# Unit 01: Exploring Properties of Matter
## UNIT PLAN

**6th Grade Science**
Suggested Duration: 12 Core Instructional Days 1-2 Flex days and 1 Assessment Day

## TABLE OF CONTENTS



## UNIT NARRATIVE

Using Lake Mendota, a lake located in southern Wisconsin, as a backdrop, this unit bundles student expectations that address how the physical properties of matter can be used for classification and identification. Lake Mendota is often called "the most studied lake in the world," Mendota is the birthplace of the field of limnology, the scientific study of inland waters. It is home to the University of Wisconsin-Madison's Center for Limnology.
Teachers should research and learn about Lake Mendota before beginning the unit. Use websites such as:

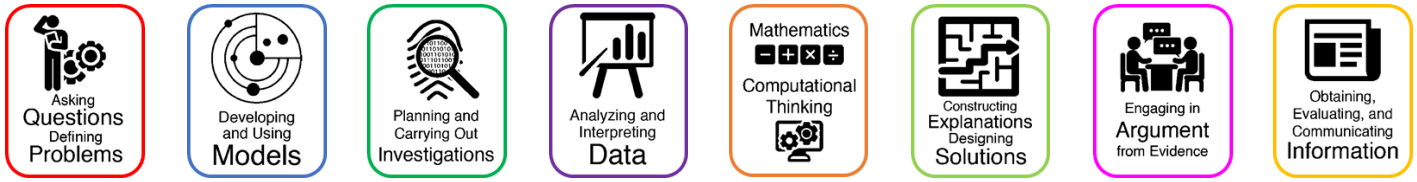
- Wisconsin Department of Natural Resources  Clean Lake Alliance  North Temperate Lakes  Center for Limnology

In lessons 1 and 2, students will learn about and engage in writing scientific claims, backed by evidence and reasoning. (The CER format). In Lesson 3, students will engage in systems thinking to explore the spheres of the Earth. Then focusing on the Hydrosphere, students will investigate water samples in lessons 4 and 5, to begin the exploration of the physical properties of matter. In lesson 6, students learn that an element is the simplest pure substance made up of one kind of matter which is represented by a chemical symbol on the Periodic Table. Next in lesson 7, they learn that a compound is a pure substance composed of two or more elements and represented by a chemical formula. In this same lesson, students will also learn about molecules and identify when a compound is also a molecule. In lesson 8, students will investigate the properties of matter to distinguish between pure substances, homogeneous mixtures (solutions), and heterogeneous mixtures. Students will discover that the properties of solids, liquids, and gases are determined by the structure, arrangement, volume, and amount of energy of the particles (on the molecular and atomic scale) that make up the substance in lessons 9 and 10. In lesson 11, students will compare the density of substances relative to various fluids. Finally in lesson 12, they will use physical properties to identify metals, nonmetals, metalloids, and rare Earth elements. Students use the Periodic Table to identify the locations of metals, nonmetals, metalloids, and rare Earth elements for the purpose of seeing how substances with like properties are classified.

**The best science instruction practice is to remember ABC (activity before concept) and CBV (concept before vocabulary.) Students need to engage in investigation, discourse, reading, and writing to discover science concepts not being told the science content. We want students to be doing science, not memorizing science. This may be counter-intuitive to you and may not be the way you learned science, but research proves this is best practice for instruction and learning.**

**Focus on Disciplinary Literacy**

In science, disciplinary literacy is synonymous with the science and engineering practices. The SEPs are the context through which all science concepts should be taught. In the lessons, you will find the Science and Engineering practices icons when the SEPs are being explicitly used by students.




## CONTENT STANDARDS

Below are the standards **taught** and **assessed** in this unit.

| **Readiness Standards** |
|---|
| 6.6A compare solids, liquids, and gases in terms of, structure, shape, volume, and kinetic energy of atoms and molecules |
| 6.6C identify elements on the periodic table as metals, nonmetals, metalloids, and rare Earth elements based on their physical properties and importance to modern life ($8^{th}$ GRADE STAAR) |
| 6.6D compare the density of substances relative to various fluids ($8^{th}$ GRADE STAAR) |
| **Supporting Standards** |
| 6.6B investigate the properties of matter to distinguish between pure substances, homogeneous mixtures (solutions), and heterogeneous mixtures |
| 6.10A differentiate between the biosphere, hydrosphere, atmosphere, and geosphere and identify components of each system |

## UNDERSTANDINGS AND QUESTIONS

Important big ideas and processes for the unit.

| **Key Understandings** |
|---|
| • A scientific claim is a one-sentence statement that answers the original scientific or research question. (Lesson 01) |
| • Good scientific evidence must accurately represent the natural world, be objective, and be repeatable by scientists. (Lesson 01) |
| • Relevant scientific evidence is evidence that is closely connected to and directly supports the claim being made. (Lesson 01) |
| • Reasoning is a justification that connects the evidence to the claim. Reasoning statements explain how or why the evidence supports the claim. (Lesson 02) |
| • The CER process enables scientists and engineers to provide well-organized, evidence-based explanations that include logical reasoning. (Lesson 02) |
| • Earth can be thought of as a system made up of four spheres. A system is a group of parts or components that are related or interact with each other. (Lesson 03) |
| • The spheres of Earth are all interdependent. Life on Earth as we know it would not be able to exist without these interactions between Earth's spheres. (Lesson 03) |
| • Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). (Lesson 03) |
| • Elements are found all around us. (Lesson 04) |
| • Freshwater samples contain more elements than hydrogen and oxygen. Freshwater samples also contain phosphorus and nitrogen. (Lesson 04) |
| • Each aquatic ecosystem has its own unique properties that allow for specific plants and animals to be found in them. (Lesson 05) |

- Human actions can alter those unique properties. (Lesson 05)
- All matter is made of atoms. Atoms consist of protons, neutrons, and electrons; the nucleus consists of protons and neutrons, and electrons are in the electron cloud. (Lesson 06)
- The Periodic Table can be used to identify the number of each subatomic particle. (Lesson 06)
- All matter is made of atoms, which can combine to form molecules and compounds with unique properties. Molecules of elements contain identical atoms, while molecules of compounds contain different atoms. Formula units represent the simplest ratio of ions in ionic compounds. Recognizing these distinctions helps in understanding chemical reactions and the behavior of substances. (Lesson 07)
- Matter can be classified based on its composition and properties. Matter can be broken down into two categories: pure substances and mixtures. Pure substances have uniform and definite composition and can be broken down into two categories. elements and compounds. Mixtures contain two or more substances physically combined. Homogeneous mixtures have a uniform composition throughout, while heterogeneous mixtures have visibly different components. (Lesson 08)
- The states of matter—solids, liquids, and gases—differ fundamentally in their molecular structure, shape, volume, and kinetic energy. Solids have a fixed structure with defined shape and volume, where atoms and molecules vibrate in place with low kinetic energy. Liquids have a definite volume but take the shape of their container, with particles that move more freely than in solids, reflecting moderate kinetic energy. Gases have neither fixed shape nor volume, filling any container they occupy, with high kinetic energy causing rapid and random motion of particles. (Lessons 09 and 10)
- Metals, nonmetals, metalloids, and rare Earth elements are classified and placed on the periodic table based on their physical properties.
- The density of an object determines its ability to sink or float. For an object to float, relative to its surroundings, it must be less dense than its surroundings. Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans).

## Key Questions

- Why is it important to have relevant evidence to back your claim? (Lesson 01)
- What do you think happens if you **do not** have the evidence to back up your claim? (Lesson 01)
- Why do scientists gather, classify, sequence, and interpret information? (Lesson 02)
- How do Earth's spheres act as a system? (Lesson 03)
- Are there regions where the spheres do not interact? (Lesson 03)
- How would life be different on Earth without one of these spheres? (Lesson 03)
- What are the different elements found in freshwater? (Lesson 04)
- How can the varying elements found in the water samples affect the aquatic life found in those ecosystems? (Lesson 05)
- What impact do you think humans have on aquatic systems? (Lesson 05)
- What is an element? (Lesson 06)
- What is an atom? (Lesson 06)
- What subatomic particles make up most of the mass of an atom? (Lesson 06)
- Where are protons, neutrons, and electrons located in an atom? (Lesson 06)
- What are the charges of the subatomic particles? (Lesson 06)
- What can the periodic table tell us about the elements? (Lesson 06)
- How are atoms and molecules of elements different? (Lesson 07)
- When is a compound a molecule? When is a compound not a molecule? (Lesson 07)
- What is a formula unit? (Lesson 07)
- What is a mixture? (Lesson 08)
- What are the two types of mixtures? (Lesson 08)
- What is pure substance? (Lesson 08)

- What is a solution? (Lesson 08)
- How do the arrangements of atoms and molecules differ in each state of matter? (Lessons 09 and 10)
- Why do solids maintain a fixed shape while liquids and gases do not? (Lessons 09 and 10)
- How does the ability of molecules to move past one another affect the shape of liquids and gases? (Lessons 09 and 10)
- Why do solids and liquids have a definite volume, while gases do not? (Lessons 09 and 10)
- How do changes in temperature affect the volume of gases compared to solids and liquids? (Lessons 09 and 10)
- What is the relationship between temperature and the kinetic energy of particles in each state of matter? (Lessons 09 and 10)
- How can physical properties such as luster, conductivity, and malleability be used to compare metals, nonmetals, metalloids, and rare Earth elements?
- How does density affect floating and sinking in water and other fluids?

ROADMAP

| AT A Glance: Unit 1 Exploring Properties of Matter | | | | |
|---|---|---|---|---|
| **Day** | **Date** | **Standard** | **Lesson** | **Lesson Title** |
| There is one flex days built into this unit to use as needed. Flex days can be used for lessons that take longer than one day or for reteaching material the students may not have gotten during tier 1 instruction. | | | | |
| 1 | | 6.3A<br>6.3B | 01 | What is CER? |
| 2 | | 6.3A<br>6.3B | 02 | Mysterious Lake Mendota |
| 3 | | 6.10A | 03 | Earth's Spheres |
| 4 | | 6.6C | 04 | What is in the Water? Part 1 |
| 5 | | 6.6C | 05 | What is in the Water? Part 2 |
| 6 | | 6.6B | 06 | Introduction to Atomic Structure and Periodic Table |
| 7 | | 6.6B | 07 | Atoms, Molecules, and Compounds |
| 8 | | 6.6B | 08 | Pure Substances and Mixtures |
| 9 | | 6.6A | 09 | Lake Mendota in the Winter States of Matter Part 1 |
| 10 | | 6.6A | 10 | Lake Mendota in the Winter States of Matter Part 2 |
| 11 | | 6.6D | 11 | Relative Density |
| 12 | | 6.6C | 12 | Properties of Metals, Nonmetals, Metalloids, and Rare Earth Metals |
| 13 | | | Flex | Flex |
| 14 | | | Unit Exam | SCI_6thHybridScience_F25_UE1 Scanning Deadline 9/18/2025 |

| Lesson 1: What is CER? | Date: |
|---|---|

## Objective

**SWBAT identify a scientific claim and relevant evidence that can be used to substantiate the claim by constructing explanations and designing solutions and engaging in argument from evidence.**

## Standards

**TEKS**

6.3A develop explanations ~~and propose solutions~~ supported by data ~~and models and consistent with scientific ideas, principles, and theories~~

6.3B communicate explanations and solutions individually and collaboratively in a variety of settings and formats

## Vocabulary

Claim
Evidence

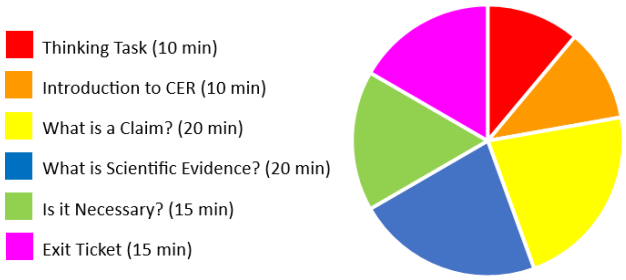
## Science Practices

6. Constructing explanations and designing solutions
7. Engaging in argument from evidence

## Recurring Themes and Concepts

## Instructional Notes

- Students will watch a video for a brief introduction to the CER format.
- Students will work with a partner to evaluate a series of statements to determine if the statements constitute a scientific claim. After a class discussion, students will develop a definition of "scientific claim."
- Students will work in groups to complete a card sort to classify statements as "scientific evidence" or "not scientific evidence."
- Students will be given a scientific claim and evidence and asked to identify evidence that is relevant to the claim and can be used to support the claim.
- Students will be given 4 research questions and asked to identify the claim that aligns with the question. Students will then identify relevant evidence to support each of the 4 claims




**Closing Knowledge Gaps:**
Teaching CER in Science Video
CER Resources for the Science Classroom

## Lesson Look Fors

**Look for teachers to:**

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
☐ Promote the use of partners and whole class discussion.

**Look for students to:**

☐ Engage in discourse and productive struggle
☐ Justify their reasoning and support their ideas with evidence.

## Students Do and Know

Do

- Students possess the ability to discern whether a statement constitutes a scientific claim and can substantiate their decision with reasoning.
- Students can differentiate between scientific evidence and non-scientific evidence.
- Students can recognize relevant scientific evidence that can be used to substantiate a given claim.

Know

- A scientific claim is a one-sentence statement that answers the original scientific or research question.
- Good scientific evidence must accurately represent the natural world, be objective, and be repeatable by scientists.
- Relevant scientific evidence is evidence that is closely connected to and directly supports the claim being made.

| Lesson 02: Mysterious Lake Mendota | Date: |
|---|---|

## Objective

**SWBAT construct a convincing claim and provide evidence and reasoning to support the claim by reading appropriate texts and graphs to obtain scientific information.**

## Standards

**TEKS**

6.3A develop explanations ~~and propose solutions~~ supported by data ~~and models and consistent with scientific ideas, principles, and theories~~

6.3B communicate explanations and solutions individually and collaboratively in a variety of settings and formats

## Vocabulary

Dependent Variable
Independent Variable
Mean
Median
Mode
Range
Reasoning

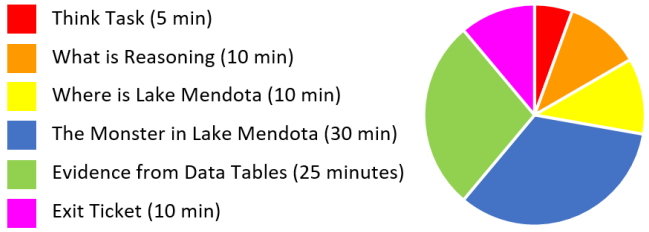
## Science Practices

4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence

## Recurring Themes and Concepts

## Instructional Notes

- Students will review the exit ticket from lesson 1 and match reasoning statements to the claim and evidence. Students will analyze the statements to determine the characteristics of quality reasoning statements.
- Students will read text-based evidence from a journal about a sighting of a mysterious creature from a lake in Wisconsin. Students will write a claim, support it with evidence and provide reasoning to explain if the monster really exists.
- Students will interpret a data table to collect evidence to answer the question "Which material makes the best thermal insulator." Students will then write a claim that is supported by the evidence and reasoning statements that explain how or why the evidence supports the claim.
- Students will put the claim, evidence, and reasoning together in paragraph form to complete the scientific explanation.




**Closing Knowledge Gaps:**
Teaching CER in Science Video
CER Resources for the Science Classroom

## Lesson Look Fors

**Look for teachers to:**

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.
- ☐ Model how to find mean, median, mode, and range.
- ☐ Model writing claims, evidence, and reasoning.

**Look for students to:**

- ☐ Engage in discourse and productive struggle.
- ☐ Justify their reasoning and support their ideas with evidence.
- ☐ Analyze data (determine mean, median, mode, and range) to use as evidence.

## Students Do and Know

| | |
|---|---|
| Do | • Students will write reasoning statements that explain how or why the evidence supports the claim.<br>• Students are able to analyze data in a data table (determine mean, median, mode, and range) to use as evidence to support a claim. |
| Know | • Reasoning is a justification that connects the evidence to the claim. Reasoning statements explain how or why the evidence supports the claim.<br>• The CER process enables scientists and engineers to provide well-organized, evidence-based explanations that include logical reasoning. |

| Lesson 03: Earth's Spheres | Date: |
|---|---|

## Objective

**SWBAT describe and identify components of Earth's systems and describe the interactions that occur among the systems during everyday phenomenon by obtaining, evaluating, and communicating information.**

## Standards

**TEKS**

6.10A differentiate between the biosphere, hydrosphere, atmosphere, and geosphere and identify components of each system

6.6D examine and model the parts of a system and their interdependence in the function of the system;

## Vocabulary

Atmosphere
Biosphere
Geosphere
Hydrosphere
System

## Science Practices

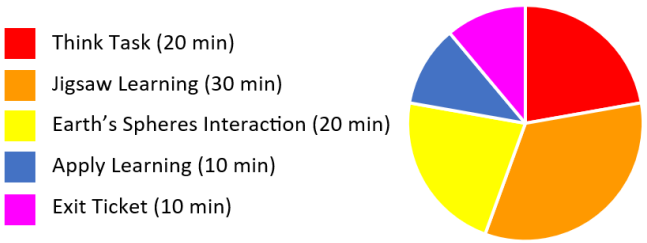
8. Obtaining, evaluating, and communicating information

## Recurring Themes and Concepts

A. Systems and System Models

## Instructional Notes

- Students will participate in a nature walk to observe the components of each of the Earth's spheres.
- Students will engage in a jigsaw reading to learn more about the components of Earth's spheres.
- Students will work with a partner to determine how the components of Earth's spheres interact.
- Students will describe and identify components of Earth's spheres and describe the interactions that occur among the spheres.




**Closing Knowledge Gaps:**

Ck-12 Earth's Outer Layers
Generation Genius Earth's Spheres
Khan Academy

## Lesson Look Fors

**Look for teachers to:**

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.
- ☐ Provide students the opportunity to obtain information and take ownership of their learning during the jigsaw reading activity.
- ☐ Engage students in higher-order thinking questions regarding the interaction of Earth's spheres.

**Look or students to:**

- ☐ Engage in discourse and productive struggle.
- ☐ Justify their reasoning and support their ideas with evidence.
- ☐ Identify and describe the components of Earth's spheres.
- ☐ Describe the interactions that occur among Earth's spheres.

## Students Do and Know

| | |
|---|---|
| Do | • Students can identify components of Earth's spheres<br>• Students are able to describe the interactions that occur among Earth's spheres. |
| Know | • Earth can be thought of as a system made up of four spheres. A system is a group of parts or components that are related or interact with each other. The spheres of Earth are all interdependent. Life on Earth as we know it would not be able to exist without these interactions between Earth's spheres. |

| Lesson 4: What is in the Water? Part 1 | Date: |
|---|---|

## Objective

**SWBAT analyze quantitative data (N, P, pH, and dissolved oxygen levels) to assess the ecological health of a freshwater source by collecting and organizing the data in a data table and writing a claim, evidence, and reasoning paragraph.**

## Standards

**TEKS**

6.6C- identify elements on the periodic table ~~as metals, nonmetals, metalloids, and rare Earth elements based on their physical~~ properties and importance to modern life ;

6.1E collect quantitative data using the International System of Units (SI) and qualitative data as evidence

6.1F construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data;

## Vocabulary

| | |
|---|---|
| Abiotic | Biotic |
| Nitrogen | Phosphorus |
| Hydrogen | Oxygen |
| Watershed | |

## Science Practices

3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions

## Recurring Themes and Concepts

A. Patterns
B. Cause and Effect

## Instructional Notes

- Students will view images of Lake Mendota and review biotic and abiotic factors.
- Students will be introduced to the structure of a water molecule, the elements nitrogen, phosphorous, hydrogen and oxygen, and watersheds.
- Students will test specific parameters of a water sample from a local water source. Students will, as a scientist would, design a data table for the parameters, including column and row labels, units, and numeric/colorimetric values. Each lab group will share their data with their peers, as scientists do when papers are published, so that the group data can be analyzed.
- Students will analyze sample data and assess the water quality of the sample. Students will then construct a scientific explanation describing the quality of water.


**Closing Knowledge Gaps:**

Why and how do we test water quality?
Interpreting Water Test in Ponds and Lakes
Lake Water Quality Testing

## Lesson Look Fors

**Look for teachers to:**

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.
- ☐ Support students as they design the data table.
- ☐ Monitor the students as they conduct the lab investigation.

**Look for students to:**

- ☐ Engage in discourse and productive struggle.
- ☐ Justify their reasoning and support their ideas with evidence.
- ☐ Design a data table to collect data.
- ☐ Conduct and investigation in groups and collect data.
- ☐ Analyze data to write a claim, evidence, and reasoning paragraph.

## Students Do and Know

| | |
|---|---|
| Do | • Students will work in lab groups to conduct an investigation.<br>• Students will design a data table to collect data.<br>• Students will collect quantitative data.<br>• Students will learn how to conduct an experiment, present the findings and share the data with classmates/group members. |
| Know | • Elements are found all around us.<br>• Fresh water samples contain more elements than hydrogen and oxygen. Fresh water samples also contain phosphorus and nitrogen. |

| Lesson 5: What is in the Water? Part 2 | Date: |
|---|---|

## Objective

**SWBAT compare the quantitative data (N, P, pH, and dissolved oxygen levels) of a freshwater source to a sample data from Lale Mendota by collecting and analyzing data, constructing graphs, and writing a claim, evidence, and reasoning paragraph.**

## Standards

**TEKS**

6.6C- identify elements on the periodic table ~~as metals, nonmetals, metalloids , and rare Earth elements based on their physical~~ properties and importance to modern life ;

6.1E collect quantitative data using the International System of Units (SI) and qualitative data as evidence

6.1F construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data;

## Vocabulary

Nutrient Pollution

## Science Practices

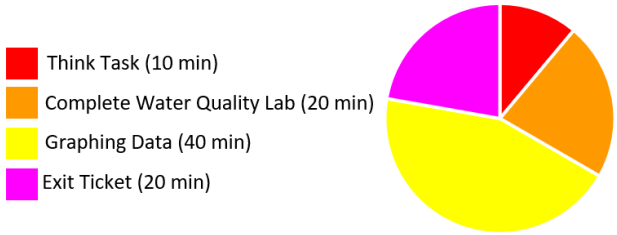
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions

## Recurring Themes and Concepts

A. Patterns
B. Cause and Effect

## Instructional Notes

- Students will watch a video on nutrient pollution and list the possible causes and effects of nutrient pollution.
- Students will complete water quality testing from the day before.
- Students will compile class data for the N, P, pH, and dissolved oxygen levels of the freshwater sample and calculate the mean. Students will construct a graph to display the data.
- Students will learn about mean, median, mode, range and frequency. Students will compile class data for the N, P, pH, and dissolved oxygen levels of the freshwater sample and calculate the mean. Students will construct a graph to display the data.
- Students will complete a Claim, Evidence, and Reasoning statement to answer the question, Which water source, our local water source or Lake Mendota, had better quality of water?




**Closing Knowledge Gaps:**
Why and how do we test water quality?
Interpreting Water Test in Ponds and Lakes
Lake Water Quality Testing

## Lesson Look Fors

**Look for teachers to:**

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
☐ Promote the use of partners and whole class discussion.
☐ Monitor the students as they conduct the lab investigation.

**Look for students to:**

☐ Engage in discourse and productive struggle.
☐ Conduct and investigation in groups and collect data.
☐ Analyze data to write a claim, evidence, and reasoning paragraph.

## Students Do and Know

| | |
|---|---|
| Do | • Collect and analyze water quality data.<br>• Collect and organize class data from the lab.<br>• Calculate the mean of the data & graph<br>• Write a CER statement to answer the question, Which water source, our local water source or Lake Mendota, had better quality of water? |
| Know | • The mean is the sum of the numbers in a data set divided by the total number of values in the data set. The mean is also known as the average. The mean can be used to get an overall idea or picture of the data set.<br>• Each aquatic ecosystem has its own unique properties that allow for specific plants and animals to be found in them.<br>• Human actions can alter those unique properties. |

| Lesson #6: Introduction to Atomic Structure and Periodic Table | Date: |
|---|---|

## Objective

**SWBAT describe the structure of atoms using information from the periodic table by determining the masses, electrical charges, and locations of protons, neutrons, and electrons.**

## Standards

**TEKS**

6.6C- identify elements on the periodic table as metals, nonmetals, metalloids~~, and rare Earth elements based on their physical properties and importance to modern life~~ ;

## Vocabulary

| | |
|---|---|
| Atom | Ion |
| Nucleus | Atomic Number |
| Proton | Atomic Mass |
| Neutron | Periodic Table |
| Electron | |

## Science Practices

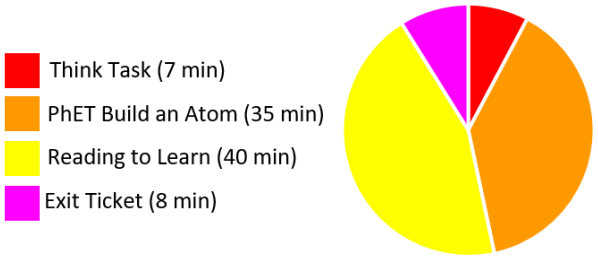
2. Developing and using models
5. Using mathematics and computational thinking
8. Obtaining, evaluating, and communicating information

## Recurring Themes and Concepts

A. Patterns

## Instructional Notes

- Students will use a PhET Simulation to discover the location and charges of the subatomic particles. Students will discover what particles make up the mass of the atoms.
- Students will participate in a reading-to-learn activity in which they will be provided a brief introduction to the history of the discovery of the atom, learn the subatomic particles (locations and charges), how to use the Periodic Table to determine the number of subatomic particles in an atom, and finally the organization of the Periodic Table. The reading to learn also includes practice opportunities and checkpoints.
- Students will use the periodic table to calculate the number of protons, neutrons, and electrons in various atoms and describe the locations and charges of the subatomic particles.




**Closing Knowledge Gaps:**

Ck-12 Atom

American Chemical Society

Khan Academy

Mc Graw Hill

## Lesson Look Fors

**Look for teachers to:**

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Promote the use of partners and whole class discussion.
- ☐ Monitor and support the students as they participate in the phET simulation.
- ☐ Engage students in the Reading to Learn activity.

**Look for students to:**

- ☐ Engage in discourse and productive struggle.
- ☐ Engage in the phET simulation to discover the location and charges of the subatomic particles of the atom.
- ☐ Engage in the reading to learn activity to obtain information.
- ☐ Use the periodic table to determine the number of the different subatomic particles in an atom.

## Students Do and Know

**Do**

- Use a simulation to discover the location and charges of the subatomic particles.
- Engage in a reading to learn to strengthen their conceptual understanding of the location and charges of the subatomic particles.
- Use the periodic table to determine the number of the different subatomic particles in an atom.

**Know**

- The location, charges and relative masses of the different subatomic particles of an atom.
- How to use information on the periodic table to determine the number of the different subatomic particles in an atom.

| Lesson #7: Atoms, Molecules, and Compounds | Date: |
|---|---|

## Objective

**SWBAT differentiate between atoms, molecules of elements, molecules of compounds, and formula units of compounds based on structure and composition by analyzing models and chemical formula**

## Standards

**TEKS**

6.6A compare ~~solids, liquids, and gases in terms of, structure, shape, volume, and kinetic energy~~

## Vocabulary

Atom
Molecule
Particle
Matter
Mass
Compound
Formula Unit
Chemical Bond

## Science Practices

2. Developing and using models
7. Engaging in argument from evidence

## Recurring Themes and Concepts

A. Patterns

## Instructional Notes

- Students will analyze model diagrams to begin to develop ideas about the differences between atoms, molecules and compounds.
- Students will continue to anchor their understanding of atoms and compounds and explore molecules of elements and when a compound is a molecule and when a compound is a formula unit.
- Students will use everyday objects to build models of atoms and molecules and be able to analyze how matter is composed
- Students will use a decision tree to differentiate between atoms, molecules of elements, molecules of compounds, and formula units of compounds by analyzing models and chemical formula.


**Closing Knowledge Gaps:**

Ck-12
STUDY.COM
Khan Academy

Mc Graw Hill

## Lesson Look Fors

**Look for teachers to:**

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Support students as they analyze and construct models.

**Look for students to:**

- ☐ Engage in discourse and productive struggle.
- ☐ Justify their reasoning and support their ideas with evidence.

## Students Do and Know

**Do**

- Students will analyze model diagrams to begin to develop ideas about the differences between atoms, molecules and compounds.
- Students will use everyday objects to build models of atoms and molecules and be able to analyze how matter is composed
- Students will use a decision tree to differentiate between atoms, molecules of elements, molecules of compounds, and formula units of compounds by analyzing models and chemical formula.

**Know**

- Atoms are the smallest component of an element.
- Multiple nonmetal atoms bonded together make up a molecule.
- A compound is a substance composed of identical particles consisting of atoms of two or more elements
- You can have molecules of elements and molecules of compounds.
- If a compound contains a metal, it is not a molecule but instead a formula unit.

| Lesson #8: Pure Substances and Mixtures | Date: |
|---|---|

## Objective

**SWBAT analyze physical properties of matter to distinguish between a pure substance, a homogeneous mixture, and a heterogeneous mixture by completing a comparative investigation.**

## Standards

**TEKS**

6.6B investigate the properties of matter to distinguish between pure substances, homogeneous mixtures (solutions), and heterogeneous mixtures

## Vocabulary

Solution
Mixture
Homogenous Mixture
Heterogenous Mixture
Pure Substance

## Science Practices

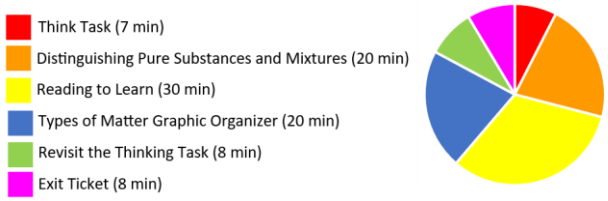
2. Developing and Using Models
3. Planning and carrying out investigations
4. Analyzing and interpreting data

## Recurring Themes and Concepts

A. Patterns

## Instructional Notes

- Students will analyze model diagrams to begin to develop ideas about the differences between pure substances and mixtures.
- Students will use the physical properties of a substance to classify it as either a pure substance, a homogeneous mixture, or a heterogeneous mixture. Then they use the physical properties of matter to separate the substances in a mixture
- Students will engage in a reading to learn activity to deepen their understanding of pure substances and mixtures.
- Complete a graphic organizer to help distinguish between pure substances, homogeneous mixtures, and heterogeneous mixtures.
- Students will analyze physical properties of matter to distinguish between a pure substance, a homogeneous mixture, and a heterogeneous mixture.




**Closing Knowledge Gaps:**

Ck-12 Mixtures
STUDY.COM
Khan Academy

Mc Graw Hill

## Lesson Look Fors

**Look for teachers to:**

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

**Look for students to:**

☐ Engage in the reading to learn activity to obtain information.
☐ Engage in the investigation of physical properties of matter.

## Students Do and Know

**Do**

- Use the physical properties of a substance to classify it as either a pure substance, a homogeneous mixture, or a heterogeneous mixture
- Engage in a reading to learn activity to deepen their understanding of pure substances and mixtures.
- Complete a graphic organizer to help distinguish between pure substances, homogeneous mixtures, and heterogeneous mixtures.
- Analyze physical properties of matter to distinguish between a pure substance, a homogeneous mixture, and a heterogeneous mixture.

**Know**

- A physical property is a characteristic that can be observed or measured without changing the substance.
- Pure substances have a uniform and definite composition and consist of only one type of particle, either an element or a compound.
- Homogeneous mixtures have a uniform composition throughout and the individual components are not visibly distinguishable.
- Heterogeneous mixtures have visibly different components or phases and the composition is not uniform throughout the mixture.

| Lesson #9: Lake Mendota in the Winter States of Matter Part 1 | Date: |
|---|---|

## Objective

**SWBAT differentiate solids, liquids, and gases in terms of their structure, shape, volume, and kinetic energy of atoms and molecules by creating and analyzing models and writing explanations**

## Standards

**TEKS**

6.6A compare solids, liquids, and gases in terms of their structure, shape, volume, and kinetic energy of atoms and molecules;

## Vocabulary

Liquid
Solid
Gas
Volume
Kinetic Energy

## Science Practices

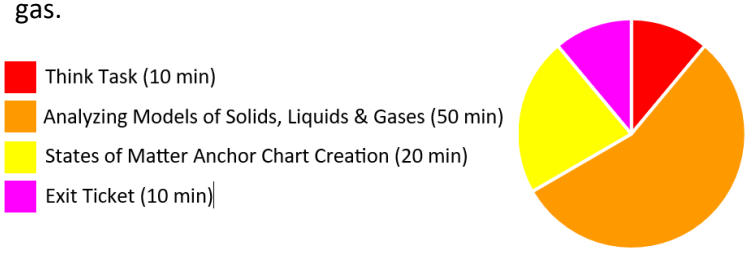
2. Developing and using models
8. Obtaining, evaluating, and communicating information

## Recurring Themes and Concepts

A. Patterns
F. Structure and Function

## Instructional Notes

- Students will analyze model diagrams to begin to develop ideas about the arrangement of particles, shape, and structure of solids liquids and gases.
- Students will use critical thinking skills to analyze and interpret the models to explore the way particles behave when water changes states—from solid to liquid to gas.
- Students will create an anchor chart that includes particle drawing, examples, arrangement of particles, shape, and structure of solids liquids and gases.
- Students will draw models to show explain the way particles behave when water changes states—from solid to liquid to gas.




**Closing Knowledge Gaps:**
Ck-12 Solids, Liquids, and Gases
CK- 12 Kinetic Theory of Matter
Khan Academy

## Lesson Look Fors

**Look for teachers to:**

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

**Look for students to:**

☐ Engage in discourse and productive struggle.
☐ Justify their reasoning and support their ideas with evidence.

## Students Do and Know

**Do**

- Students analyze and interpret models to determine that particle arrangement, shape and structure depend on the state of matter
- Students can analyze and interpret models while collaborating in their groups by creating an Anchor Chart
- Students use critical thinking skills to analyze and interpret the models and then use that information to answer the questions.

**Know**

- Solids have a fixed shape; an orderly structure and the particle arrangement is tightest/most compact.
- Liquids take on the shape of their container have a random order and the particle arrangement is more fluid/spaced out.
- Gasses take on the shape of their container, have a very random order and the particle arrangement is furthest apart.

| Lesson #10: Lake Mendota in the Winter States of Matter Part 2 | Date: |
|---|---|

## Objective

**SWBAT differentiate solids, liquids, and gases in terms of their structure, shape, volume, and kinetic energy of atoms and molecules by creating and analyzing models and writing explanations**

## Standards

**TEKS**

6.6A compare solids, liquids, and gases in terms of their structure, shape, volume, and kinetic energy of atoms and molecules;

## Vocabulary

Liquid
Solid
Gas
Volume
Kinetic Energy

## Science Practices

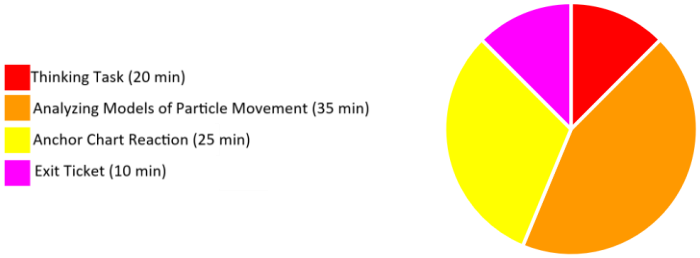
2. Developing and using models
8. Obtaining, evaluating, and communicating information

## Recurring Themes and Concepts

A. Patterns
F. Structure and Function

## Instructional Notes

- Students will use a simulation to begin to explore how particles move in solids, liquids, and gases.
- Students will analyze models to determine the relationship between temperature and kinetic energy.
- Students will update their anchor chart from the previous lesson and complete the sections on compressibility, volume and motion of particles.
- Students will draw diagrams (models) and justify their drawing to show the relationship between temperature and kinetic energy.




**Closing Knowledge Gaps:**

Ck-12 Solids, Liquids, and Gases
CK- 12 Kinetic Theory of Matter
Khan Academy

Mc Graw Hill

## Lesson Look Fors

**Look for teachers to:**

☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

**Look for students to:**

☐ Engage in discourse and productive struggle.
☐ Justify their reasoning and support their ideas with evidence.

## Students Do and Know

| | |
|---|---|
| Do | • Use a simulation to begin to explore how particles move in solids, liquids, and gases.<br>• Analyze models to determine the relationship between temperature and kinetic energy. |
| Know | • As the temperature increases the amount of kinetic energy of the particles increases.<br>• As the average speed of particles increases, the kinetic energy of the substance increases. |

| Lesson #11: Relative Density | Date: |
|---|---|

## Objective

**SWBAT compare the density of substances to the density of various fluids to predict whether a substance will since or float by creating models, conducting investigations and analyzing data.**

## Standards

**TEKS**

6.6.D compare the density of substances relative to various fluids

## Vocabulary

Density
Convection

## Science Practices

2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data

## Recurring Themes and Concepts

D. Systems and System Models

## Instructional Notes

- Students will observe a demo of convection currents and compare this to lake turn over. Lake turnover is the phenomenon in which density is introduced.
- Students will make a density column and place different items into the column to estimate the density of the objects.
- Students will use a model to show how various liquids will layer in a density column and interpret density data to identify unknown substances.

Thinking Task (15 min)
Introduction to Density (30 min)
Density Column Lab (35 min)
Exit Ticket (10 min)

**Closing Knowledge Gaps:**

Ck-12 Density

Mc Graw Hill

## Lesson Look Fors

**Look for teachers to:**

- ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.
- ☐ Demonstrate convection currents and lake turnover and use this to introduce relative density.

**Look for students to:**

- ☐ Engage in discourse and productive struggle.
- ☐ Justify their reasoning and support their ideas with evidence.
- ☐ Create a density column and make observations to estimate the density of objects placed in the column.

## Students Do and Know

**Do**

- Students will make a density column and place different items into the column to estimate the density of the objects.
- Students will use a model to show how various liquids will layer in a density column and interpret density data to identify unknown substances.

**Know**

- Substances with greater density than the fluid will sink; those with less density will float.
- The same substance will behave differently in different fluids based on the fluid's density.
- Fluids have their own density that can be measured and compared.

| Lesson #12: Properties of Metals, Nonmetals, Metalloids, and Rare Earth Metals | Date: |
|---|---|

## Objective

**SWBAT identify metals, nonmetals, and metalloids on the periodic table of elements using their physical properties and describe the position and importance of rare earth elements by constructing explanations and designing solutions.**

## Standards

**TEKS**

6.6C identify elements on the periodic table as metals, nonmetals, metalloids, and rare Earth elements based on their physical properties and importance to modern life

## Vocabulary

Metal
Nonmetal
Metalloid
Rare Earth Metal
Brittleness
Malleability
Conductivity
Luster
Ductility
Insulator

## Science Practices

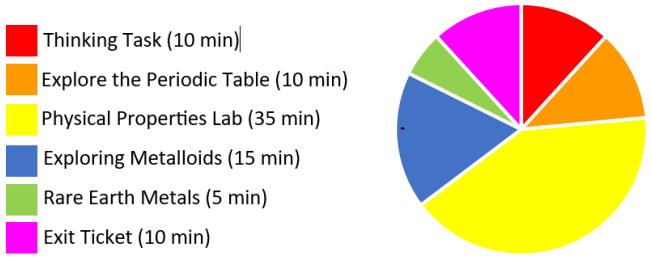
3. Planning and carrying out investigations
4. Analyzing and interpreting data
6. Constructing explanations and designing solutions

## Recurring Themes and Concepts

D. Systems and System Models

## Instructional Notes

- Students will explore the periodic table by coloring coding the metals, nonmetals, metalloids and rare earth metals.
- Students will conduct an investigation and identify physical properties of various substances. Students will connect the classification of the substance to its location on the periodic table to develop a list of characteristics of metals, and nonmetals.
- Students will analyze the characteristics of metalloids to understand the unique properties of this group of elements.
- Students will watch a video to determine the uses of rare earth metals.
- Students will use physical properties and uses to classify elements as metals, nonmetals, metalloids and rare earth metals.




**Closing Knowledge Gaps:**

Ck-12 Metals, Nonmetals and Metalloids LibreText

Mc Graw Hill

## Lesson Look Fors

**Look for teachers to:**

☐ ☐ Engage students in ABC. (Activity before content) The teacher should stamp key points AFTER students have had the time to engage in the content (productive struggle) and discuss.

**Look or students to:**

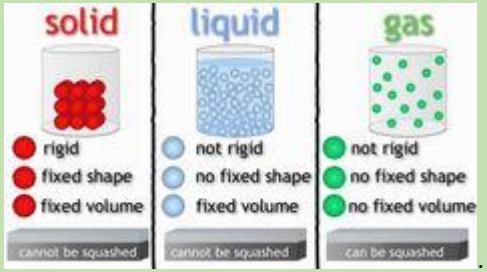
☐ Engage in discourse and productive struggle.
☐ Justify their reasoning and support their ideas with evidence.

## Students Do and Know

| | |
|---|---|
| Do | • Use the physical properties and uses of elements to classify them as metals, nonmetals, metalloids and rare earth metals. |
| Know | • Elements can be classified as metals, nonmetals, metalloids, or rare Earth elements based on their physical properties, and each type plays a unique role in modern life and technology. |

## UNPACKED STANDARDS

Focus standards for this unit.

<table>
<tr><th>Standard:</th><th colspan="2">6.6A compare solids, liquids, and gases in terms of, structure, shape, volume, and kinetic energy of atoms and molecules</th></tr>
<tr><th colspan="2">Specificity</th><th>Content Builder</th></tr>
<tr><td colspan="2">Cognition: Compare<br>Content: solids, liquids, and gases<br>Including, but not limited to:<br>• Explain the relationship between kinetic energy of particles and states of matter.<br>○ Kinetic energy<br>▪ Matter is made up of small particles (atoms and molecules).<br>▪ The particles are in motion due to kinetic energy.<br>▪ The more kinetic energy – the faster the particles move.<br>▪ Pictorial models can be used to differentiate between the particles in solids, liquids, and gases.<br>○ Solids<br>▪ Shape -- definite shape<br>▪ Volume – definite volume<br>▪ Structure – close together in a consistent, regular pattern<br>▪ Kinetic energy – vibrate in fixed places<br>○ Liquids<br>▪ Shape – indefinite shape (take the shape of the container)<br>▪ Volume – definite volume<br>▪ Structure – close together in a random arrangement<br>▪ Kinetic energy – particles slide around each other<br>○ Gases<br>▪ Shape – indefinite shape (take the shape of the container)<br>▪ Volume – indefinite volume (changes when temperature or pressure changes; spreads out to the volume of a container)<br>▪ Structure – far apart in a random arrangement<br>Kinetic energy – moves quickly in all directions</td><td>• Particles of matter exert an attractive force (pull) on each other. The strength of the attraction depends on how close together the distance between the particles. The closer together the particles are the stronger the attraction.<br>• The arrangement and distance between particles and the strength of attraction help determine if the shape of mater is fixed (definite) or not (takes on shape of the container).<br>• Matter is anything that has mass and takes up space.<br>• Mass is the amount of matter in an object<br>• Volume- the amount of space an object takes up.<br>• Students should be able to create and interpret models.<br>• Models of the states of matter look as follows.<br>  <br>• Solids have a definite structure, shape, and volume because their atoms and molecules are closely packed and vibrate in fixed positions with low kinetic energy. Liquids have a definite volume but take the shape of their container since their atoms and molecules are close together but can move around with more kinetic energy than solids. Gases have no fixed shape or volume as their atoms and molecules are widely spaced and move freely with high kinetic energy. Gases do have mass and weight.</td></tr>
<tr><th>Notes</th><th colspan="2">Instructional Implications</th></tr>
<tr><td>This is the introduction to the kinetic particle model.<br>• Focus is understanding the microscopic scale properties of solids, liquids, and gases.<br>○ Grade 3 has investigated the macroscopic scale properties of solids, liquids, and gases.<br>○ Grade 5 has developed the concept that all matter is made of particles too small to be seen.</td><td colspan="2">• Students might encounter challenges when connecting the role of kinetic energy in determining the state of matter.<br>• When you teach this concept, remember to:<br>○ Conduct experiments that demonstrate how the shape of each state of matter changes when placed in different containers to reinforce the concept of shape and container dependence.</td></tr>
</table>

| Student Misconceptions | |
|---|---|
| Students may make the following mistakes:<br>• Thinking that kinetic energy is not related to the temperature of an object<br>• Confusing states of matter with non-traditional examples (e.g., forms of energy)<br>• Thinking gases are not matter simply because they cannot always be seen<br>• Assuming that gases are weightless<br>• Thinking that all gases expand to fill any container, ignoring temperature and pressure | ○ Engage students with investigations that explore how changes in temperature and pressure can affect the volume of liquids and gases.<br>○ Create simulations or hands-on experiments that demonstrate the relationship between temperature, kinetic energy, and the state of matter. Students can observe how heating a substance increases its kinetic energy and can lead to changes in state.<br>○ Provide opportunities for students to describe the properties and characteristics of unfamiliar substances, promoting critical thinking and scientific reasoning. |

| **Standard:** | **6.6B investigate the properties of matter to distinguish between pure substances, homogeneous mixtures (solutions), and heterogeneous mixtures** |
|---|---|

| Specificity | Content Builder |
|---|---|
| Cognition: distinguish<br>Content: between pure substances, homogeneous mixtures (solutions), and heterogeneous mixtures<br><br>Including, but not limited to:<br>• Investigate substances<br>○ Observe, measure, and test the properties of various substances to collect evidence to determine the type of substances.<br>• Pure substances – have the same type of particles (atoms or molecules) throughout the sample<br>○ Only one type of substance can be seen with the naked eye and with the most sensitive magnification.<br>▪ Solid gold<br>▪ Pure oxygen<br>▪ Distilled water<br>○ Evidence is often related to not being able to separate into different substances<br>• Homogeneous mixtures (solutions) – a mixture of one kind of particles (atoms and molecules) dissolved in another different type of particles (atoms and molecules)<br>○ Only one type of substance can be seen with the naked eye and classroom magnification.<br>▪ Food coloring in water<br>▪ Saltwater solution<br>▪ 14 karat gold<br>○ Evidence is sometimes collected by using the differing properties of matter to separate substances.<br>▪ Ability to evaporate<br>➢ Salt and water can be separated by evaporating or vaporizing water.<br>• Heterogeneous mixtures -- a combination of two or more substances | • Matter can be broken down into two categories: pure substances and mixtures. Pure substances are further broken down into elements and compounds. Mixtures are physically combined structures that can be separated into their original components.<br>• A pure substance is matter that contains one element or compound and has definite chemical and physical properties and cannot be separated by physical means.<br>• An element is a pure substance that is made up of only one type of atom.<br>• A compound is a pure substance made of two or more elements that are chemically bonded.<br>• A mixture is composed of different types of atoms or molecules that are not chemically bonded.<br>• Molecules are two or more nonmetal atoms that are held together by chemical bonds and act as a unit. Molecules can be both compounds (such was water) and elements (such as O2).<br>• A heterogeneous mixture is a mixture of two or more chemical substances where the various components can be visually distinguished.<br>• A homogeneous mixture is a type of mixture in which the composition is uniform, and every part of the solution has the same properties.<br>• Pure substances have a uniform composition and distinct properties, homogeneous mixtures (solutions) are evenly mixed with no visible boundaries, and heterogeneous mixtures have non-uniform composition with visible components. |
| | **Instructional Implications** |
| | • Students should understand that while solutions are a type of mixture, not all mixtures are solutions.<br>• Students may mistakenly think that all solids are pure substances. However, mixtures can also exist in solid form such as alloys (e.g., brass, which is a mixture of copper and zinc) and composite materials (e.g., fiberglass, which is a mixture of glass fibers in a plastic matrix). |

| | |
|---|---|
| ○ The original substances can often still be seen in the mixture.<br>○ Evidence is often collected by using the differing properties of matter to separate substances.<br>• Size<br>➢ Rocks may be handpicked from sand.<br>➢ Gravel may be separated from sand using a sieve.<br>• Relative density (sink / float)<br>➢ Wood chips may be separated from marbles by adding the mixture to a container of water.<br>➢ Oil may be separated from water by settling and pouring off oil or by using a pipet to suction out water.<br>• Magnetism<br>➢ Iron filings and sand may be separated using a magnet.<br>• Solubility in water<br>➢ Sand and table salt may be separated by adding water, filtering the sand from the salt water, and evaporating the water from the salt. | • When you teach this concept, remember to:<br>○ Engage students in hands-on experiments to observe and compare the properties of different substances (e.g., dissolving various solutes in solvents to create solutions, mixing different materials to form heterogeneous mixtures, and analyzing pure substances).<br>○ Use visual aids such as models, charts, diagrams, and images to illustrate the differences between pure substances, homogeneous mixtures, and heterogeneous mixtures.<br>○ Provide students with samples of various materials and challenge them to classify each as a pure substance, homogeneous mixture, or heterogeneous mixture based on their physical properties.<br>○ Integrate real-world examples of pure substances, homogeneous mixtures, and heterogeneous mixtures to help students relate the concepts to everyday life (e.g., discuss the composition of common household products or natural substances). |
| **Notes** | **Student Misconceptions** |
| • Focus is on connecting the particle theory to the microscopic composition of pure substances and various types of mixtures.<br>○ This is the continuation to the elementary study of mixtures, including solutions and the concept of particles.<br>▪ Grades 4 and 5 have investigated the macroscopic scale properties of mixtures and solutions.<br>▪ Grade 5 has developed the concept that all matter is made of particles too small to be seen. | Students may make the following mistakes:<br>• Confusing mixtures and solutions<br>• Thinking that pure substances can be broken down into ingredients<br>• Thinking that mixtures cannot be separated by their ingredients<br>• Overemphasizing and relying solely on color to identify substances<br>• Assuming all homogeneous mixtures are liquids, when some can also be gases (e.g., air) or solids (e.g., alloys)<br>• Assuming transparency means homogeneity<br>• Assuming all solids are pure substances |

| Standard: | 6.6C identify elements on the periodic table as metals, nonmetals, metalloids, and rare Earth elements based on their physical properties and importance to modern life |
|---|---|

## Specificity

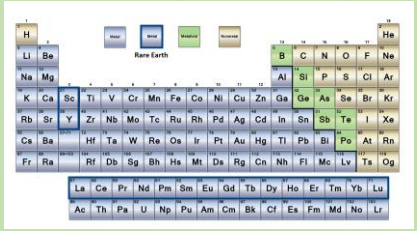
Cognition: Identify
Content: elements on the periodic table as metals, nonmetals, metalloids, and rare Earth elements

Including, but not limited to:

- Periodic table – an organized table of all the chemical elements in order of increasing atomic number
- Element – a pure substance composed of the same type of atom throughout and cannot be broken down into simpler substances
- Physical property – a feature of matter that can be observed or measured to describe and differentiate between samples of matter
  - Luster – the ability to reflect light
  - Conductivity – ability to conduct thermal and / or electric energy
  - Malleability – the ability to be hammered into thin sheets
  - Ductility – the ability to be pulled into wire
  - Magnetism – the ability to interact with a magnet
  - States of matter – the form that the matter is existing in
  - Density (relative) – ability of an element to sink or float in water
- Metals
  - Largest number of elements that are mostly solids at room temperature, have luster, and are good conductors of heat and electricity
  - The metals are on the left-hand side of the periodic table and separated from nonmetals by the zigzag line in the periodic table.
  - Physical Properties
    - High luster; shiny
    - Metals are good conductors of thermal energy and conductivity.
    - Metals are malleable.
    - Metals are ductile.
    - Only iron, nickel, and cobalt are magnetic.
    - Most metals are solids at room temperature, except for mercury (Hg); a liquid at room temperature.
    - Denser than water, with a few exceptions
  - Important to modern life
    - Copper wire for electrical circuits and HVAC units
    - Important vitamins in our foods; magnesium, calcium, and potassium
    - Used for manufacturing and industry; iron
- Nonmetals
  - Elements that are mostly liquids and gases at room temperature and bad conductors of heat and electricity

## Content Builder

- Elements are organized on the periodic table based on their physical properties.




- Metals, nonmetals, and metalloids can be classified by comparing physical properties such as luster, conductivity, ductility, magnetism, density, state of matter and malleability.
- To identify elements on the periodic table based on their physical properties, look for traits such as conductivity, malleability, ductility, and appearance. Metals are good conductors with a lustrous appearance, while nonmetals lack metallic properties. Metalloids have intermediate traits, and rare Earth elements share unique electronic configurations. Metals, nonmetals, and metalloids are classified based on a combination of properties, not just one.
- To identify elements based on their importance to modern life, consider their applications in technology, electronics, manufacturing, and energy production. Metals are essential for construction and electrical uses, nonmetals are employed in various chemical processes, metalloids are used in semiconductor devices, and rare earth elements play a crucial role in advanced technologies such as electronics, magnets, and green energy solutions.

## Instructional Implications

- Students may find it challenging to comprehend and apply new properties such as luster, malleability, and ductility.
- When you teach this concept, remember to:
  - Conduct hands-on activities to explore the physical properties of various elements such as appearance, conductivity, malleability, ductility, and hardness.
  - Group elements based on their similar physical properties and discuss the patterns that emerge in the periodic table.
  - Use visual aids such as color-coded periodic tables or interactive apps to help students distinguish between metals, nonmetals, and metalloids.
  - Provide real-life examples of each category, emphasizing their applications in everyday items or industries (e.g., metals in electrical conductors, nonmetals in plastics, metalloids in semiconductors).
  - Investigate the applications of rare earth elements in advanced technologies such as smartphones, electric vehicles, renewable energy, and magnets.

- Found on the right side of the periodic table of elements; there are 20 nonmetal elements
- Physical Properties
  - Low luster; dull
  - Nonmetals are not good conductors of thermal energy and conductivity.
  - Nonmetals are not malleable; brittle
  - Nonmetals are not ductile.
  - Nonmetals are not magnetic.
  - Most nonmetals are gasses; however, some are solids and liquids at room temperature.
  - Denser than water, with a few exceptions
- Important to modern life
  - Living organisms that need oxygen (O) to breathe
  - All living organisms are carbon (C) based.

- Metalloids – seven elements
  - 7 elements that border between the metals and the nonmetals along a zigzag line on the periodic table of elements
  - These elements have characteristics of both metals and nonmetals.
  - Physical Properties
    - High luster; shiny
    - Referred to as semiconductors because they are both good and poor conductors of electricity, depending on the temperature of the sample
    - They are hard, but brittle.
    - Some are ductile, and some are not.
    - Metalloids are not magnetic.
    - They are solid at room temperature.
    - Less dense than metals but denser than nonmetals.
  - Important to modern life
    - Semiconductors for electronics; computers, tablets, and mobile phones
    - Pyrotechnics (fireworks)
    - Cosmetics
- Rare earth metals – 17 metallic elements
  - Located in the middle of the periodic table (atomic numbers 21, 39, and 57–71)
  - Physical Properties
    - High luster
    - Good conductors of thermal and electrical energy
    - They are soft and malleable.
    - Most are ductile.
    - Some are magnetic.
    - They are solid at room temperature.
    - Denser than metals and water.
  - Important to modern life

## Student Misconceptions

Students may make the following mistakes:

- Thinking that metalloids are a form of metal because of their name
- Confusing “malleable” and “ductile”
- Thinking all metals are magnetic
- Confusing the location of metalloids and rare earth metals on the periodic table
- Ignoring all relevant properties and focusing solely on one property (e.g., luster or conductivity)

## Notes

- Focus of learning is on learning to use the properties and location of the periodic table to identify if an element is a metal, nonmetal, metalloid, or rare earth metal.
- Memorization of element names and symbols is not required.
- Discussion of atomic radii, and relative reactivity and chemical bonding will be introduced in high school.

| | |
|---|---|
| ▪ Screens for smart phones, TVs, and computers<br>▪ Batteries of hybrid and electric cars<br>• Periodic table of elements – a conceptual model in which the elements are classified and organized according to their properties; often displayed as a chart<br>• Elements – a pure substance composed of the same type of particle (atom)<br>○ Properties can be used to identify different elements.<br>○ Organized on the periodic table of elements based on properties<br>○ Building blocks of matter<br>○ Helium, lithium, and gold | |

| **Standard:** | **6.6D compare the density of substances relative to various fluids** |
|---|---|
| **Specificity** | **Content Builder** |
| Cognition: compare<br>Content: density of substances relative to various fluids<br>Including, but not limited to:<br>• Relative density – ability of a material (not an object) to sink or float in various fluids (liquids or gases)<br>○ Use common fluids, such as cooking oil and / or corn syrup.<br>○ Test by placing the sample in a container of the reference liquid that is deeper and wider than the sample.<br>▪ Identify matter as less dense or more dense than the reference liquid.<br>➢ Less dense than – liquids or objects that float to or near the surface of the reference liquid<br>❖ A Styrofoam ball floats in oil; therefore, Styrofoam is less dense than oil.<br>➢ More dense than – liquids or objects that sink below the surface of the reference liquid<br>❖ A glass marble sinks in corn syrup; therefore, the marble is more dense than corn syrup.<br>○ Compare substances to multiple fluids.<br>▪ Vegetable oil is more dense than rubbing alcohol, but less dense than water. | • Liquids or objects with lower density than water or another fluid will float in water (A ping pong ball floats in water. The ping pong ball is less dense than water.)<br>• Liquids or objects with higher density than water or another fluid will sink in water (A glass marble sinks in water. The marble is more dense than water.)<br>• The density of substances relative to various fluids determines whether they sink or float in those fluids. Substances with a density greater than the fluid will sink; those with a density lower than the fluid will float.<br>**Instructional Implications**<br>• Students may struggle with this concept since they have only compared densities of objects to water in previous grade levels.<br>• When you teach this concept, remember to:<br>○ Plan investigations that use a variety of fluids for students to test relative density of substances.<br>○ Provide opportunities for students to plan and test ways to compare the densities of a variety of substances.<br>○ Use diverse visuals and scenarios (diagrams, models, graphs, videos, real-life examples) to engage students in interpreting density-related phenomena. |
| **Notes** | **Student Misconceptions** |
| • With the updated TEKS students do not need to calculate density anymore.<br>• In Grade 5 students compare and contrast matter based on measurable, testable, or observable physical properties, including relative density (sinking and floating using water as a reference point). | Students may make the following mistakes:<br>• Thinking that larger objects will always sink while smaller objects will always float<br>• Thinking that all solids have a higher density than liquids |

| Standard: | 6.10A differentiate between the biosphere, hydrosphere, atmosphere, and geosphere and identify components of each system |
|---|---|

## Specificity

Cognition: differentiate and identify
Content: Earth's spheres and components of each system

Including, but not limited to:

- Biosphere
  - Extends from the deepest layers of soil and oceans that are inhabited by living things
  - Exists in parts of the hydrosphere, atmosphere, and geosphere
  - Biotic components:
    - Producers
    - Consumers
    - Decomposers
  - Abiotic components:
    - Water
    - Earth materials, including nutrients
    - Gases
    - Energy
- Hydrosphere
  - All the waters on, above, and below Earth's surface
  - Recycled through the biosphere, atmosphere, and geosphere
  - Oceans
  - Surface water
    - Rivers
    - Streams
    - Lakes
    - Glaciers
  - Ground water
    - Runoff
    - Aquifers
  - Atmospheric water vapor
- Atmosphere
  - Any element in gas form between the surface of Earth and space
  - Layers of the atmosphere – troposphere, stratosphere, mesosphere, thermosphere, and ionosphere
  - Atmospheric gases:
    - Nitrogen
    - Oxygen
    - Water vapor
    - Carbon dioxide
    - Trace amounts of other gases

## Content Builder

- The **biosphere** includes all living things on Earth, from plants and animals to fungi and microscopic plankton. Life on Earth lives close to the surface, where it can access oxygen and/or carbon dioxide, sunlight, water, minerals, and organic matter.
- The **atmosphere** surrounds the Earth in gaseous layers held in place by gravity. It is made up of about 78% nitrogen, 21% oxygen and 1% carbon dioxide and other gases, including water vapor. The atmosphere blankets the Earth in layers.
- The **hydrosphere** includes Earth's water. Most (97%) is salt water in the oceans. Freshwater is found in underground in aquifers, on the surface in lakes, rivers and frozen in glaciers. Earth's water is always moving through a water cycle.
- The **geosphere**, also called the lithosphere, includes all Earth's rock, soil and sand in all its forms from mountains to its rocky stream beds, mudflats, ocean trenches, sandy beaches and lava flows. It even includes the very ground that is made up of tectonic plates forming our islands and continents.
- These systems work together, shaping Earth's environment and supporting life. All four systems are dynamic and constantly changing due to natural processes, including geological activity, weather patterns, climate shifts, and biological evolution. Students may struggle with this concept because some components (e.g., water) exist in multiple systems (hydrosphere and biosphere), leading to confusion and difficulty in categorizing them correctly.

## Instructional Implications

When you teach this concept, remember to:

- Emphasize that while Earth is a complex system, categorizing it into different spheres allows us to study and understand the components and processes that make up our planet.
- Focus on interactions of the different spheres
- Introduce and explain the prefixes of each sphere (bio- for life, hydro- for water, atmos- for air, and geo- for Earth). Emphasize these prefixes and their meanings to help students make connections.
- Use a variety of models, diagrams, or hands-on activities for students to sort and categorize components of each sphere.
- Incorporate examples from different geographical locations to illustrate the components of each sphere.

## Student Misconceptions

Students may make the following mistakes:

- Thinking that the Earth cannot be divided into four different spheres
- Thinking that the spheres of Earth are entirely isolated and independent from one another
- Thinking that the biosphere only includes land-based ecosystems or visible life forms and excluding their habitats on land, in water, and in the air

| | |
|---|---|
| • Geosphere<br>○ All of the rock or mineral parts of the Earth<br>○ Soil<br>▪ Rocks<br>▪ Decomposing parts of organisms<br>▪ Fossilized remains of organisms<br>▪ Layers of the Earth – crust, mantle, outer core, and inner core | • Thinking that the geosphere only consists of the Earth's crust and topsoil, neglecting the underlying layers<br>• Thinking of these systems as static and unchanging over time<br>**Notes**<br>• Learning to differentiate and identify components within Earth's systems forms the basis for comprehending the complex interactions among the geosphere, hydrosphere, atmosphere, and biosphere. |

**VERTICAL STANDARDS**

This section details the **progression** of key student expectations/standards** in the courses **before** and **after** this course. This will help you understand what **prior knowledge skills to build upon** and guide you in knowing what **skills you are preparing your students** for in the subsequent course.

| Prior Grades | 6th Grade | Next Grades |
|---|---|---|
| 4.6A classify and describe matter using observable physical properties, including temperature, mass, magnetism, relative density (the ability to sink or float in water), and physical state (solid, liquid, gas) | **6.6A compare solids, liquids, and gases in terms of their structure, shape, volume, and kinetic energy of atoms and molecules** | 7.6A compare and contrast elements and compounds in terms of atoms and molecules, chemical symbols, and chemical formulas<br>7.6B use the periodic table to identify the atoms and the number of each kind within a chemical formula; |
| 5.6A compare and contrast matter based on measurable, testable, or observable physical properties, including mass, magnetism, relative density (sinking and floating using water as a reference point), physical state (solid, liquid, gas), volume, solubility in water, and the ability to conduct or insulate thermal energy and electric energy<br>5.6D illustrate how matter is made up of particles that are too small to be seen such as air in a balloon. | | 8.6C describe the properties of cohesion, adhesion, and surface tension in water and relate to observable phenomena such as the formation of droplets, transport in plants, and insects walking on water<br>8.6D compare and contrast the properties of acids and bases, including pH relative to water |
| 4.6B investigate and compare a variety of mixtures, including solutions that are composed of liquids in liquids and solids in liquids<br>4.6C demonstrate that matter is conserved when mixtures such as soil and water or oil and water are formed | **6.6B investigate the physical properties of matter to distinguish between pure substances, homogeneous mixtures (solutions), and heterogeneous mixtures** | 7.6D describe aqueous solutions in terms of solute and solvent, concentration, and dilution<br>7.6E investigate and model how temperature, surface area, and agitation affect the rate of dissolution of solid solutes in aqueous solutions |
| 5.6B demonstrate and explain that some mixtures maintain physical properties of their substances such as iron filings and sand or sand and water | | 8.6A explain by modeling how matter is classified as elements, compounds, homogeneous mixtures, or heterogeneous mixtures; |

| | | |
|---|---|---|
| 5.6C compare the properties of substances before and after they are combined into a solution and demonstrate that matter is conserved in solutions | | |
| 4.6A classify and describe matter using observable physical properties, including temperature, mass, magnetism, relative density (the ability to sink or float in water), and physical state (solid, liquid, gas) | **6.6C identify elements on the periodic table as metals, nonmetals, metalloids, and rare Earth elements based on their physical properties and importance to modern life** | 8.6C describe the properties of cohesion, adhesion, and surface tension in water and relate to observable phenomena such as the formation of droplets, transport in plants, and insects walking on water |
| 5.6A compare and contrast matter based on measurable, testable, or observable physical properties, including mass, magnetism, relative density (sinking and floating using water as a reference point), physical state (solid, liquid, gas), volume, solubility in water, and the ability to conduct or insulate thermal energy and electric energy | | 8.6D compare and contrast the properties of acids and bases, including pH relative to water |
| 4.10A describe and illustrate the continuous movement of water above and on the surface of Earth through the water cycle and explain the role of the Sun as a major source of energy in this process; | **6.10A differentiate between the biosphere, hydrosphere, atmosphere, and geosphere and identify components of each system** | 7.10A describe the evidence that supports that the Earth has changed over time, including fossil evidence, plate tectonics, and superposition |
| 5.10A model and describe the processes that led to the formation of sedimentary rocks and fossil fuels | | |

## VOCABULARY GLOSSARY

Domain-specific words and definitions for this unit.

| Key Content Vocabulary |
|---|
| **Abiotic:** nonliving things (Lesson 04)<br>**Atmosphere:** the thin layer made up of a mixture of gases and particles suspended in the air that surrounds the Earth (atmo-means air) (Lesson 03)<br>**Atom:** the smallest component of an element (Lesson 06)<br>**Atomic Mass-** the number of protons and neutrons in an atom (Lesson 06)<br>**Atomic Number-** the number of protons in an atom (Lesson 06)<br>**Biosphere:** a sphere that includes all of Earth's organisms including humans, and matter that has not yet decomposed (bio-living things) (Lesson 03)<br>**Biotic**: living things (Lesson 04)<br>**Brittleness:** when something is easy to break or snap<br>**Chemical bond:** the attraction between two or more atoms (Lesson 07)<br>**Chemical Weathering**: Involves changes that some substances can cause in the surface of rock that make it change shape or color.<br>**Claim:** a one-sentence statement that answers the original scientific or research question (Lesson 01)<br>**Compound:** substance composed of identical molecules consisting of atoms of two or more elements metal (Lesson 07)<br>**Convection current:** a current that is created when hot rises and cold air sinks.<br>**Conductivity:** ability to conduct electrical current or thermal energy<br>**Density:** the measure of mass per unit volume of a substance |

**Dependent Variable:** the variable that changes as a result of the independent variable manipulation. (Lesson 02)
**Ductility** – ability to be stretched into a wire without breaking.
**Electron**- negatively charged particle located outside the nucleus of the atom. (Lesson 06)
**Evidence:** Data collected during research/investigation (Lesson 01)
**Formula unit:** The smallest unit of a compound that contains a metal. (Lesson 07)
**Gas:** state of matter without a definite shape or a definite volume (Lessons 09 and 10)
**Geosphere**: a sphere that includes the solid Earth; the core, mantle, crust, and soil layers (geo- means land) (Lesson 03)
**Heterozygous mixture:** when components/substances are NOT evenly distributed-you can easily separate or distinguish between the different components/substances. (Lesson 08)
**Homogeneous mixture:** when the components/substances are evenly distributed-you cannot physically separate the substances. (Lesson 08)
**Hydrogen:** essential component of fats, oils, proteins, carbohydrates, and DNA/RNA (Lesson 04)
**Hydrosphere**: A sphere that includes the liquid ocean, inland water bodies, and groundwater (hydro-means water) (Lesson 03)
**Independent Variable:** the variable you manipulate or vary in an investigation to explore its effects. (Lesson 02)
**Insulator** – a substance or object that does not allow energy to flow through it easily.
**Ion-** particle with a positive or negative charge, which is formed by the loss or gain of electrons. (Lesson 06)
**Kinetic Energy:** the form of energy that an object or a particle has by reason of its motion. (Lessons 09 and 10)
**Liquid:** a state of matter with a definite volume but not a definite shape (Lessons 09 and 10)
**Luster:** the manner in which the surface of metal reflects light
**Malleability:** when something is able to be hammered or pressed permanently out of shape without breaking or cracking
**Matter:** is anything that has mass and takes up space (Lesson 07)
**Mass:** the amount of matter in an object (Lesson 07)
**Mixture:** when two or more substances are combined but NOT by chemical means (you are still able to separate the substances back into their individual forms) (Lesson 08)
**Mean:** The average of a set of numbers. (Lesson 02)
**Median:** the middle number in a set of ordered numbers. (Lesson 02)
**Metalloids** – substances that exhibit some properties of metals and nonmetals
**Metals** – substances that have the physical properties of luster, conductivity, and malleability; may appear in all three states of matter
**Mode:** the number that occurs most often in a set of numbers. (Lesson 02)
**Molecule:** multiple nonmetal atoms connected by a chemical bond (Lesson 07)
**Nitrogen:** component of amino acids (necessary for all living things) (Lesson 04)
**Nonmetals** – substances that have the physical properties of being dull, insulators, and brittle; may appear in all three states of matter
**Nucleus-** center part of the atom made up of protons and neutrons (Lesson 06)
**Neutron-** subatomic particle with no charge located in the nucleus of the atom (Lesson 06)
**Nutrient Pollution**- process where too many nutrients, mainly nitrogen and phosphorus, are added to bodies of water and can act like fertilizer, causing excessive growth of algae. (Lesson 05)
**Oxygen:** essential component of fats, oils, proteins, carbohydrates, and DNA/RNA (Lesson 04)
**Particle:** an extremely small part of matter that exerts a force (Lesson 07)
**Periodic Table-** contains all of the elements (Lesson 06)
**Phosphorous:** key component in molecules such as DNA and lipids (fats and oils) (Lesson 04)
**Proton-** positively charger subatomic particle located in the nucleus of the atom (Lesson 06)
**Pure substance**: substances that are only made up of ONE type of particle-cannot by separated by physical means (Lesson 08)
**Range:** the spread of data from the lowest to the highest value in the distribution. (Lesson 02)

**Rare Earth Metal:** Rare earth metals are a set of seventeen metallic elements. These include the fifteen lanthanides on the periodic table plus scandium and yttrium. Rare earth metals are key components in many electronic devices that we use in our daily lives, as well as in a variety of industrial applications.
**Reasoning:** Logical connections to explain how or why the evidence supports the claim (Lesson 02)
**Solid:** a state of matter with a definite shape and volume (Lessons 09 and 10)
**Solution:** A type of mixture in which the particles of one or more substances are dissolved (uniformly dispersed throughout) in another substance (Lesson 08)
**System:** a collection of parts or a process that depends partly on other parts, that work together (Lesson 03)
**Volume:** the amount of space an object takes up (Lessons 09 and 10)
**Watershed-** a land area that channels rainfall and snowmelt to creeks, streams, and rivers, & eventually to outflow points such as reservoirs, bays, and the ocean. (Lesson 04)

## Unit Supply List

**Consumable Materials and Lab Supplies for Unit 1 (1 per group of 4 students unless noted)**

| Lesson | Consumable | Lab Supplies |
|---|---|---|
| Lesson 01: What is CER | Resealable baggies for card sort | None |
| Lesson 02: Mysterious Lake Mendota | Resealable baggies for card sort | Calculators |
| Lesson 03: Earth's Spheres | None | None |
| Lesson 04: What is the Water Part 1 | LaMotte 5849 TesTab Water Investigation Kit | • Small glass vials for testing- included in the original LaMotte Kit<br>• Goggles (1 per student)<br>• Nitrile Gloves (1 pair per student) |
| Lesson 5: What is the Water Part 2 | Same supplies needed as the day before | Same supplies needed as the day before |
| Lesson 6: Introduction to Atomic Structure and Periodic Table | None | None |
| Lesson 7: Atoms, Molecules, and Compounds | • Colored Paper Clips (red, yellow, blue, green, pink, white) See lesson for # per color needed<br>• Silver Paper Clips<br>• Resealable bag | None |
| Lesson 8: Pure Substances and Mixtures | • water | • 3 large beakers<br>• Measuring spoons<br>• 5 small blue glass beads<br>• 5 small red glass beads<br>• Strainer<br>• 3 wooden beads<br>• Iron filings<br>• Funnel<br>• Masking tape<br>• Cork pieces<br>• 7 paper clips<br>• Coffee filter |

| | | |
|---|---|---|
| | | • Salt<br>• Tweezers<br>• Magnet in a sealable bag |
| Lesson 9: Lake Mendota in the Winter (states of matter) Part 1 | • Chart paper markers (for the teacher to make a class anchor chart)<br>• Beakers, water, balloon, etc. for the teacher to model during anchor chart creation | • Metric ruler for students to measure |
| Lesson 10: Lake Mendota in the Winter (states of matter) Part 2 | • Anchor chart from the previous lesson<br>• Beakers, water, balloon, etc. for the teacher to model during anchor chart creation.<br>• Three water bottles of the same volume. Freeze water in one the night before, one should be completely full of water, and one should be empty with the lid. | |
| Lesson 11: Relative Density | Convention Current Demo teacher supplies:<br>• Four identical wide-mouth glass bottles<br>• Two index cards<br>• Food coloring, two colors<br>• Hot and cold water<br>• Two plastic plates or trays (to hold any spilled water)<br>• Scissors<br>Density Column Lab (Per group):<br>• Pony bead<br>• a small ball of candle wax<br>• piece of cork<br>• Water, 30-mL<br>• Cooking oil, 30-mL (peanut oil)<br>• Isopropyl alcohol, 70% or higher (available at stores), 30-mL<br>Students: Colored Pencils | Convention Current Demo teacher supplies:<br>• Hot plate and beaker to heat water<br>• Thermometer<br>• Place water in freezer or add lots of ice for cold water<br><br>Density Column Lab (Per group):<br>• Tray for equipment and materials<br>• 100-mL graduated cylinder<br>• 25-mL graduated cylinder<br>• Goggles 1/student |
| Lesson 12: Metals, Nonmetals, and Metalloids | Students: Colored Pencils<br><br>Teacher to make conductivity tester:<br>String of holiday lights (1 per teacher)<br>Copper wire- 1 roll<br>9-volt battery- 1 per lab group | |

| | | |
|---|---|---|
| | Electrical tape- 1 role<br><br>Physical Properties Station Lab (1 sample for the stations)<br>aluminum can<br>Iron filings or pieces of iron pipe<br>Sample of sulfur<br>Copper wire or pipe<br>Charcoal<br>Lead fishing weight<br><br>1 flashlight per group (small pen light works well)<br>1 magnet per group<br>1 conductivity tester (see above) | |