sheet Week 12

Separating Mixtures and Compounds

Experiment: Can I split water?

Materials:

- | | |
|-------------------|-----------------------|
| ✓ Distilled water | ✓ 2 Alligator clips |
| ✓ 2 test tubes | ✓ Covered copper wire |
| ✓ Salt | ✓ 6v Lantern battery |
| ✓ Glass cup | ✓ Permanent marker |

Procedure:

1. Read the introduction to this experiment and make your hypothesis.
2. Mix together 4 cups (1000 mL) of distilled water with $\frac{1}{2}$ cup (136.5 g) of salt and set the solution aside. Next, cut your wire into two lengths and expose the two ends of each of the wires. Attach one end of the first length of wire to one of the alligator clips. Repeat for the second wire.
3. Now, tape your test tubes to opposite sides of your cup. Fill the cup half of the way full with your salt water solution. Some of the water will go into your test tubes, which is what you want. They should be fairly close to full of water. Fit the other exposed end of your wire into the bottom of your test tubes, making sure that it does not touch the sides of your test tube. Rest the remaining part of the wire on the side of your container.
4. Then, mark the water level in each of the tubes with a permanent marker and check your set up to make any necessary adjustments. Now, you can attach the alligator clips to each of the battery terminals of the lantern battery. **CAUTION—Do NOT touch the water when the wire is attached to the battery!!!**
5. Wait for 30 minutes and then detach the wires from the battery. Mark the water level on each of the tubes once again. Remove the tubes and measure the distance between each of your lines to determine how much gas you collected.
6. Draw conclusions and complete your experiment sheet.

⚠ CAUTION

**DO NOT DO THIS
EXPERIMENT WITHOUT
ADULT SUPERVISION!**

This experiment has the potential to form hydrogen gas, which is extremely flammable.

Vocabulary & Memory Work

- Vocabulary: anode, cathode, electrolyte
- Memory Work—This week, add the following elements to what you are working on memorizing:
 - ✓ 45-Rh-Rhodium, 46-Pd-Palladium, 47-Ag-Silver, 48-Cd-Cadmium
- Memory Work: Continue to work on the Law of Constant Composition

Sketch: Electrolysis

- Label the Following: anode, cathode, electrolyte solution, battery

Writing

- 🔗 Reading Assignment: *DK Encyclopedia of Science* pg. 61, Separating Mixtures and pg. 67, Electrolysis
- 🔗 Additional Research Readings: Separation and Purification: *KSE* pp. 160-161

Dates

- 🕒 1778-1829 – English chemist Humphrey Davy lives. He is one of the first scientists to see electrolysis in action.
- 🕒 1832 – Michael Faraday writes a mathematical equation that can be used to calculate the quantity of the separated elements in electrolysis.

Schedules for Week 12

Two Days a Week

Day 1	Day 2
<input type="checkbox"/> Do the “Can I split water?” experiment, then fill out the experiment sheet on SG pp. 90-91 <input type="checkbox"/> Define anode, cathode, electrolyte on SG pg. 75 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 8-13	<input type="checkbox"/> Read pp. 61 and 67 from <i>DK EOS</i> , then discuss what was read <input type="checkbox"/> Color and label the “Electrolysis” sketch on SG pg. 89 <input type="checkbox"/> Prepare an outline or narrative summary, write it on SG pp. 92-93
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ Distilled water, salt ✓ 2 test tubes, glass cup or beaker ✓ 2 alligator clips, covered copper wire, 6-volt Lantern battery ✓ Permanent marker 	
<p><i>Things I Need to Prepare</i></p>	

Five Days a Week

Day 1	Day 2	Day 3	Day 4	Day 5
<input type="checkbox"/> Do the “Can I split water?” experiment, then fill out the experiment sheet on SG pp. 90-91 <input type="checkbox"/> Enter the dates onto the date sheets on SG pp. 8-13	<input type="checkbox"/> Read pp. 61 and 67 from <i>DK EOS</i> , then discuss what was read <input type="checkbox"/> Write an outline on SG pg. 92	<input type="checkbox"/> Define anode, cathode, electrolyte on SG pg. 75 <input type="checkbox"/> Color and label the “Electrolysis” sketch on SG pg. 89	<input type="checkbox"/> Read one or all of the additional reading assignments <input type="checkbox"/> Write a report from what you learned on SG pg. 93	<input type="checkbox"/> Complete one of the Want More Activities listed OR <input type="checkbox"/> Study a scientist from the field of Chemistry
<p><i>Supplies I Need for the Week</i></p> <ul style="list-style-type: none"> ✓ Distilled water, salt ✓ 2 test tubes, glass cup or beaker ✓ 2 alligator clips, covered copper wire, 6-volt Lantern battery ✓ Permanent marker 				
<p><i>Things I Need to Prepare</i></p>				

Additional Information Week 12

Experiment Information

- ☞ **Caution – Do NOT allow your students to do this experiment on their own as it has two main hazards, electricity with water and potentially flammable hydrogen gas.** It can be done safely in your home as long as you follow the two rules below:
 1. **Do NOT touch the water when the wire is connected to the battery.** You can wear rubber gloves when you are dealing with the electrical part of this experiment for an extra measure of safety.
 2. **Do NOT do this experiment anywhere near an open flame.** Also, do not smoke in the house while performing this experiment.
- ☞ **Introduction – (from the Student Guide)** Scientists can use a variety of methods to separate mixtures, such as filtration, decantation, distillation, evaporation and centrifugation. Electrolysis separates the components of a molecule within a solution. It uses electrical current to break the compound into its pieces. This process requires that the substance can conduct electricity and that it is either in solution or in a molten state. Electricity passes from two electrodes into the solution, which breaks the compound into its parts. In this experiment we are going to see if we can use electrolysis to split water.
- ☞ **Results –** The students should see gas collected in each test tube. They should see twice as much gas in the cathode test tube, which is connected to the positive terminal on their battery.
- ☞ **Explanation –** We added salt to the water so that it would conduct electricity and allow the process of electrolysis to occur. The bubbles you saw at the tip of the wires in the solution were beads of oxygen and hydrogen gas. These two elements make up the compound water. The oxygen gas forms at the anode, which is the wire connected to the negative terminal on your battery. The hydrogen gas at the cathode, which is the wire connected to the positive terminal on your battery. You were able to collect twice as much hydrogen gas than oxygen gas because there are twice as many hydrogen atoms in water than there are oxygen atoms.
- ☞ **Take it Further –** Test to see if the concentration of salt in the water produces more or less of the two gases. Make sure that you use distilled water to make up your salt water solutions. *(The students should see that the more salt they added to the water, the quicker the electrolysis occurred.)*

Discussion Questions

pg. 61, Separating Mixtures

1. How does decanting separate mixtures? *(Decanting separates two substances with differing densities.)*
2. What is desiccation? *(Desiccation is a separating technique that removes water from a solid.)*
3. What is necessary for filtration to be able to separate the substances in a mixture? *(To separate the substances in a mixture by filtration, the substances must be of different sizes.)*
4. What is evaporation? *(Evaporation is the process of removing a liquid from a mixture using heat.)*
5. When is distillation generally used to separate a mixture? *(Distillation is generally used*
Chemistry Unit 3: Solutions ~ Week 12 Separating Mixtures and Compounds

to separate a mixture when the liquid part of the mixture is needed.)

6. How does centrifuging separate a mixture? (*Centrifuging separates the liquids and solids in a mixture by spinning them around at a high rate of speed.*)

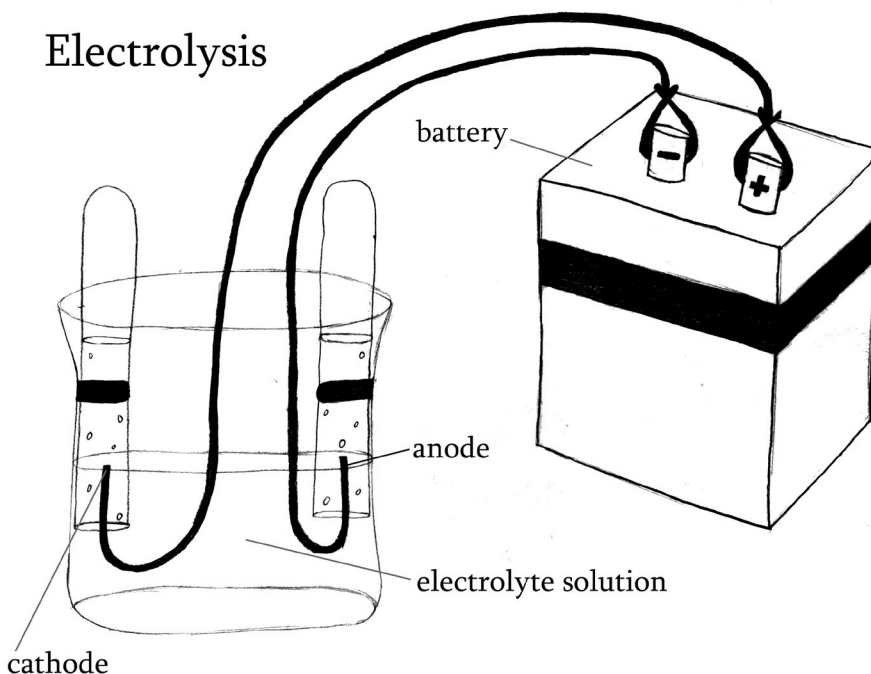
pg. 67, Electrolysis

1. What creates the negative and positive ions in electrolysis and where do they go? (*The electrical current used in electrolysis splits a compound into positive and negative ions. The positive ions are attracted to the cathode and the negative ions are attracted to the anode. Some of these ions stay in the solution and some of them are given off as gas.*)
2. What is electrorefining? (*Electrorefining is the process of using electrolysis to purify a metal, such as copper.*)
3. How does electroplating use electrolysis? (*Electroplating uses electrolysis to coat a given object with a thin layer of a metal.*)

Want More

- ✦ **Filtration** – Have the students make a solution of water and dirt from outside. Then have them line three funnels with several different filtering materials, such as cotton balls, a coffee filter and gravel. Place each of the funnels into a glass cup and have them pour a cup of the dirt solution they made. Observe each of the cups to see which filtration material worked the best.
- ✦ **Evaporation** – Have the students make a solution of $\frac{1}{2}$ cup (120 mL) hot water and $1\frac{1}{2}$ TBSP (25.7 g) of salt. Pour the solution onto a plate and set it in on a window sill in the sun. Check on the plate every 30 minutes. The students should see the water evaporate, leaving salt crystals on the plate.

Sketch Week 12



Chemistry Unit 3: Solutions Discussion Questions

Week 10

1. How are compounds and mixtures alike? How do they differ?
2. What is the law of constant composition and who discovered it?
3. What are three types of liquid mixtures?
4. What is synthesis?
5. What is an alloy?
6. How do chemists define the purity of a substance?

Week 11

pg. 60, Solutions

1. What is the difference between concentrated and dilute solutions?
2. Why is water such a good solvent?
3. What is a saturated solution?

pg. 75, Chemistry of Water

1. Why is water rarely found in its pure state?
2. What is unique to solid water (a.k.a. ice)?
3. What is hard water and what causes it to form?

Week 12

pg. 61, Separating Mixtures

1. How does decanting separate mixtures?
2. What is desiccation?
3. What is necessary for filtration to be able to separate the substances in a mixture?
4. What is evaporation?
5. When is distillation generally used to separate a mixture?
6. How does centrifuging separate a mixture?

pg. 67, Electrolysis

1. What creates the negative and positive ions in electrolysis and where do they go?
2. What is electrorefining?
3. How does electroplating use electrolysis?

Week 13

1. What is qualitative analysis?
2. What are two ways that scientists use chemical analysis in real life?
3. Why do scientists use titration?
4. Why do scientists use chromatography?
5. How does a mass spectrometer work?

Unit 3: Solutions Unit Test Answers

Vocabulary Matching

- | | | |
|------|------|-------|
| 1. D | 5. B | 9. L |
| 2. C | 6. H | 10. F |
| 3. A | 7. K | 11. E |
| 4. G | 8. I | 12. J |

True or False

- | | | |
|--|--|--|
| 1. False (<i>A mixture is composed of elements or compounds that have not been chemically joined.</i>) | 6. True | <i>of a mixture to separate it into its components.)</i> |
| 2. True | 7. True | |
| 3. True | 8. False (<i>Scientists use chemical analysis in real life situations everyday.</i>) | |
| 4. True | | |
| 5. False (<i>Evaporation uses the heating</i> | | |

Short Answer

- The law of constant composition states that a pure compound always contains the same elements in the same proportions. It was discovered by Joseph-Louis Proust.
- Concentrated solutions have a large amount of solute in relation to solvent. Dilute solutions have a small amount of solute in relation to solvent.
- The electrical current used in electrolysis splits a compound into positive and negative ions. The positive ions are attracted to the cathode and the negative ions are attracted to the anode. Some of these ions stay in the solution and some of them are given off as gas.
- Qualitative analysis is when a scientist uses a variety of methods to determine the components of a substance.
- 37-Rb-Rubidium, 38-Sr-Strontium, 39-Y-Yttrium, 40-Zr-Zirconium, 41-Nb-Niobium, 42-Mo-Molybdenum, 43-Tc-Technetium, 44-Ru-Ruthenium, 45-Rh-Rhodium, 46-Pd-Palladium, 47-Ag-Silver, 48-Cd-Cadmium, 49-In-Indium, 50-Sn-Tin, 51-Sb-Antimony, 52-Te-Tellurium

Unit 3: Solutions Unit Test

Vocabulary Matching

- | | |
|-------------------------|--|
| 1. Molecule ____ | A. Liquids that can be blended together. |
| 2. Mixture ____ | B. A homogenous mixture of two or more substances. |
| 3. Miscible ____ | C. A combination of two or more elements or compounds that are not chemically combined. |
| 4. Immiscible ____ | D. A substance that is formed when two or more atoms chemically join together. |
| 5. Solution ____ | E. A substance that conducts electricity when it is in solution. |
| 6. Solubility ____ | F. The positively charged electrode by which current enters the cell. |
| 7. Solvent ____ | G. Liquids that cannot be blended together. |
| 8. Solute ____ | H. The ability of a solute to be dissolved. |
| 9. Anode ____ | I. The substance that dissolves in the solvent to form a solution. |
| 10. Cathode ____ | J. A method of separating the substances in a mixture by the rate they move through or along a medium, such as filter paper. |
| 11. Electrolyte ____ | K. The substance in which the solute dissolves to form a solution, typically a liquid. |
| 12. Chromatography ____ | L. The negatively charged electrode by which current leaves the cell. |

True or False

1. _____ A mixture is composed of elements or compounds that have been chemically joined.
2. _____ Chemists say that a substance is pure when it contains only one atom or molecule.
3. _____ Water is a good solvent because it is a polar molecule.

3. What creates the negative and positive ions in electrolysis and where do they go?

4. What is qualitative analysis?

5. Fill in elements 37-52 from the periodic table.

- | | | |
|-------------|--------------|--------------|
| • Rubidium | • Strontium | • Silver |
| • Tin | • Molybdenum | • Indium |
| • Yttrium | • Cadmium | • Technetium |
| • Ruthenium | • Rhodium | • Antimony |
| • Zirconium | • Palladium | |
| • Niobium | • Tellurium | |

37. _____

38. _____

39. _____

40. _____

41. _____

42. _____

43. _____
44. _____
45. _____
46. _____
47. _____
48. _____
49. _____
50. _____
51. _____
52. _____

*Chemistry
for the
Logic Stage*

Student Guide

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Chemistry for the Logic Stage

Letter to the Student

Dear Student,

Welcome to your journey through chemistry. Chemistry is the study the various forms of matter, their composition, structure, and properties, as well as how they react with each other. This year, you will examine atoms and molecules along with how they are related to the various forms of energy. You will look at the building blocks of chemistry, matter, solutions, mixtures, acids, and bases along your voyage. This guide is written for you, so enjoy your journey!

What this guide contains

First, this guide includes your date sheets and unit sheets. The unit sheets have your vocabulary words, weekly student assignment sheets, sketches, experiment sheets, and space for each of your writing assignments. After your unit sheets, you will find the Appendix. In it, you will find a list of all your memory work for the year, a glossary, and a place to record any additional activities you have done which pertain to chemistry.

Student Assignment Sheets Explained

The Student Assignment Sheets contain your weekly assignments for each week. Each of the student assignment sheets contains the following:

- ✓ **Experiment** — Each week will revolve around a weekly topic. You will be assigned an experiment to complete that poses a question about what you are studying. Each student assignment sheet contains the list of materials you will need and the instructions to complete the experiment. This guide also includes experiment sheets for you to fill out each week. In each of these experiments, you will use the scientific method.




A Word about the Scientific Method —The scientific method is a method for asking and answering scientific questions. This is done through observation and experimentation. The following steps are key to the scientific method:

- 1. Ask a Question** — The scientific method begins with asking a question about something you observe. Your questions must be about something you can measure. Good questions begin with how, what, when, who, which, why or where.
- 2. Do Some Research** — You need to read about the topic from your question so that you can have background knowledge of the topic. This will keep you from repeating mistakes of the past.
- 3. Formulate a Hypothesis** — A hypothesis is an educated guess about the answer to your question. Your hypothesis must be easy to measure and answer the original question you asked.
- 4. Test with Experimentation** — Your experiment tests whether your hypothesis is true or false. It is important for your test to be fair. This means that you may need to run multiple tests. If you do, be sure to only change one factor at a time so that you can determine which factor is causing the difference.

- 5. Record and Analyze Observations or Results** — Once your experiment is complete, you will collect and measure all your data to see if your hypothesis is true or false. Scientists often find that their hypothesis was false. If this is the case, they will formulate a new hypothesis and begin the process again until they are able to answer their question.
- 6. Draw a Conclusion** — Once you have analyzed your results, you can make a statement about them. This statement communicates your results to others.

Each of your experiment sheets will begin with a question and an introduction. The introduction will give you some background knowledge for the experiment. The experiment sheet also contains sections for the materials, a hypothesis, a procedure, an observation and a conclusion. In the materials section you need to fill out what you used to complete the experiment. In the hypothesis section you need to predict what the answer to the question posed in the lab is. In the procedure section you need to write step by step what you did during your experiment (so that someone else could read your report and replicate your experiment). In the observation section you need to write what you saw. Finally, in the conclusion section you need to write whether or not your hypothesis was correct and any additional information you have learned from the experiment. If your hypothesis was not correct, discuss why with your teacher and then include why your experiment did not work on your experiment sheet.

Safety Advisory: Do not perform any of the experiments marked “☹ CAUTION” on your own. Be sure you have adult supervision.

-  **Vocabulary & Memory Work** — Throughout the year, you will be assigned vocabulary and memory work for each unit. Each week, you will need to look up the word in your glossary and fill out the definitions on the Unit Vocabulary sheet found at the beginning of each unit in this guide. You may also want to make flash cards to help you work on memorizing these words. Each week, you will also have a memory work selection to work on. Simply repeat this selection until you have it memorized, and then say the selection to your teacher. There is a complete listing of the memory work selections in the Appendix on pp. 253-255 of this guide.
-  **Sketch** — Each week, you will be assigned a sketch to complete. Color the sketch and label it with the information given on the Student Assignment sheet. Be sure to give your sketch a title.
-  **Writing** — Each week, you will be writing an outline and/or a narrative summary. The student assignment page will give you a reading assignment for the topic from your spine text, the *DK Encyclopedia of Science (DK EOS)*. After you have finished the assignment, discuss what you have read with your teacher. Your teacher will let you know whether to write an outline or a narrative summary from your spine text reading. Your teacher may also assign additional research reading out of the following books:

 *Kingfisher Science Encyclopedia (KSE)*

 *Usborne Illustrated Dictionary of Science (UIDS)*

📖 *DK Eyewitness BookL Chemistry (DKChem)*

Once you finish the additional reading, prepare a narrative summary about what you have learned from your reading. Your outlines should be one-level main topic style outlines, and your narrative summaries should be one to three paragraphs in length, unless otherwise assigned by your teacher.

- ⌚ **Dates** —Each week, dates of important discoveries within the topic and dates from the readings are given on the student assignment sheet. You will enter these dates onto one of four date sheets. The date sheets are divided into the four time periods laid out in *The Well-Trained Mind* by Susan Wise Bauer and Jessie Wise (Ancients, Medieval-Early Renaissance, Late Renaissance-Early Modern, Modern). These sheets are found in the ongoing projects section of this guide. You can choose to just write the dates and information on the sheet or if you want you can draw a timeline in the space provided and enter your dates on that.

How to schedule this study

Chemistry for the Logic Stage is designed to take up to three hours per week. You, along with your teacher, can choose whether to complete the work over five days or over two days. Below are two options for scheduling to give you an idea of how you can schedule your week.

- ✓ A typical two day schedule:
 - ⌚ **Day 1** — Define the vocabulary, do the experiment and complete the experiment page, record the dates;
 - ⌚ **Day 2** — Read assigned pages and discuss together, prepare the science report or outline, complete the sketch.
- ✓ A typical five day schedule:
 - ⌚ **Day 1** — Do the experiment and complete the experiment page;
 - ⌚ **Day 2** — Record the dates and define the vocabulary;
 - ⌚ **Day 3** — Read assigned pages and discuss together and complete the sketch;
 - ⌚ **Day 4** — Prepare the science report or outline;
 - ⌚ **Day 5** — Complete one of the Want More activities from the Teacher Guide.

Final Thoughts

As the author and publisher of this curriculum, I encourage you to contact me with any questions or problems that you might have concerning *Chemistry for the Logic Stage* at support@elementalscience.com. I will be more than happy to answer them as soon as I am able. I hope that you will enjoy *Chemistry for the Logic Stage*!

Sincerely,
Paige Hudson, BS Biochemistry, Author

Chemistry
Unit 3

Solutions

Unit 3: Solutions Vocabulary Sheet

Define the following terms as they are assigned on your Student Assignment Sheet.

1. Molecule – _____

2. Mixture – _____

3. Miscible – _____

4. Immiscible – _____

5. Solution – _____

6. Solubility – _____

7. Solute – _____

8. Solvent – _____

9. Anode – _____

10. Cathode – _____

11. Electrolyte – _____

12. Chromatography – _____

Student Assignment Sheet Week 10

Molecules and Mixtures

Experiment: Marshmallow Molecules

Materials:

- ✓ Bag of multi-colored marshmallows
- ✓ Toothpicks

Procedure:

1. Read the introduction to this experiment.
2. Choose a color of marshmallow to represent each of the following atoms: oxygen, nitrogen, hydrogen and carbon. When you make your molecules you must follow these rules:
 - ➔ Oxygen prefers to bond twice, nitrogen prefers to bond three times, hydrogen prefers to only bond once and carbon prefers to bond 4 times;
 - ➔ Each atom must have its preferred number of bonds to form a stable molecule and you must only create stable molecules;
 - ➔ All of nitrogen's bonds should point down and all of carbon's bonds need to be opposite from each other (except in the case of a multiple bond).
3. Make the following molecules from your marshmallows: NH_3 (ammonia), H_2O (water), CH_4 (methane), CO_2 (carbon dioxide), $\text{C}_2\text{H}_5\text{OH}$ (ethanol) (**Hint**—You can make multiple bonds between the atoms.)
4. Draw a quick sketch of each of your molecules after you finish assembling them.
5. Draw conclusions and complete your experiment sheet.

Vocabulary & Memory Work

- Vocabulary: molecule, mixture
- Memory Work—This week, add the following elements to what you are working on memorizing:
 - ✓ 37-Rb-Rubidium, 38-Sr-Strontium, 39-Y-Yttrium, 40-Zr-Zirconium
- Memory Work—Work on memorizing the Law of Constant Composition: A pure compound always contains the same elements in the same proportions.

Sketch

- No sketch this week.

Writing

- 🔗 Reading Assignment: *DK Encyclopedia of Science* pp. 58-59 (Compounds and Molecules)
- 🔗 Additional Research Readings: Chemical Compounds: *KSE* pp. 164-165, Molecules: *UIDS* pg. 125, Atoms and Molecules: *DK Chem* pp. 16-17

Dates

- 🕒 1649 – Pierre Gassendi states that atoms can be joined together to form molecules.
- 🕒 1798-1808 – Joseph-Louis Proust analyzes the different sources of several compounds and finds that their elements always contained the same ratio by weight. This leads to the discovery of the law of constant composition.

Experiment: Marshmallow Molecules

Introduction

Molecules are formed when two or more atoms are held together by a chemical bond. These molecules form the millions of substances that surround us in daily life, such as water and table salt. The atoms tend to follow a set of rules when they form molecules. In this experiment, you are going to make marshmallow representations of several common molecules.

Materials

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Procedure

Observations and Results



H_2O (water)

CH_4 (methane)

CO_2 (carbon dioxide)

**Conclusion**

Student Assignment Sheet Week 11 Solutions

Experiment: Is it polar or nonpolar?

Materials:

- | | |
|-----------------------------|-------------------|
| ✓ 5 clear cups (or beakers) | ✓ Flour |
| ✓ 5 plastic spoons | ✓ Petroleum jelly |
| ✓ Sugar | ✓ Water |
| ✓ Salt | ✓ Vegetable oil |
| ✓ Baking soda | ✓ Tablespoon |

Procedure:

1. Read the introduction to this experiment and write down which molecules you think are polar and which ones you think are nonpolar.
2. Label the cups #1 through #5. Add $\frac{1}{2}$ cup (120 mL) of room temperature water to each of the five cups.
3. Then stir in 1 TBSP (12.6 g) of sugar to cup #1, 1 TBSP (17.1 g) of salt to cup #2, 1 TBSP (12 g) of baking soda to cup #3, 1 TBSP (5 g) of flour to cup #4 and 1 TBSP (8 g) of petroleum jelly to cup #5.
4. Gently stir each of the cups with a spoon, using a different spoon for each cup. Wait 10 minutes and record your observations and results.
5. Pour out the solutions, rinse well and dry each of the cups. Add $\frac{1}{2}$ cup (120 mL) of room temperature oil to each of the five cups.
6. Repeat steps 3 and 4.
7. Draw conclusions and complete your experiment sheet.

Vocabulary & Memory Work

- Vocabulary: solution, solubility, solute, solvent
- Memory Work—This week, add the following elements to what you are working on memorizing:
 - ✓ 41-Nb-Niobium, 42-Mo-Molybdenum, 43-Tc-Technetium, 44-Ru-Ruthenium
- Memory Work—Continue to work on the Law of Constant Composition

Sketch: Anatomy of a Water Molecule

- ⊕ Label the following: chemical bonds, the symbol for an oxygen atom (O), the symbol for the hydrogen atoms (H), the charges associated with the molecule

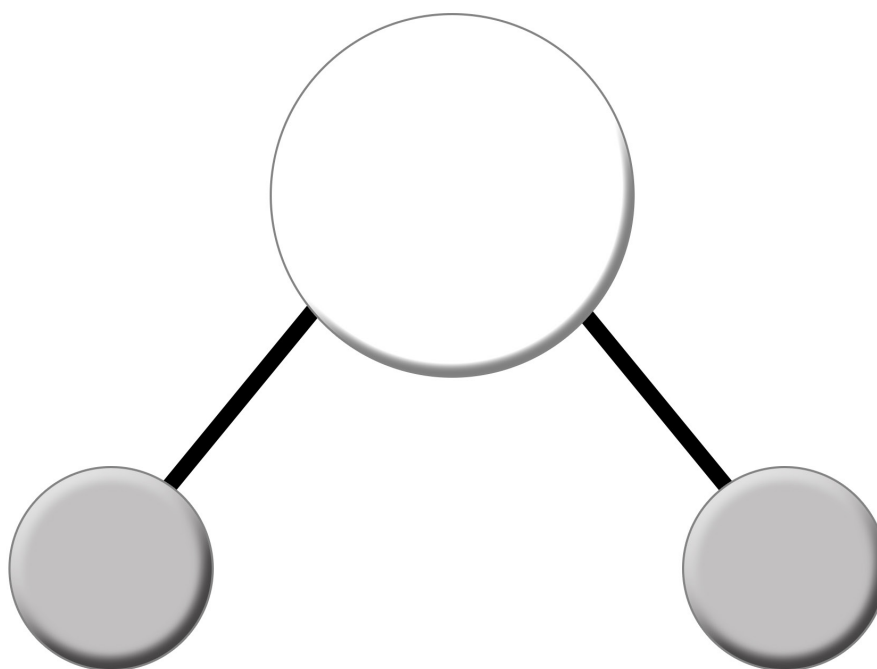
Writing

- 🔗 Reading Assignment: *DK Encyclopedia of Science* pg. 60 (Solutions) and pg. 75 (Chemistry of Water)
- 🔗 Additional Research Readings:
 - 📖 Solutions: *KSE* pp. 158-159
 - 📖 Solutions and Solubility: *UIDS* pp. 144-145

Dates

- ⊕ No dates to be entered this week.

Sketch Week 11



Experiment: Is it polar or nonpolar?

Introduction

A solution contains several different types of molecules that have been evenly mixed. Generally, a solution is made when one type of molecule, which we call the solute, is dissolved in another, which we call the solvent. The molecules can be either polar or nonpolar. Polar molecules have a positive and a negative end, while nonpolar molecules do not carry a charge. As a general rule, like dissolves like; this means that solvents with polar molecules dissolve solutes with polar molecules and vice versa. In this experiment, you are going to use a polar solvent, water, and a nonpolar solvent, vegetable oil, to determine if several substances are polar or nonpolar.

Hypothesis

I think that _____ are polar.

I think that _____ are nonpolar.

Materials

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Procedure

Observations and Results

Solute	Solvent: Water	Solvent: Vegetable Oil
Sugar		
Salt		
Baking Soda		
Flour		
Petroleum Jelly		

***S=Soluble, SS=Semi-soluble, NS=not soluble**

Conclusion

Student Assignment Sheet Week 12

Separating Mixtures and Compounds

Experiment: Can I split water?

Materials:

- | | |
|-------------------|-----------------------|
| ✓ Distilled water | ✓ 2 Alligator clips |
| ✓ 2 test tubes | ✓ Covered copper wire |
| ✓ Salt | ✓ 6v Lantern battery |
| ✓ Glass cup | ✓ Permanent marker |

Procedure:

1. Read the introduction to this experiment and make your hypothesis.
2. Mix together 4 cups (1000 mL) of distilled water with $\frac{1}{2}$ cup (136.5 g) of salt and set the solution aside. Next, cut your wire into two lengths and expose the two ends of each of the wires. Attach one end of the first length of wire to one of the alligator clips. Repeat for the second wire.
3. Now, tape your test tubes to opposite sides of your cup. Fill the cup half of the way full with your salt water solution. Some of the water will go into your test tubes, which is what you want. They should be fairly close to full of water. Fit the other exposed end of your wire into the bottom of your test tubes, making sure that it does not touch the sides of your test tube. Rest the remaining part of the wire on the side of your container.
4. Then, mark the water level in each of the tubes with a permanent marker and check your set up to make any necessary adjustments. Now, you can attach the alligator clips to each of the battery terminals of the lantern battery. **CAUTION—Do NOT touch the water when the wire is attached to the battery!!!**
5. Wait for 30 minutes and then detach the wires from the battery. Mark the water level on each of the tubes once again. Remove the tubes and measure the distance between each of your lines to determine how much gas you collected.
6. Draw conclusions and complete your experiment sheet.

⚠ CAUTION

**DO NOT DO THIS
EXPERIMENT WITHOUT
ADULT SUPERVISION!**

This experiment has the potential to form hydrogen gas, which is extremely flammable.

Vocabulary & Memory Work

- Vocabulary: anode, cathode, electrolyte
- Memory Work—This week, add the following elements to what you are working on memorizing:
 - ✓ 45-Rh-Rhodium, 46-Pd-Palladium, 47-Ag-Silver, 48-Cd-Cadmium
- Memory Work: Continue to work on the Law of Constant Composition

Sketch: Electrolysis

- Label the Following: anode, cathode, electrolyte solution, battery

Writing

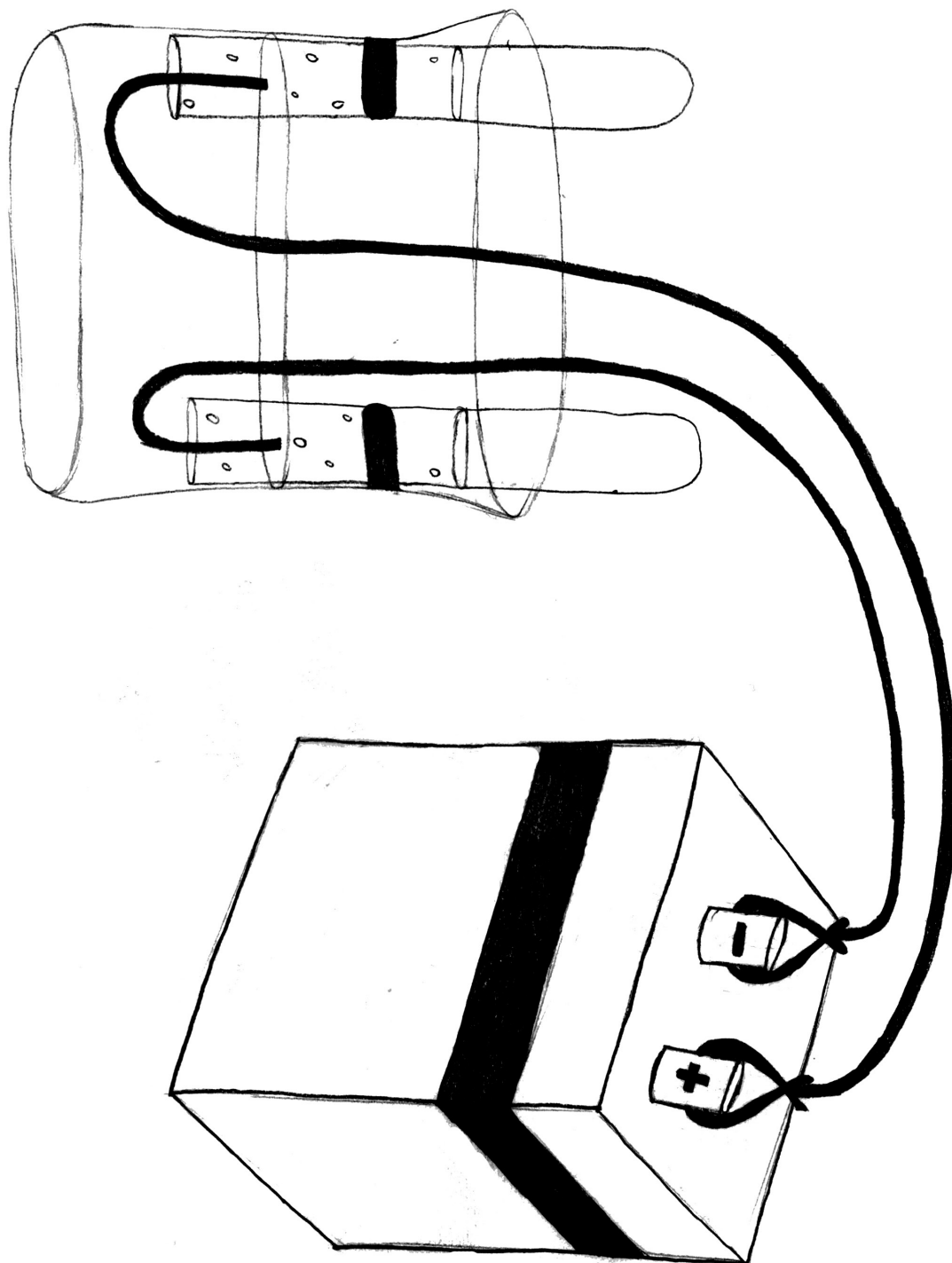
- 📖 Reading Assignment: *DK Encyclopedia of Science* pg. 61, Separating Mixtures and pg. 67, Electrolysis
- 📖 Additional Research Readings: Separation and Purification: *KSE* pp. 160-161

Dates

- 🕒 1778-1829 – English chemist Humphrey Davy lives. He is one of the first scientists to see electrolysis in action.
- 🕒 1832 – Michael Faraday writes a mathematical equation that can be used to calculate the quantity of the separated elements in electrolysis.

Student Guide Unit 3: Solutions ~ Week 12 Separating Mixtures and Compounds

Sketch Week 12



Experiment: Can I split water?

Introduction

Scientists can use a variety of methods to separate mixtures, such as filtration, decantation, distillation, evaporation and centrifugation. Electrolysis separates the components of a molecule within a solution. It uses electrical current to break the compound into its pieces. This process requires that the substance can conduct electricity and that it is either in solution or in a molten state. Electricity passes from two electrodes into the solution, which breaks the compound into its parts. In this experiment we are going to see if we can use electrolysis to split water.

Hypothesis

I think that I will see _____

Materials

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

⚠ Caution – Do NOT do this experiment on your own as it has two main hazards, electricity with water and potentially flammable hydrogen gas. It can be done safely under adult supervision in your home as long as you follow the two rules below.

- 1. Do NOT touch the water when the wire is connected to the battery.** You can wear rubber gloves when you are dealing with the electrical part of this experiment for an extra measure of safety.
- 2. Do NOT do this experiment anywhere near an open flame.** Also, do not smoke in the house while performing this experiment.

Procedure

Observations and Results

Gas	Amount Collected
Oxygen Gas (found at the anode)	
Hydrogen Gas (found at the cathode)	

Conclusion
