Student’s Lesson at a Glance

Lesson Summary

Students are introduced to what chemistry is and what transferable skills are necessary for a student to have and develop in the class. Students begin their exploration of levels in chemistry: macroscopic, microscopic, submicroscopic, and symbolic. Students are asked to make predictions to represent water at each of these levels. In the final decoding activity, students are introduced to formula writing using molecules that they will see throughout the unit.

SWBAT (Students Will Be Able To)

Understand what skills scientist use, understand how to make scientific observations, and define macroscopic, microscopic, submicroscopic, and symbolic levels.

Essential Vocabulary

Keep a list of all important words from this lesson. This list, in addition to lists from other lessons, will make studying easier and improve scientific communication skills. The essential vocabulary from the unit is in bold. Additional words that will expand your scientific vocabulary are in italics.
CCC Reminder

- Students and teachers from many different schools helped designed CCC so that the lessons are more helpful and meaningful for all classroom participants.
- Many questions will ask you “what you think” or “to make predictions.” The only wrong answer is the answer that is left blank.
- Prefixes and suffixes on words can help you discover the meaning of a word.
- Use the vocabulary section and note section to take good notes so that studying for tests and quizzes is easier.
- Supporting claims with evidence is not only a skill that scientists use, but a skill that will help you in other classes and everyday life.
- Draw a key when you are sketching. Keys can help you and others decode your sketches at a later time.
- There is a periodic table and list of common elements used in the back of this book. You will need to refer to the periodic table often.

Notes

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Homework

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Upcoming Quizzes/Tests

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Activity 1: Connecting

There are many careers a student can pursue after graduating from high school. Every career requires a unique skill set. Skills are tools that people use to do their jobs. Some skills require education and training to develop. Developing strong work skills related to a career allows a person to increase his or her earnings, which will affect their lifestyle in a positive way. Science is one area that offers a wide range of career opportunities.

A chemist is a scientist who specializes in the field of chemistry. **Chemistry** is the study of matter and energy. Chemists make observations of phenomena in the world around them and gather qualitative and quantitative data through research. The data they gather may include information about the mass, density, size, shape, and composition of different substances. Chemists use these data to better understand the known and unknown substances they work with in their labs and in the field. Chemists can be found working for the Federal Bureau of Investigation (FBI) analyzing evidence from a crime scene. Some chemists work for pharmaceutical companies developing new drug treatments for diseases ranging from the common cold to cancer. Chemists can even be found working for car companies to develop new materials and fuels to make cars faster, lighter, stronger, and more fuel efficient.

In the chemistry classroom, you are doing the work of a scientist as you make qualitative and quantitative observations about demonstrations, labs, and computer simulations. These observations will help you better understand how the world around you works. Many students may not be interested in becoming a chemist. A student might ask, “Why bother taking chemistry classes? I am not going to be a chemist.” You do not have to be a chemist to use the knowledge and skills gained in chemistry classes. Hair stylists, nurses, doctors, engineers, chefs, biologists, agriculturalists, teachers, jewelry makers, mechanics, psychologists, cosmetologists, forest rangers, computer technicians, and military personnel are just some of the professionals who use skills gained in the chemistry classroom.

1. What specific skills do you think scientists need to do their job?

2. What do you think scientists use to gather observations?
3. Should initial scientific observations contain statements trying to explain why phenomena happen?

You are a scientist when in a chemistry classroom. Yes or no is not a scientific answer. Instead, provide evidence to support your claim.

4. What happens when claims are made without using evidence to support them?

Activity 2: Exploring the Levels of Observations

Part 1

1. What does the prefix **macro** mean?

2. What does the prefix **micro** mean?

3. What does the prefix **submicro** mean?

Imagine the following situations:

- Smelling your favorite food cooking
- Wrapping up in a blanket on a chilly evening
- Biting into a slice of sour fruit
- Scratching your nails down a chalkboard
- Watching the sun set on a summer evening

Qualitative observations are often made using personal experience from the five senses. All these experiences are on the **macroscopic level**. They can be observed and experienced without the use of special...
scientific equipment. Imagine if you were shrunk down in size - how would the world appear different?

A world surrounds us that cannot be seen with the naked eye - a world that requires the use of a microscope. For example, a tiny cell taken from inside of your cheek or from the root of an onion can be seen using a microscope. These observations are on the **microscopic level**. Most cells cannot be seen unless you have a microscope.

Many scientists study small things that cannot even be seen with a microscope. Some objects, such as molecules and atoms, are found only at the **submicroscopic level**. We cannot see the submicroscopic level without sophisticated technology. Scientists make models of the submicroscopic objects in the world. Chemists have helped the rest of the world learn about the submicroscopic level using **symbolic representations**, such as chemical formulas. In chemistry, scientists attempt to connect the macroscopic, microscopic, and submicroscopic levels. Specifically in CCC, simulations show how events on the submicroscopic level explain observations on the macroscopic level that can be observed with the five senses. Chemists can then communicate such observations using symbolic representations.

*Based on the paragraph you have just read, define the following terms:*

4. **Macroscopic**

5. **Microscopic**

6. **Submicroscopic**

7. **Symbolic**
Check your definitions for macroscopic, microscopic, submicroscopic, and symbolic against the definitions your teacher provides. If your definition is different than your teacher’s, record your teacher’s definition in the vocabulary section of the Lesson At A Glance found at the beginning of the Lesson.

### Part 2

<table>
<thead>
<tr>
<th>Figure 1: _______________</th>
<th>Figure 2: _______________</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="leaf.png" alt="Figure 1" /></td>
<td><img src="microscope.png" alt="Figure 2" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Figure 3: _______________</th>
<th>Figure 4: _______________</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="molecule.png" alt="Figure 3" /></td>
<td><strong>Common Name</strong> Elm</td>
</tr>
<tr>
<td></td>
<td><strong>Scientific Name</strong> Ulmus carpinifolia</td>
</tr>
<tr>
<td></td>
<td><strong>Family</strong> Ulmaceae</td>
</tr>
</tbody>
</table>

8. In the table above, there are four figures. Classify each figure as belonging to the submicroscopic, symbolic, microscopic, or macroscopic level and label each figure. Explain your choices below.

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9. Some teachers use the words particulate, molecular or subatomic to describe submicroscopic level. Why do you think the picture for submicroscopic fits these three other terms?

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Activity 3: Representing Different Levels of Water

Consult the definitions you gave in the previous activity. Using these definitions as a guide, sketch what you think water looks like at each of the four levels.

<table>
<thead>
<tr>
<th>Sketch water at the macroscopic level</th>
<th>Sketch water at the microscopic level</th>
<th>Sketch water at the submicroscopic level</th>
<th>Sketch water at the symbolic level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key</td>
<td>Key</td>
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<td>Key</td>
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</tbody>
</table>

10. Revisit your initial definitions of macroscopic, microscopic and submicroscopic. How has your understanding about these three levels changed?
Activity 4: Putting It All Together - Decoding Scientific Representations Using a Key

What does the key on a map tell the reader? A key is a list of symbols and their meanings. It is important to make a key when using the simulations for CCC lessons. This will help you to clarify your drawings of substances so that you can communicate your ideas clearly. The periodic table that is included can be used to make future keys, but in this activity a key has been provided. Each color represents a specific element on the periodic table. From these colored models, you can create chemical formulas. For example, the chemical formula for carbon dioxide, a gas exhaled while breathing, is CO₂.

11. Is the order you write out the elements in the formula important?

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12. Is writing 2H₂O the same as writing H₂O₂? Explain your answer, and include a diagram to support your explanation.

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Using the key, provide the chemical formula for the following substances.

<table>
<thead>
<tr>
<th>Key</th>
<th>Formula</th>
<th>Key</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex/ Carbon Dioxide</td>
<td>CO₂</td>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td>Hydrogen Peroxide</td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td></td>
<td>Pentane</td>
<td></td>
</tr>
<tr>
<td>Bromine</td>
<td></td>
<td>Silicon Dioxide</td>
<td></td>
</tr>
</tbody>
</table>

Key