Exploration of Chemicals and Chemical Information

Chemical Scavenger Hunt

Finding Chemicals Around You

Introduction

Chemicals are all around us, and we are all a product of chemistry. In fact, the American Chemical Society has a sticker set and game that is used for National Chemistry week where the challenge is to find something that does not contain chemicals. (This is a trick question, of course, in that everything is made up of atoms which is the basic unit of a chemical element.) When you understand this, you begin to realize all of the misinformation that is out there in the world of advertising. How can they really say that this water has no chemicals or that all of the chemicals have been removed from the water? Water is a chemical compound made from hydrogen and oxygen. It has the chemical formula H2O, two atoms of hydrogen for every one atom of oxygen.

Everything we see, feel, taste and smell is made from chemicals. Some of the chemical formulas are simple like water and table salt (the formula for table salt is NaCl, sodium chloride). Others may be very complex in terms of the number of atoms and/or elements they contain. Examples of complex molecules are sugars, starches, proteins, and DNA (deoxyribonucleic acid). Moving up from single molecules to mixtures or products, the complexity of the interactions increases. Think of a bottle of shampoo. Shampoos contain water, detergents, and perfumes. Just how many different chemicals and the types of interactions may be present?

In our first activity, the chemical safety scavenger hunt, we looked at common household products and learned where to find important information about how to use the product and keep us safe. We looked at the labels, and the safety data sheet (SDS). And, hopefully, you found that there was chemical information: the chemical formula and its CAS number. (The CAS is the chemical abstract number that has been assigned by the American Chemical Society to help uniquely identify the chemical substance.) You may have also found a molecular structure.

In this activity, your mission is to identify many chemicals that are commonly used around your house. People are performing chemistry at home, every day. Think about the many activities that require chemistry? Washing your hands – you use a detergent to remove the greases and oils. Have you ever used a carpet stain lifter?

Or, how about removing rust? How do you get your gravy to thicken? All of these are chemical reactions. But, how do you know what chemicals are being used?

There is one more thing about chemicals – most of the common chemicals go by their common names. Table salt, for example, is really sodium chloride, NaCl. Finding the true chemical name and molecular (chemical) formula may require going to more than one source. The ingredients with the chemical name will generally be listed in the ingredients section of the SDS. Once you have the name, you can do a search for the chemical formula using either the name or the CAS#. The CAS# is the Chemical Abstract Registry Number used by the American Chemical Society to uniquely identify the chemical.

So, now it is time to go on a scavenger hunt and find out just "what is that stuff" on a molecular level!

The molecular or chemical formula is symbolic representation of the chemical using the symbols for the atoms us contained in the molecule. The formula includes the number of each atom used in the molecule. Recall the example of water, H2O. It contains 2 atoms of hydrogen and 1 atom of oxygen in each water molecule.

General Safety Considerations for this Activity

As was mentioned in the first activity, we will be doing hazard analyses for all of our experiments. This is an activity – there is a difference between an experiment and an activity. In an experiment, you are testing a hypothesis and the outcomes are not necessarily certain. In an activity, you are primarily performing a task. Many tasks will require you to conduct a hazard analysis as well; however, for this activity, you are primarily looking at labels, and obtaining information from the Internet or other sources. This activity does not require a hazard analysis as discussed as the physical risks associated with doing some Internet research does not typically involve activities which have significant "bad outcomes", or could cause you harm.

Yet, if you think about it – this activity does pose some risk. For example: if you store your spices in a cabinet that is difficult for you to reach from the ground, getting that container, may pose a hazard (you could fall). Some the materials that you

may be looking at in the garage or under the sink may be hazardous, antifreeze and cleaning products contain materials that require special precautions as you learned in the last activity. So, you still need to use caution.

Just because a chemical is common or can be readily purchased, does not mean that there are no hazards associated with them. You still need to pay attention to warning labels. You need to take care when getting things from their storage areas. You need to be aware of your surroundings. So, keep the following "rules" in mind when conducting this activity:

- Make sure someone else is aware of what your are doing
- Follow any household or classroom guidelines associated with using the Internet and/or other reference materials
- Be aware of your surroundings, look for hazards: tripping, heights, other containers, etc.
- Read the labels, be aware of any cautions or warning statements

For this activity, please do not open the packages or handle any of the material directly. Use your familiarity with the product or item to answer the questions.

Equipment required for the Activity

- Access to reference materials: Internet or other materials
- Notebook

Objectives

- Identify common household items by a variety of names: common, chemical, and molecular (chemical) formula – example: Bleach (common name), Clorox™ (trade name), sodium hypochlorite (chemical name), and NaClO (chemical formula)
- Establishing a laboratory notebook and documenting laboratory activities.
- Learn to recognize anything and everything as a chemical
- Start to "see" that some chemicals are simple and others are complex
- Identify compounds (molecules)

- Identify pure compounds versus mixtures
- Find the molecular formula for common materials

Activity/Procedure

This activity is a good introduction to taking notes. As mentioned in the student introduction, during this course you are going to be developing a laboratory skills. One of those skills is the recording of information about your activities and findings. In this activity, you will be collecting a variety of information about household products and be using a variety of sources. This information will be collected and documented in your laboratory notebook.

Note taking is a skill used by all scientists. The notes taken by the scientist cover a variety of topics, everything from the references used, general information, experimental conditions, observations, ideas, hypotheses, experimental results, initial conclusions, etc. Scientists use this information to develop new experiments and new hypotheses. The laboratory notebook becomes an essential tool and record for discoveries. They are used to document findings, establish records of invention, and provide the detail of the experimental conditions and tests.

The challenge, of course, is coming up with a systematic method of note taking and documentation in the notebook so that this information can be used not only by you, but by someone else. Being able to reproduce your results is critical to the scientific method and process. The only way for you to learn what works for you is through practice and repetition. Throughout this course you are going to get multiple opportunities to work on your note taking skills. And, while activity sheets and data collection sheets may be provided as part of the materials; as you move through the course, you should start to rely more and more on your notes and notebook. This activity is your first opportunity to get started on this task.

<u>First, what is the activity?</u>

During this activity, you are going to obtain chemical information for the following items:

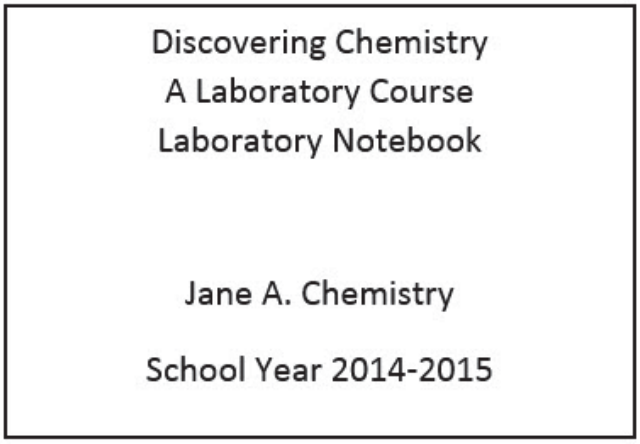
- Baking Soda
- Washing Soda
- Ammonia
- Antifreeze
- Fertilizer
- Vanilla
- Vinegar

For each of the items, you will need to obtain:

- The common name
- The trade name or product specific name
- Chemical name
- Chemical formula
- What the material is used for or common use
- Warnings/Cautions associated with the material
- Any special handling instructions
- Emergency contact information
- Physical state of the material (solid, liquid, gas)
- Description of the product (physical observation)
- Any other information that you think might be relevant.

Setting up your laboratory notebook

Now that you know what you are going to be doing and the information that you are going to be collecting you can begin to set up your notebook. Remember that your notebook is going to be documentation for this laboratory course, so you will need to set it up that way. The first page should be the title page and should look something like:



Leave the next two pages blank. These will become your table of contents. (Note: it is a good idea to number your pages, front and back. (This allows someone to know that you haven't ripped or torn any out.)) So, starting at about page 5; begin to lay out your activity. Using bleach as an example, your page may look something like this:

Today's Date

Activity – Chemical Information Scavenger Hunt

Objective: Find information about 7 common household chemicals

Information to be obtained includes:

Common name, chemical name, chemical formula, safety information, physical information, etc.

Chemical 1:

Common Name: Bleach

Trade Name: Clorox Regular Bleach

Chemical Name: sodium hypochlorite

Chemical Formula: NaClO

CAS#: 7681-52-9

Physical description: Liquid – light yellow with a characteristic chlorine odor

Uses: Household cleaning and bleaching of clothes in laundry

Cautions/Warnings: Danger, Corrosive – may cause irritation or damage to eyes and skin. Vapor or mist may irritate. Harmful is swallowed. Keep out of reach of children.

Reactivity: Stable under normal use and storage. REACTS with other household chemicals such as toilet cleaners, rust removers, vinegar, acids or ammonia to produce a hazardous gas.

Special Precautions: Avoid contact with eyes, skin and clothing.

Emergency Contact Information: Medical – 1-800-446-1014

Other Information: Generally found in concentrations of 5 to 10% in household product.

Household product may also contain sodium hydroxide (NaOH) at <1%

Source of Information: SDS from Clorox Company on the internet, copy of SDS is on computer hard drive.

Initials: *JAC*

*** *Keep a copy of all of the SDSs you use. You will use some of the information in later activities/experiments.* ***

Safety aside – one of the comments about bleach is its characteristic odor. When working with hazardous chemicals, a person avoids contact with the chemical, i.e. you do not want to have the material come into contact with the skin or ingested. Using your sense of smell becomes a bit tricky, as many chemicals are dangerous when inhaled. Yet, smell is also used for identification of certain chemicals. Thus, there is a laboratory technique called wafting.

Wafting is done by moving a vial of the material gently back and forth so that the vapor or smell "floats" in the air and you can smell it without being overcome. As with any laboratory course, you should not directly smell the chemicals unless instructed to do so and then only by wafting.

For highly odorous or where concentrations of vapor may cause a hazard, chemists use other protective measures to ensure that exposure to the vapors is eliminated or significantly reduced. Safety equipment such as laboratory hoods, and respirators are used in these cases. This course uses materials that are commonly found, thus these extra safety precautions will not be required.

You can see from this laboratory notebook page, some information was added above what was requested in the list of essential information. This was included because JAC thought that they might need that information down the road. Also, the source of the information was documented. Even though that was not requested in the list of information; this item should be recorded for all reference material. Where did I get this piece of information? This is important as it documents and gives credit to the appropriate source.

JAC could have taped or stapled the SDS into the notebook as well. But, since this was a reference from the Internet, recording the website, or location of the SDS is just as acceptable. As you move through this course, you will want to tape graphs or other information into your notebook. Anything that you add to your notebook should include your initials and each page should be initialed once it is complete.

Continue collecting information on the other six common items. Some things to think about while you are collecting the information. Are the chemicals simple or complex? For bleach, the active ingredient is the sodium hypochlorite. This is a

fairly simple compound made up of three different elements. As noted the product is a mixture containing 5 to 10% sodium hypochlorite with the remainder being water. The mixture is a homogeneous one, as the mixture is uniform throughout. (Another type of mixture is the heterogeneous mixture. A heterogeneous mixture is not uniform throughout. In the heterogeneous mixtures one sample of the mixture may have a different concentration than another sample. Concrete, soils, and vegetable soup are all examples of heterogeneous mixtures.) But, think about some of the other products, are the chemical formulas going to be as simple? Or, more complex?

Our consumer products are typically mixtures. What is the carrier? For example, flavorings may be a mixture of the volatile oil (like peppermint oil) and alcohol. Even solids can be mixtures. Look at ground pepper. You can have multiple types of pepper corns ground together. A gravy mix has corn starch, flour, and dehydrated beef broth. The flour can be considered the carrier for the gravy mix.

Is there more than one active ingredient? Is there an inert (meaning that the ingredient is there for color or packaging and does not participate in the product) ingredient? For example: many powdered products contain ingredients that help to prevent clumping allowing for easy pouring.

Summing It Up:

While this activity was designed for you to get familiar with note taking and finding information on the various chemical compounds that are present in the household, there are some other things that you may have noted.

- As you went through the activity, were you able to predict whether or not the chemicals were complex or simple?

- Did you happen to compare the same common product from one or more manufacturers? Clorox is not the only manufacturer of bleach. Were the ingredients the same from one manufacture to another? Did they have the same types of information?

- Was the molecular (chemical) formula hard or easy to find? Did you have to go to more than one source?

- Were you able to distinguish between a homogeneous and heterogeneous mixture? Did you have an example of a heterogeneous mixture in one of your items?

- As you went through the activity, did you tend to gather more information about your item?

Let's return to the initial objectives of the activity:

- Identify common household items by a variety of names: common, chemical, and molecular (chemical) formula – example: Bleach (common name), Clorox™ (trade name), sodium hypochlorite (chemical name), and NaClO (chemical formula)

- Establishing a laboratory notebook and documenting laboratory activities.

- Learn to recognize anything and everything as a chemical

- Start to "see" that some chemicals are simple and others are complex

- Identify compounds (molecules)

- Identify pure compounds versus mixtures

- Find the molecular formula for common materials

Did the activity meet all of these objectives?

Take some time to summarize your thoughts about this activity in your laboratory notebook. This can be done in a discussion or observation section in your notebook.