Exploring

The

BUILDING BLOCKS

of

SCIENCE

Featuring Chapters from:

Student Textbook
Laboratory Notebook
Teacher's Manual
Lesson Plan
Study Notebook
Quiz questions

REBECCA W. KELLER, PhD
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Today we know that the fundamental building blocks of matter are atoms. The word atom comes from the Greek word *atomos*, which means “uncuttable.”

Today we know that atoms are not really uncuttable but are made of even smaller particles called protons, neutrons, and electrons. However, during chemical reactions atoms act as whole units, so the model of the atom as an uncuttable unit of matter works well for understanding chemical reactions.

Protons and neutrons are roughly equal in size, but electrons are much smaller than either protons or neutrons. Together, protons, neutrons, and electrons make up an atom. Protons and neutrons combine to form the central core (the nucleus) of an atom, and the electrons occupy the space surrounding the central core.

Electrons have a negative electric charge, protons have a positive charge, and neutrons have no charge. For neutral elements (those that do not have an electric charge) the number of electrons in an atom always equals the number of protons.

Notice that in the helium atom there are two protons and two electrons. Sometimes the number of protons also equals the number of neutrons, as in helium, but this is not always true.
Most of the size of an atom is actually made of the space between the electrons and the core. The protons and neutrons make up only a very small part of the total size.

On the other hand, almost all of the weight of an atom comes from the protons and neutrons. The electrons weigh almost nothing compared to the nucleus.

3.2 The Periodic Table of Elements

The periodic table of elements is a chart used by chemists that categorizes the elements (atoms) and shows their characteristics. Recall from Chapter 2 that the first periodic table of elements was put together by John Dalton (1766–1844) who proposed that all matter is made of atoms.

In 1869 Dmitri Mendeleev, who was a chemist born in Tobolsk, Siberia (Russia), expanded Dalton’s table. While scribbling in his notebook, Mendeleev developed the first version of our modern periodic table of elements.

Mendeleev carried with him cards that had the names and weights of the 63 known elements written on them. He thought about the elements and their weights a great deal. After much thinking, he decided to arrange the elements into a chart that was based on their atomic masses.

In 1869 Mendeleev published his chart in a book called Principles of Chemistry. He left spaces in his chart because he thought that some elements were missing, and he was right! With his table, he was able to predict a few of the elements that were missing, and while he was still living, the next three elements were indeed discovered. His table gave other scientists the information they needed to find the missing elements. Those missing elements were exactly what Mendeleev predicted! He was famous for the success of his predictions.
Today, the periodic table of elements is much larger than Mendeleev’s table and contains 118 elements. Some of the newer elements have been created in the laboratory. The International Union of Pure and Applied Chemistry (IUPAC) is an organization that reviews and verifies the discovery of new elements. As of this writing, the elements ununtrium, ununpentium ununseptium, and ununoctium have been given temporary names until they have been verified and given their official names.

In the standard periodic table used by most scientists, the elements are arranged horizontally from left to right in order of increasing atomic number. The atomic number is the number of protons in the nucleus of each atom. For example, carbon has an atomic number of 6. This means carbon has 6 protons in its nucleus. Oxygen has an atomic number of 8, which means it has 8 protons in its nucleus.
Each of the elements has its own symbol. For example, hydrogen has the symbol “H,” carbon has the symbol “C,” and oxygen has the symbol “O.” Notice that for these elements the symbol is the same as the first letter of the name. Other elements have the first two letters of their name as their symbol—for example, “He” for helium and “Ne” for neon.

Some elements have a symbol that is different from the first letter or letters of their name. For example, the symbol for gold is “Au” from the word *aurum* which means gold in Latin. The name for sodium comes from the Latin word *natrium*, so sodium has the symbol “Na.” Other examples include lead, which has the symbol “Pb” from the Latin word *plumbum*, and tungsten which has the symbol “W” from the German word *wolfram*.

In an atom, the number of protons equals the number of electrons. The atomic number is also the number of electrons in an atom. For example, the smallest element is hydrogen. It has an atomic number of 1, which means it has only one proton. It also has only one electron, since the number of protons equals the number of electrons.
Though atoms are very small, each one has a weight called the atomic weight. For most atoms the atomic weight is very close to the sum of the protons and neutrons in the nucleus. Protons and neutrons each have an atomic weight of 1. Electrons are so small that they are considered to have almost no weight at all. The number of neutrons for an atom can be calculated by subtracting the number of protons from the atomic weight.

For example, the atomic weight of hydrogen is 1.0079, which on this periodic table is the number found below the name. To find the number of neutrons, the number of protons (1) is subtracted from the atomic weight (1.0079 or 1); 1 - 1 = 0. This means that hydrogen has no neutrons and only one proton in its nucleus, or core.

The largest naturally occurring element is uranium. It has an atomic number of 92, which means it has 92 protons and 92 electrons. It has an atomic weight of 238.0289. To calculate the number of neutrons, the number of protons is subtracted from the atomic weight (238 - 92 = 146), so uranium has 146 neutrons.

The elements in the periodic table are arranged vertically according to their chemical properties. All of the elements in a single column undergo similar chemical reactions and have similar chemical properties. All of the elements in the far right-hand column are called the noble gases. They are similar to each
other because they don’t react with other atoms or molecules. The elements in the far left-hand column are called the alkali metals. They are similar to each other because they react with lots of different atoms and molecules.

All of the elements in a single column have similar properties.

The periodic table of elements organizes a lot of information about the elements and their chemical properties. This table helps chemists predict the behavior of the elements and how they might interact with each other.
3.4 Summary

- All things, both living and nonliving, are made of atoms, which are also called elements.
- Atoms are made of protons, neutrons, and electrons.
- In an atom, the number of protons equals the number of electrons.
- All atoms (elements) are found in the periodic table of elements.
- The elements (atoms) are arranged in the periodic table in groups that have similar properties.
7.1 Introduction

In Chapters 2-5 we saw that all things, including living things, are made of small units of matter called atoms and molecules. Atoms and molecules join to form cells, which are the basic building blocks of life. What makes a cell special is the high organization of atoms and molecules that work together through chemical reactions to keep the cell alive.

For example, in order for a cell to be alive, it must convert food into energy. To convert food into energy, food molecules are broken down into smaller pieces during a series of chemical reactions within the cell. When this happens, chemical bonds are created and destroyed and energy is released. These processes keep cells alive.

There are literally millions of chemical reactions going on in each cell at every moment. All of these chemical reactions are performed by millions of little molecules reacting with each other. When these chemical reactions stop, the cell dies.
7.2 Types of Atoms Inside Cells

As we saw in Chapter 3 there are over 100 different atoms, but the majority of biological molecules are made up of just five different types of atoms. This set of atoms is called the HCNOPS group and includes hydrogen, carbon, nitrogen, oxygen, phosphorus, and sulfur.

One of the special features that distinguishes living things from nonliving things is that living things have biological molecules. Most biological molecules are made of the five atoms in the HCNOPS group.

7.3 Types of Biological Molecules

There are many different types of biological molecules, including large biological molecules made up of millions of atoms and small biological molecules made up of only a few atoms. Some biological molecules are made up of smaller molecules that are hooked together to form long chains, and these molecular chains are grouped together in particular shapes.

Biological molecules perform different jobs inside cells. Some biological molecules provide energy for chemical reactions. These are called energy molecules. Other biological molecules are used to hold different parts of the cell together. These are called structural molecules. Some molecules move other molecules, break down unwanted molecules, and make molecules. These molecules are all molecular machines. And some molecules give the cell instructions for how to grow and when to die. These molecules are called information and storage molecules.

All of these different types of biological molecules work together to keep cells alive, make them grow, process energy, and eventually tell the cell when to die.
Energy molecules play an important role in many different biological processes. One of the most important jobs that molecules perform inside cells is storing and transferring energy. In order for a cell to use glucose, the cell must have a way to store and transfer the energy it gets from the glucose molecules. To store and transfer energy, cells use special energy molecules.

The most important energy molecule inside cells is called adenosine triphosphate, or ATP. The ATP molecule gets its name because it has an adenosine group attached to three phosphate groups. A phosphate group is a cluster of phosphorus, oxygen, and hydrogen molecules. In an ATP molecule, the energy is stored in the phosphate bonds. A phosphate bond is the bond between two phosphate groups.

When the phosphate bonds are broken during a chemical reaction, energy is released. Energy can be put back into the molecule when the phosphate bonds form again. The phosphate bonds can be broken and created over and over again, so the cell can store and release energy as often as needed. It is useful to think of ATP as being like a little rechargeable battery that stores and releases energy as the cell needs it.
7.5 Structural Molecules

Cells also have molecules that hold the cell together. These molecules are called structural molecules.

Plant cells, for example, have a stiff outer wall that helps the plant stand upright. This stiff outer wall is made of cellulose. Cellulose is a structural molecule composed of millions of glucose molecules.
An animal cell is surrounded by a cell membrane. The cell membrane is made of a type of fat molecule called a lipid. The lipid molecules in a cell membrane form two layers that together are called a lipid bilayer. The lipid bilayer is a structural molecule made of lipids, and it holds a cell together.

Structure is provided to cells by the molecules in both cellulose and lipid bilayers. Both types of molecules are structural molecules.
7.6 Molecular Machines

Cells perform a variety of different jobs, and to do those jobs cells use molecular machines. Molecular machines are specialized molecules that can cut other molecules apart and glue them back together. Molecular machines can also move other molecules around inside the cell or transport them outside the cell. Some molecular machines read molecules, others transcribe molecules from one molecular language to another, and others move molecules from one end of the cell to the other end.

Kinesin is a molecular machine that moves cargo around within the cell on a molecular “road.”
Molecular machines are made mostly of proteins. Proteins are a special type of biological molecule made of long chains of molecules (polymers) that can fold into a variety of structures. The structure of the folded protein is important. If a protein does not fold properly, it won't function. Proteins can perform a wide array of important jobs for the cell because they can fold into so many different shapes.

7.7 Information Storage and Transfer

Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) are special types of biological molecules that are used by the cell to store and transfer information. DNA and RNA store and transfer all the information a cell needs to grow, divide, make proteins, and eventually die. The information in DNA and RNA molecules is like the code in a computer. This code tells the cell when to grow, how to convert food into energy, when to stop growing, and when to die. The cell uses molecular machines to read the DNA code and make sense of it so the cell can know what functions to perform.

Deoxyribonucleic acid (DNA) is a polymer that is made of nucleotides which are made of two parts: nucleic acid bases and ribose sugars. The bases are connected to the sugars, and the sugars are connected to each other. RNA is similar to DNA but lacks an oxygen group on the sugar. RNA also folds differently than DNA.
7.8 Chemical Reactions in Cells: Metabolism

Metabolism is the term used to refer to all of the chemical processes your body uses to stay alive. The word metabolism comes from the Greek word *metabole* which means “to change or overthrow.” In biology, the word metabolism describes all of the chemical reactions living things use to change food into energy and other materials in order to live and grow.

There are literally millions of chemical reactions happening in your body every minute. Your cells are constantly making and destroying molecules, which converts them from one form to another, and cells are constantly creating and using energy.

Today we know a great deal about the chemical reactions cells use for metabolism. Chemical reactions in a cell follow a certain order, with one chemical reaction leading to another. This order is called a metabolic pathway. There is a different metabolic pathway for each function the cell is performing.

Two of the most important metabolic processes cells perform are the conversion of food into energy and the conversion of energy into food. The conversion of food into energy is called glycolysis. The conversion of energy into food is called photosynthesis.

Animals use glycolysis to convert the food they eat into energy, and plants use photosynthesis to convert energy from the Sun into food. Both glycolysis and photosynthesis are metabolic pathways with many chemical reactions linked together. And photosynthesis and glycolysis depend
on each other. Without photosynthesis, glycolysis cannot happen and without glycolysis, photosynthesis cannot happen. Because these processes depend on each other, the organisms that perform them depend on each other. Plants depend on animals and animals depend on plants!

7.9 Summary

- Living things are made of atoms and molecules that are highly organized and perform millions of chemical reactions every moment.
- Most biological molecules are made of five different atoms called the HCNOPS group which includes hydrogen, carbon, nitrogen, oxygen, phosphorus, and sulfur.
- There are different types of biological molecules that perform different functions inside cells.
- Energy molecules, such as ATP, are like little batteries that store and release energy.
- Structural molecules, such as cellulose and lipid bilayers, give cells the structure they need to function properly.
- Molecular machines are mostly proteins that can read, cut, transcribe, and move molecules inside a cell.
- Molecules such as DNA share and transfer information.
- All of the chemical processes in a cell together are called metabolism.
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19.1 Introduction

In this chapter we will start looking at celestial objects in space. The first object in space that we will explore is Earth itself.

What is the shape of the Earth? Is it flat, round, elliptical? Where does the Earth sit with respect to the larger universe? Is it in the middle, off to the side, on the outer edge? In this chapter we will explore these questions and others as we examine the Earth in space.

19.2 The Earth in Space

The ancient Greeks understood that the Earth is a ball, or spherical mass. The best evidence in ancient times for the Earth being spherical came from the observation that a circular shadow is cast during a lunar eclipse. The ancient Greeks could see the curvature of Earth from its shadow on the Moon.

However, it was only within the last 100 years that we have been able to photograph the Earth in space. The very first pictures of Earth as seen from space were taken in 1946 by a group of scientists in New Mexico. These scientists attached a 35 millimeter camera to a missile and launched the missile 65 miles into space. The missile came crashing down, but
the camera was protected in a tough metal container. The crude black and white photos showed the curvature of the Earth and marked a new era of space exploration.

Earth is a **planet**. The word planet comes from the Greek word *planetai* which means “wanderer.” A planet is a large spherical object or celestial body that “wanders” in space. To qualify as a planet, a celestial body must orbit a sun, must have enough mass to have its own **gravity**, and must have cleared its orbit of other celestial bodies (in other words, a planet can’t have other celestial bodies with it in the same orbit around the Sun). Because Earth “wanders,” or moves in space, around the Sun, is massive enough to have its own gravity, and also has cleared its orbit, Earth qualifies as a planet.

At the **equator**, Earth is 12,756 kilometers (7,926 miles) in diameter. Between the North Pole and the South Pole Earth’s diameter is 12,714 kilometers (7,900 miles). You can see that Earth is not a perfect sphere but is slightly larger in one dimension.
Earth sits on a tilted axis, which is the imaginary line around which the Earth rotates. Having a tilted axis means that the North and South Poles are not straight up and down in relation to the Earth's orbit around the Sun. If you were to look at the planetary axis, you would see that the poles are tilted about 23 degrees from center. This deviation from perpendicular is called orbital obliquity. Orbital obliquity, the tilt of Earth's axis, gives us the seasons.

As the Earth spins, or rotates, on its axis, different parts of the Earth face toward or away from the Sun. The Earth actually makes one full rotation around its axis in slightly less than 24 hours, at 23.93 hours. This rotation on a roughly 24 hour cycle gives us our days and nights.

During different seasons of the year, the North and South Poles get more sunlight or less sunlight than the areas around the equator because the tilt of the axis points a pole toward or away from the Sun. Because of this, the poles can have nearly 24 hours of sunlight or 24 hours of darkness. So, not all days and nights are equal everywhere on the planet.
19.3 The Earth and the Moon

The Earth has one moon. A moon is any celestial body that orbits a planet. A moon is also called a natural satellite. The word moon comes from the Greek word *menas* which means month. The Moon orbits the Earth and completes one orbit every 27 days (roughly one month), hence its name—the “Moon.”

The Moon can be seen from Earth because the Moon reflects light from the Sun. As the Moon orbits the Earth and as both the Earth and the Moon orbit the Sun, the appearance of the Moon changes. We call these changes phases.

In the first phase, on Day 0, the Moon is called a new moon. The new moon occurs when the Moon is between the Earth and the Sun. Only the back side of the Moon is illuminated by the Sun, so from Earth the Moon looks dark.

As the Moon continues to orbit the Earth, by Day 4 it enters the next phase called the waxing crescent moon. From Earth, only a small portion of the Moon appears illuminated and is crescent shaped. By Day 7 the Moon moves to the next phase and appears half-illuminated, This is called the first quarter moon, or half-moon. A few days later, on Day 10, the Moon moves to the waxing gibbous phase. A gibbous moon is between a full moon and a quarter moon. The word gibbous means “marked by convexity or swelling,” so a gibbous moon is a moon that looks “swollen.”

By Day 14, the Moon enters the full moon phase. The Moon is now on the opposite side of the Earth from the Sun and is seen with full illumination. A few days later, by Day 18, the Moon becomes a waning gibbous moon. Then, by Day
22, it enters the next to last phase, the last quarter moon, when the Moon is again half-illuminated, but now the illumination appears on the opposite side from the first quarter moon. Finally, by Day 26 the Moon enters the last phase, becoming a waning crescent moon. By Day 30 the Moon is back to being a new moon and the cycle repeats.

The Moon and the Earth interact with each other through long range gravitational forces. Any object that has mass (the property that makes matter resist being moved) also has gravitational force (the force exerted by objects on one another). Your body has mass and also a small amount of gravitational force. But because you are very small compared to the Earth, your gravitational force does not affect the Earth.
The Moon is much bigger than you. But it has much less mass than the Earth and therefore has less gravitational force. However, the Moon has enough mass to create a gravitational pull on the Earth.

The Moon has dramatic effects on Earth. For example, the Moon is believed to stabilize Earth’s rotation and the tilt of its axis. Without a moon, the Earth might swing more dramatically between degrees of obliquity, unable to maintain an average tilt of 23 degrees. If the Earth tilted more or less dramatically, this could result in extreme or even catastrophic changes in the seasons.

The Moon also contributes to the rise and fall of ocean tides. Ocean tides on Earth are created in part by the gravitational forces exerted by the Moon. The Moon (together with the Sun) pulls on the Earth’s center, which creates two tidal bulges. As the Earth rotates on its own axis, these bulges are dragged along the Earth’s surface, causing the sea level to rise and fall, thus creating tides.
19.4 The Earth and the Sun

The Sun is a celestial body in space. It provides the Earth with power. The Sun is like a big battery that never runs out, continuously giving us energy in the form of light and heat. From this energy, life is possible. Without the Sun there would be no plants, animals, reptiles, fish, or even microbes. All of life requires energy in order to move, grow, eat, and reproduce. Every chemical reaction in your body requires energy, and it is ultimately the Sun’s energy that powers the chemical reactions in your body.

Not only does the Sun power our planet, it also interacts with Earth, affecting tides, weather, and even our magnetic field. We saw in the last section how the Moon pulls on the Earth causing tides in our oceans. The Sun also pulls on the Earth causing tidal activity.

Did you know that “space weather” affects our own weather on Earth? It’s easy to forget that Earth is not a closed system. We are a blue ball in space, interacting with other space objects like planets and the Sun. The Sun affects our planet in major ways, and one way is the weather.

Weather can be tough to predict on Earth. You might not think that a solar storm on the Sun could cause a storm on our planet, yet this is exactly what happens. Earth’s weather is caused by temperature and moisture variations in different places. When the Sun has a solar storm and a burst of heat escapes, we get a rise in temperature on Earth, which can then create storms.
The Sun also interacts with Earth’s atmosphere causing **auroras**, which are sometimes called **northern lights** and **southern lights**. Auroras are caused by solar storms that charge particles in space. These charged particles get trapped by Earth’s magnetic field. When this happens, they pass through our atmosphere and give off light as they release energy.

*Photo Credit: NASA/nasaimages.org*
There are two types of eclipses that occur. A lunar eclipse occurs when the Moon passes directly behind the Earth and the Earth blocks the Sun's rays from illuminating the Moon. The Moon is darkened as the Sun's rays are blocked and the Earth's shadow passes across the Moon.

The other type of eclipse is called a solar eclipse. A solar eclipse occurs when the Moon passes between the Sun and the Earth, blocking the Sun's rays from reaching some location on Earth.

It is tempting to look at a solar eclipse with your naked eye. However, it is very dangerous to look at the eclipse directly. Special glasses or projection techniques must always be used to view a solar eclipse.
19.6 Summary

- Earth is classified as a planet because it rotates around the Sun, has enough mass to have its own gravity, and has cleared its orbit.

- Earth rotates on a tilted axis. This tilt is called orbital obliquity. The rotation of Earth on its axis gives us night and day, and orbital obliquity creates the different seasons.

- The Earth has one moon orbiting it. The Moon stabilizes the tilt and rotation of Earth and contributes to the activity of the tides.

- The Earth orbits the Sun. The Sun provides Earth with energy and contributes to Earth’s weather and tidal activity.
Exploring

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BUILDING BLOCKS

of

SCIENCE

Book 5

LABORATORY NOTEBOOK

REBECCA W. KELLER, PhD
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Experiment 3

What Is It Made Of?

H
Hydrogen
1.0079

Atomic number
Symbol
Name
Atomic weight
Hydrogen has only one proton and no neutrons.
Introduction

Discover what things are made of!

I. Think About It

1. Do you think all atoms are the same? Why or why not?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. If you wanted to find out how much an atom weighs, how would you do it?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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3. What things do you think you could find out about atoms by looking at a periodic table of elements?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
What do you think your favorite breakfast food is made of?

If you wanted to know the details of what your favorite breakfast food is made of, how would you find out?

Do you think it's important to know what things are made of? Why or why not?
II. Experiment 3: What Is It Made Of? Date _________

**Objective**
To become familiar with the periodic table of elements and investigate the composition of some common items.

**Hypothesis**

---

**Materials**
- food labels
- periodic table of elements from *Student Textbook*
- resources (books or online) such as:
  - dictionary
  - encyclopedia
- computer with internet access (optional)

**EXPERIMENT**

1. Using the periodic table of elements, answer the following questions:

   **A.** How many protons does aluminum have? __________________________
   How many electrons? __________________________

   **B.** What is the symbol for carbon? __________________________

   **C.** List all the elements that have chemical properties similar to helium.
       __________________________
       __________________________
       __________________________

   **D.** What is the atomic weight of nitrogen? __________________________
   How many neutrons does nitrogen have? __________________________
In the table on the next page, fill in the following information:

- **ITEM**
  Think of several different items and write them in the column labeled ITEM. These can be any item, like “tires” or “cereal.” Try to be specific. For example, instead of writing just “cereal,” write “corn cereal” or “sweet, colored cereal.”

- **COMPOSITION**
  In an encyclopedia, on the food label, or online, look up the composition of the items you have selected, and write this information in the column labeled COMPOSITION. Try to be as specific as possible when identifying the composition. For example, if your cereal contains vitamin C, write “sodium ascorbate” if that name is also listed. Try to identify any elements that are in the compounds you have listed. For example, vitamin C contains the element “sodium.”

- **SOURCE**
  Write the source in the column next to the composition. “Source” means where you got your information; for example, “food label” or “encyclopedia,” or if you got the information online, list the name of the website.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>COMPOSITION</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>
**Results**

Briefly describe what you discovered about the composition of the various items.

For example:

*Kellogg’s Sugar Smacks cereal contains vitamin C, which is called* sodium ascorbate.
III. Conclusions

State your conclusions based on the information you collected.

For example:

Many cereals contain sodium in the form of salt and vitamin C.
IV. Why?

In order to do chemistry, scientists need to know the properties of atoms. The properties of all the atoms, or elements, that make up all living and nonliving things are in the periodic table of elements. The periodic table is a large chart that organizes and categorizes all of the elements according to their chemical properties and shows the underlying order that exists among the elements.

The periodic table gets its name because it shows the general law of periodicity among all of the elements. This means that certain chemical properties of the atoms repeat. Grouping the elements according to their chemical properties gives rise to the “periods” which are the horizontal rows. These rows are organized by the number of protons an element contains, starting with hydrogen which has one proton. As you go across the row, the elements have increasingly larger numbers of protons. The last naturally occurring element is uranium with 92 protons. The elements after uranium are artificially made.

The columns in the periodic table organize the elements by their chemical properties. For example, fluorine (F) undergoes chemical reactions similar to those of chlorine (Cl), bromine (Br), iodine (I), and astatine (At). All of these similar elements are arranged in a single column of the periodic table.

The symbols for different atoms can be used in writing about them so the whole name doesn’t need to be written out. Because the periodic table lists the symbols for all the elements, all scientists will know what a certain symbol means when they are looking at someone else’s work.

Knowing the properties of the different types of atoms helps scientists understand how the atoms will or won’t combine with each other. Also, when chemists are measuring amounts of the different substances needed for a chemical reaction, knowing the atomic weights of the different atoms can help them measure out the proper amounts.
V. Just For Fun

Select one or more items from your chart. Find out as much as you can about how it was made, where it was made, and where the different components it is made of might have come from.

Details about
Experiment 7

What’s in Spit?

[Diagram showing the process of breaking down fats and sugars in the mouth to produce energy and carbon dioxide.]
Introduction

Discover what happens to bread when it’s in your mouth.

I. Think About It

1. What do you think happens when you chew food?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

2. What do you think the saliva in your mouth does?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. Do you think you could eat bread if you did not have saliva? Why or why not?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
4. Do you think all digestion of food happens in the stomach? Why or why not?


5. Do you think there are any differences in how your body digests bread and how it digests celery?


6. Do you think saliva is part of a metabolic process? Why or why not?


II. Experiment 7: What’s in Spit? Date __________

Objective

Hypothesis

Materials

tincture of iodine [VERY POISONOUS—DO NOT EAT any food items that have iodine on them]
bread
timer
wax paper
marking pen
cup

EXPERIMENT

1. Break the bread into several small pieces.

2. Chew one piece for 30 seconds (use the timer), chew another piece for 1 minute, and a third piece for as long as possible (several minutes).

3. Each time, after chewing the bread, spit it onto a piece of wax paper. Using the marking pen, label the wax paper with the length of time the bread has been chewed.

4. Take three small pieces of unchewed bread, and place one next to each of the chewed pieces.

5. Add a drop of iodine to each piece of bread—chewed and unchewed.

6. Record your observations in the following chart.
7. Take two more pieces of bread. Collect as much saliva from your mouth as you can (spit into a cup several times). Soak both pieces of bread in the saliva.

8. Place each piece of soaked bread on a piece of wax paper. Put one piece in the refrigerator and leave the other one at room temperature. Let them sit for 30 minutes.

9. After 30 minutes add a drop of iodine to each.

10. Record your results.

### Chewed Bread

<table>
<thead>
<tr>
<th>30 Seconds</th>
<th>1 Minute</th>
<th>Several Minutes</th>
<th>Unchewed Bread</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Bread + Saliva — 30 Minutes

<table>
<thead>
<tr>
<th>Refrigerated</th>
<th>Not Refrigerated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
III. Conclusions

What conclusions can you draw from your observations?
IV. Why?

In this experiment you saw how your saliva begins the process of food being digested.

Your body gets much of its energy from starches in foods. Starches are long chains of sugar molecules that have to be broken down into single sugar molecules called glucose before the sugars can be used by your body for energy. Amylose is a starch that is found in foods such as bread and potatoes.

Amylase is a protein called an enzyme, and it is found in saliva. Amylase is a molecular machine that cuts a long chain of amylase into individual sugar molecules. When we chew food, the amylase protein begins to digest (break down) amylase starch molecules in our mouth before we even swallow. Our bodies can then use these sugar molecules for energy.

In this experiment iodine reacts with starch and turns black. Iodine doesn’t react with glucose. Therefore, the more the bread was chewed and the more the starch was broken down into glucose by the amylase, the less of a color change you saw with the iodine.

The names of amylase and amylose are very similar. Many enzymes (protein machines) are named after the molecules they work on. An enzyme is a protein molecular machine that carries out different functions, such as breaking down food molecules. Amylase is the enzyme that breaks down amylase, the starch. Notice that the endings differ: “-ase” for the enzyme, “-ose” for the starch.

Enzymes are highly specific. That is, each type of enzyme works only on a certain type of molecule. Amylase does not digest cellulose, only amylase. Cellulase, a different enzyme, digests cellulose. The name of an enzyme usually tells which molecule the enzyme works on.

Scientists still do not know everything about all of the proteins inside cells and the roles they play. Many proteins are very complex. Protein machines act as very sophisticated motors, rotors, gears, pumps, and scissors. We have not yet learned to build machinery that has the precision and complexity of these remarkable molecular machines.
V. Just For Fun

Repeat the experiment using celery, kale, or another green vegetable. You can also test other vegetables or fruits of your choice. Compare your results to what you found with bread. What conclusions can you draw?

<table>
<thead>
<tr>
<th>Chewed Vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Seconds</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetable + Saliva — 30 Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerated</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Experiment 19

Lunar and Solar Eclipses
Introduction

Use a model to see how lunar and solar eclipses are created.

I. Think About It

1. What do you think people learned about the Earth, Moon, and Sun by observing eclipses? Why?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

2. Do you think there would be solar eclipses if Earth did not have a Moon? Why or why not?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

3. Do you think there would be eclipses if the Moon did not orbit Earth but always stayed in the same position above Earth? Why or why not?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________
Do you think there is a lunar eclipse every time the Moon is on the opposite side of Earth from the Sun? Why or why not?

Do you think when there is a solar eclipse, everyone on the side of Earth facing the Sun will be able to see the solar eclipse? Why or why not?

If you were living at a space station on the Moon, do you think you would see any eclipses? Why or why not?
II. Experiment 19: Lunar and Solar Eclipses  Date _________

Objective

Hypothesis

Materials
- basketball
- ping-pong ball
- flashlight
- empty toilet paper tube
- tape
- scissors
- a dark room

EXPERIMENT

In this experiment you will observe how lunar and solar eclipses occur.

1. In a dark room, place the basketball on top of one end of a toilet paper tube that is sitting upright on the floor. The toilet paper tube will hold the basketball in place.

2. Holding the flashlight, stand several feet away from the basketball. Turn on the flashlight and point it towards the basketball. Lay the flashlight on the floor in a position that keeps the basketball illuminated.

3. Hold the ping-pong ball so that it is between the flashlight and the illuminated basketball. Adjust the position of the ping-pong ball until you can see its shadow on the basketball.
4. Move the ping-pong ball up until there is no shadow on the basketball.

5. Now lower the ping-pong ball until there is no shadow on the basketball.

6. Move the ping-pong ball in an “orbit” around the basketball. Observe where the ping-pong ball needs to be in order for it to cast a shadow on the basketball and where the ping-pong ball needs to be for the basketball to cast a shadow on the ping-pong ball. Also note the position of the ping-pong ball when no shadows are cast.

Results

Repeat Step 6 several times, moving the ping-pong ball in different orbits. Note whether shadows are or are not cast.

Draw several of the “orbits” you test and note whether or not the ping-pong ball casts a shadow on the basketball or the basketball casts a shadow on the ping-pong ball (see the example below). You will need to spend some time “playing” with the ping-pong ball to find the positions where shadows occur.

(Example: Orbits and Shadows)
Orbits and Shadows
III. Conclusion

Based on your observations, discuss how a lunar eclipse occurs.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Based on your observations, explain how a solar eclipse occurs.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
IV. Why?

An eclipse is a fascinating event to witness. When the Earth passes in between the Sun and the Moon, a lunar eclipse occurs, and when the Moon passes between the Sun and Earth, we get a solar eclipse. Both types of eclipses can give us valuable information about the Earth, Moon, and Sun.

In order for an eclipse to occur, the Sun, Earth, and Moon have to be precisely lined up. If they are not, there won’t be an eclipse, or the eclipse will be partial. In a partial lunar eclipse, the shadow of Earth moves over only a part of the Moon. In a partial solar eclipse, only part of the Sun will be covered as the Moon passes in front of it.

Because the Moon’s orbit around the Earth is a little bit tipped when compared to Earth’s orbit around the Sun, the Moon, Earth, and Sun don’t always line up precisely enough to create an eclipse. This is why there isn’t a total eclipse of the Sun and a total eclipse of the Moon each time the Moon orbits the Earth. The Earth, Moon, and Sun aren’t always lined up precisely enough.

Lunar eclipses occur only when the Moon is full, which is when it is at its farthest distance from the Sun and is passing directly behind the Earth. The Moon is the right size and the right distance from Earth for the Earth’s shadow to completely cover the Moon during a total lunar eclipse.

It so happens that the Moon is at just the right distance from Earth that it can fully block out the disk of the Sun during a total solar eclipse. Solar eclipses occur only during a new moon phase when the Moon is lined up precisely between the Sun and the Earth. Even though the disk of the Sun is covered by the Moon during a solar eclipse, intense sunlight shines around the edges of the Moon. If a total or partial solar eclipse is viewed directly, the intense sunlight can cause permanent damage to the eyes.

An interesting fact about the Moon is that the same side of the Moon always faces Earth. When we see a full Moon, the Moon is positioned so that the side facing Earth is illuminated, and during the new (or dark) Moon, this side is not illuminated. Because it takes the Moon about four weeks to orbit Earth, this means that at any particular place on the Moon, daylight lasts for two weeks and nighttime lasts for two weeks.
V. Just For Fun

**Part A:** Use your experimental setup to model how day and night occur on the Moon. Put a mark on the ping-pong ball to identify the side of the Moon that always faces Earth and then model the Moon’s orbit.

Record your results.

**Night and Day on the Moon**
Part B: Think about how suns, planets, and moons might be arranged in different solar systems that we haven’t yet visited. What do you think would happen with eclipses if you discovered a planet that, like Earth, had one moon, but the planet was orbiting two suns? What if a planet had two moons? What if the Sun were shining on the planet from above? What if Earth’s Moon was a different shape, like a square or a dumbbell? What other different conditions can you think of? Model or draw some of your ideas and record your results in the following boxes.

Eclipses in Other Solar Systems
More Eclipses in Other Solar Systems
Exploring The BUILDING BLOCKS of SCIENCE Book 5 TEACHER'S MANUAL

REBECCA W. KELLER, PhD
A Note From the Author

This curriculum is designed for middle school level students and provides further exploration of the scientific disciplines of chemistry, biology, physics, geology, and astronomy. *Exploring the Building Blocks of Science Book 5 Laboratory Notebook* accompanies *Exploring the Building Blocks of Science Book 5 Student Textbook*. Together, both provide students with basic science concepts needed for developing a solid framework for real science investigation. The *Laboratory Notebook* contains 44 experiments—two experiments for each chapter of the Student Textbook. These experiments allow students to further explore concepts presented in the *Student Textbook*. This *Teacher’s Manual* will help you guide students through laboratory experiments designed to help students develop the skills needed for using the scientific method.

There are several sections in each chapter of the *Laboratory Notebook*. The section called *Think About It* provides questions to help students develop critical thinking skills and spark their imagination. The *Experiment* section provides students with a framework to explore concepts presented in the *Student Textbook*. In the *Conclusions* section students draw conclusions from the observations they have made during the experiment. A section called *Why?* provides a short explanation of what students may or may not have observed. And finally, in each chapter an additional experiment is presented in *Just For Fun*.

The experiments take up to 1 hour. The materials needed for each experiment are listed on the following pages and also at the beginning of each experiment.

Enjoy!

*Rebecca W. Keller, PhD*
## Materials at a Glance

<table>
<thead>
<tr>
<th>Experiment 1</th>
<th>Experiment 3</th>
<th>Experiment 4</th>
<th>Experiment 5</th>
<th>Experiment 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>family photos</td>
<td>food labels, several (students' choice) periodic table of elements from <em>Student Textbook</em> resources (books or online) such as: dictionary encyclopedia</td>
<td>small, colored marshmallows, 1 pkg large marshmallows, 1 pkg (could also use gumdrops and/or jellybeans in place of marshmallows) toothpicks, 1 box</td>
<td>baking soda lemon juice balsamic vinegar salt and water: 15-30 ml salt dissolved in 120 ml water (1-2 tbsp. salt dissolved in 1/2 cup of water) 2 or more egg whites milk small jars, 7 or more measuring cups and spoons eye dropper <strong>Peanut Brittle</strong> 360 ml (1 1/2 cups) sugar 240 ml (1 cup) white corn syrup 120 ml (1/2 cup) water 360 ml (1 1/2 cups) raw peanuts (can be omitted) 5 ml (1 teaspoon) baking soda buttered pan</td>
<td>pencil and eraser Objects chosen by students, such as: rubber ball cotton ball orange banana apple paper sticks leaves rocks grass Legos building blocks other objects <strong>Optional</strong> several sheets of paper</td>
</tr>
<tr>
<td>Experiment 2</td>
<td></td>
<td>Optional computer with internet access</td>
<td></td>
<td></td>
</tr>
<tr>
<td>imagination</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Experiment 7</th>
<th>Experiment 8</th>
<th>Experiment 9</th>
<th>Experiment 10</th>
<th>Experiment 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>tincture of iodine [VERY POISONOUS—DO NOT ALLOW STUDENTS TO EAT any food items that have iodine on them] bread, 1 slice timer wax paper marking pen cup refrigerator green vegetable, 1 one or more other vegetables</td>
<td>pencil colored pencils or crayons student-selected materials to build a model cell</td>
<td>dehydrated agar powder* distilled water cooking pot measuring spoons measuring cup cup plastic petri dishes (20)** cotton swabs permanent marker oven mitt or pot holder tennis ball paperclip yarn or string (about 3 meters [10 ft]) marble bouncing ball, 1 (or 2 or more of different sizes) <strong>Optional</strong> penknife, ice pick, awl, or other sharp tool pliers</td>
<td>tennis ball paperclip yarn or string (about 3 meters [10 ft]) marble bouncing ball, 1 (or 2 or more of different sizes) Slinky several paperclips 1-2 apples 1-2 lemons or limes 1-2 oranges 1-2 bananas spring balance scale or food scale meterstick, yardstick, or tape measure tape</td>
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</tr>
</tbody>
</table>

* [http://www.hometrainingtools.com/nutrient-agar-8-g-dehydrated/p/CH-AGARN08/]  
** A stack of 20 can be ordered from: [http://www.hometrainingtools.com/petri-dishes-plastic-20-pk/p/BE-PETRI20/]
### Experiment 12
- small to medium size toy car
- stiff cardboard
- wooden board, smooth and straight (more than 1 meter [3 feet] long)
- straight pin or tack, several small scale or balance
- one banana, sliced
- 10 pennies
- meterstick, yardstick or tape measure

### Experiment 13
- student-selected materials
- several sheets of paper

### Experiment 14
- pencil, pen, colored pencils
- small jar
- trowel or spoon

**Optional**
- binoculars

### Experiment 15
- known mineral samples: calcite, feldspar, quartz, hematite
- several rocks from backyard or nearby copper penny, steel nail, streak plate (unglazed white ceramic tile), paper, scissors, marking pen, tape, vinegar (small amount), lemon juice (small amount), eyedropper or spoon

* Find minerals at a local rock and mineral store or order online.

### Experiment 16
- Students will select materials and use them to make a model of Earth's layers
- See Experiment 16 for ingredients for chocolate lava cake

### Experiment 17
- student-made brittle candy (see first page of experiment)
- 1 jar smooth peanut butter (for students with allergies to peanuts, whipped cream can be substituted)
- 118 ml (1/2 cup) crushed graham crackers
- plate or second cookie sheet
- materials to make a model volcano of student's choice

### Experiment 18
- pencil
- flashlight
- compass

A clear night sky away from bright lights is needed.

### Experiment 19
- basketball
- ping-pong ball
- flashlight
- empty toilet paper tube
- tape
- scissors
- a dark room
- student-selected objects

### Experiment 20
- modeling clay in the following colors: gray, white, brown, red, blue, green, orange
- butter knife or sculptor's knife
- colored pencils

Materials other than clay can be used, such as Styrofoam balls or plaster of Paris and paint.

### Experiment 21
- modeling clay in the following colors:
  - gray
  - white
  - brown
  - red
  - blue
  - green
  - orange

### Experiment 22
- a video recording device (camcorder, iPad, cell phone)

## Materials
### Quantities Needed for All Experiments

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Foods</th>
<th>Foods (continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td>baking pan</td>
<td>apples, 2-3</td>
<td></td>
</tr>
<tr>
<td>ball, bouncing, 1 (or 2 or more of different sizes)</td>
<td>baking soda</td>
<td></td>
</tr>
<tr>
<td>ball, ping-pong</td>
<td>bananas, 3-4</td>
<td></td>
</tr>
<tr>
<td>ball, rubber</td>
<td>bread, 1 slice</td>
<td></td>
</tr>
<tr>
<td>ball, tennis</td>
<td>brittle candy, student-made (see Experiment 17)</td>
<td></td>
</tr>
<tr>
<td>basketball</td>
<td>corn syrup, white, 240 ml (1 cup)</td>
<td></td>
</tr>
<tr>
<td>car, toy, small to medium size</td>
<td>egg whites, 2 or more</td>
<td></td>
</tr>
<tr>
<td>compass</td>
<td>graham crackers, crushed, 118 ml (1/2 cup)</td>
<td></td>
</tr>
<tr>
<td>computer with internet access</td>
<td>lemon juice</td>
<td></td>
</tr>
<tr>
<td>cookie sheet or plate</td>
<td>lemons or limes, 1-2</td>
<td></td>
</tr>
<tr>
<td>cup, 1</td>
<td>oranges, 2-3</td>
<td></td>
</tr>
<tr>
<td>eye dropper</td>
<td>marshmallows, small, colored, 1 pkg</td>
<td></td>
</tr>
<tr>
<td>flashlight</td>
<td>marshmallows, large, 1 pkg</td>
<td></td>
</tr>
<tr>
<td>jars, small, 7 or more</td>
<td>(could also use gumdrops and/or jellybeans in place of marshmallows)</td>
<td></td>
</tr>
<tr>
<td>knife, butter or sculptor’s knife</td>
<td>milk</td>
<td></td>
</tr>
<tr>
<td>Legos</td>
<td>peanuts, raw, 360 ml (1 1/2 cups) (can be omitted)</td>
<td></td>
</tr>
<tr>
<td>marble, 1</td>
<td>peanut butter, 1 jar smooth, (for students with allergies to peanuts, whipped cream can be substituted)</td>
<td></td>
</tr>
<tr>
<td>measuring cups and spoons</td>
<td>salt, 15-30 ml (1-2 tbsp.)</td>
<td></td>
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<tr>
<td>meterstick, yardstick, or tape measure</td>
<td>sugar, 360 ml (1 1/2 cups)</td>
<td></td>
</tr>
<tr>
<td>nail, steel</td>
<td>vegetables, 1 green and students’ choice</td>
<td></td>
</tr>
<tr>
<td>oven mitt or pot holder</td>
<td>vinegar</td>
<td></td>
</tr>
<tr>
<td>pennies, copper, 10</td>
<td>balsamic vinegar</td>
<td></td>
</tr>
<tr>
<td>pot, cooking</td>
<td>water</td>
<td></td>
</tr>
<tr>
<td>refrigerator</td>
<td><a href="#">See Experiment 16 for ingredients needed for chocolate lava cake.</a></td>
<td></td>
</tr>
<tr>
<td>ruler</td>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>scale, spring balance or food scale</td>
<td>food coloring</td>
<td></td>
</tr>
<tr>
<td>scissors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slinky</td>
<td></td>
<td></td>
</tr>
<tr>
<td>stove</td>
<td></td>
<td></td>
</tr>
<tr>
<td>streak plate (unglazed white ceramic tile)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>timer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>trowel (garden) or spoon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>video recording device (camcorder, iPad, cell phone)</td>
<td></td>
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</tr>
</tbody>
</table>

**Optional**
- binoculars
- penknife, ice pick, awl, or other sharp tool
- pliers
## Materials

**Quantities Needed for All Experiments**

<table>
<thead>
<tr>
<th>Materials</th>
<th>Materials (continued)</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>agar powder* (dehydrated)</td>
<td>paper, several sheets</td>
<td>clear night sky away from bright lights</td>
</tr>
<tr>
<td>birth certificate</td>
<td>paperclips, several</td>
<td>a dark room</td>
</tr>
<tr>
<td>board, wooden, smooth and straight (more than 1 meter [3 feet] long)</td>
<td>pen, marking</td>
<td>resources (books or online) such as:</td>
</tr>
<tr>
<td>cardboard, stiff</td>
<td>pencil</td>
<td>dictionary</td>
</tr>
<tr>
<td>clay, modeling in the following colors</td>
<td>pencils, colored or crayons</td>
<td>encyclopedia</td>
</tr>
<tr>
<td>blue</td>
<td>periodic table of elements from <em>Student Textbook</em></td>
<td></td>
</tr>
<tr>
<td>brown</td>
<td>petri dishes, plastic (20)***</td>
<td></td>
</tr>
<tr>
<td>gray</td>
<td>photos, family</td>
<td></td>
</tr>
<tr>
<td>green</td>
<td>rocks, several</td>
<td></td>
</tr>
<tr>
<td>orange</td>
<td>sticks</td>
<td></td>
</tr>
<tr>
<td>red</td>
<td>straight pin or tack, several</td>
<td></td>
</tr>
<tr>
<td>white</td>
<td>tape</td>
<td></td>
</tr>
<tr>
<td>cotton ball, several</td>
<td>toilet paper tube, empty</td>
<td></td>
</tr>
<tr>
<td>cotton swabs</td>
<td>toothpicks, 1 box</td>
<td></td>
</tr>
<tr>
<td>documents, family</td>
<td>water, distilled</td>
<td></td>
</tr>
<tr>
<td>eraser</td>
<td>wax paper</td>
<td></td>
</tr>
<tr>
<td>food labels, several (students’ choice)</td>
<td>yarn or string (about 3 meters [10 ft])</td>
<td></td>
</tr>
<tr>
<td>grass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iodine, tincture of [<strong>VERY POISONOUS—DO NOT ALLOW STUDENTS TO EAT</strong> any food items that have iodine on them]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>leaves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mineral samples**:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>calcite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>feldspar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hematite</td>
<td></td>
<td></td>
</tr>
<tr>
<td>quartz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Find minerals at a local rock and mineral store or order online.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>misc. model building materials - students’ choice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>objects, misc. student-chosen</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* http://www.hometrainingtools.com/nutrient-agar-8-g-dehydrated/p/CH-AGARN08/

** A Mineral Scale of Hardness Set of Minerals is available from Home Science Tools: http://www.hometrainingtools.com

*** A stack of 20 can be ordered from: http://www.hometrainingtools.com/petri-dishes-plastic-20-pk/p/BE-PETRI20/
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Materials Needed

• food labels, several (students’ choice)
• periodic table of elements from Student Textbook
• resources (books or online) such as:
  dictionary
  encyclopedia

Optional

• computer with internet access (optional)
Objectives

In this experiment students will be introduced to the concept that all things are made of atoms and will begin to explore the periodic table of elements.

The objectives of this lesson are for students to:

- Understand that atoms, or elements, are the fundamental components of all things.
- Discover that each type of atom has specific properties.

Experiment

I. Think About It

Read this section of the Laboratory Notebook with your students.

Ask questions such as the following to guide open inquiry.

- Do you think all atoms are the same? Why or why not?
- Do you think some atoms are the same? Why or why not?
- Do you think it is possible to tell one atom from another? How would you do it?
- Do you think you can find out what properties a particular atom has? Why or why not?
- How would you find out what your food is made of?
- How would you find out what other things are made of?

II. Experiment 3: What Is It Made Of?

Have the students read the entire experiment.

Objective: An objective is provided for this experiment:

Hypothesis: Have the students write a hypothesis. Some examples:

- Food labels can be used to tell what is in food.
- I can find out what things are made of.
- I can use the periodic table of elements to tell me about atoms.
**EXPERIMENT**

1. Answers to the questions:

   A. Protons in aluminum: 13  
      Electrons in aluminum: 13

   B. Symbol for carbon: C

   C. The elements that have chemical properties similar to helium are neon, argon, krypton, xenon, and radon.

      Elements that have the same chemical properties as helium are in the same column in the periodic table.

   D. Atomic weight of nitrogen: 14.0067  
      Number of neutrons in nitrogen: 7

2. A table is provided for students to record information they discover about the makeup of items of their choice.

   The goals of this experiment are to help students begin to investigate the things in their world and to have them start to examine what those things are made of.

   There are many possible answers for this experiment. Students will begin to think about what substances are made of and how they are produced. By using basic resources such as the dictionary or encyclopedia, they may not be able to find the elemental composition of all the items they think of.

   Some examples of answers are the following:

   Things made of metals:
   - soda cans and aluminum foil - aluminum
   - silverware (steel) - iron, nickel, silver
   - coins - copper, nickel
   - jewelry - gold, silver

   Things we eat:
   - salt - sodium and chlorine
   - sugar - carbon, oxygen, hydrogen
   - water - hydrogen and oxygen
   - bread (carbohydrates) - carbon, oxygen, hydrogen, other proteins, and other substances

   Also, students can select food items with labels, such as cake mixes, cereal, noodles, and vitamins (with vitamins the label is very detailed so students can also find out how much of something is in the vitamin).
Students DO NOT need to find every component for each item. To say that a cake mix contains salt, flour, and sugar is enough. Let the students go as far as they want to with a particular item. Also, it is not necessary to look up components for each item the students think of. Have them pick a few items they are interested in researching and go from there.

Some examples of information that may be gathered:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>COMPOSITION</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>graham crackers</td>
<td>sodium bicarbonate (sodium)</td>
<td>food label</td>
</tr>
<tr>
<td>graham crackers</td>
<td>salt (sodium, chlorine)</td>
<td>food label, dictionary - page 1600</td>
</tr>
<tr>
<td>car tires</td>
<td>rubber (carbon and hydrogen)</td>
<td>Wikipedia (or <a href="http://www.wikipedia.org">www.wikipedia.org</a>)</td>
</tr>
</tbody>
</table>

Results

Students will describe what they discovered about the composition of the items they researched.

Help the students write accurate statements about the data they have collected. Some examples:

- Kellogg’s Sugar Smacks™ cereal contains vitamin C, which is called sodium ascorbate.
- Table salt is made of sodium and chlorine.
- Iodized table salt contains sodium, chlorine, and iodine.
- Chocolate cake mix contains sugar.
- Sugar has oxygen, hydrogen, and carbon in it.

Next, help the students think specifically about what their data show. This is an important critical thinking step that will help them evaluate future experiments.

III. Conclusions

Have the students review the results they recorded for the experiment. Have them draw conclusions based on the data they collected.

Help them write concluding statements that are valid. Encourage them to avoid stating opinions or any conclusions that cannot be drawn strictly from their data.

For example, it may be true that all cereals contain salt. However, this particular investigation cannot confirm or deny that conclusion. The most that can be stated from this investigation is “Brand X contains salt and Brand Y contains salt,” but any further statement is conjecture.

Help them formulate their conclusions using the words some, all, many, and none. Point out that the statement, “All cereals contain salt,” is not valid, but based on this investigation, it is valid to say, “Some cereals contain salt.”
Again, there are numerous possible answers. One student may list “sugar” as a component in soup, and another may list “salt,” and both answers could be correct. The true test is whether the statements about the data are valid or not valid.

Also, try to show students where broad statements can be made validly. For example, “All recent U.S. pennies contain copper” is probably a valid statement even though we haven’t checked every U.S. penny.

This may seem fairly subtle, but the main point is to help them understand the kinds of valid conclusions science can offer based on scientific investigation.

IV. Why?

Read this section of the Laboratory Notebook with your students. Discuss any questions that might come up.

V. Just For Fun

Students are to select one item from their list and do research to find out as much as they can about how it was made, where it was made, and where the different components might have come from.
Experiment 7

What’s in Spit?

Materials Needed

- tincture of iodine [VERY POISONOUS—DO NOT ALLOW STUDENT TO EAT any food items that have iodine on them]
- bread, 1 slice
- timer
- wax paper
- marking pen
- cup
- refrigerator
- a green vegetable
- one or more other vegetables or fruits
Objectives

In this experiment students will observe a chemical reaction in part of the metabolic process.

The objectives of this lesson are for students to:

- Observe evidence of a chemical reactions that happens in the body.
- Observe how the process of digestion of food begins.

Experiment

I. Think About It

Read this section of the Laboratory Notebook with your students.

Ask questions such as the following to guide open inquiry.

- How do you think your body digests food?
- Why do you think food needs to be chewed?
- Why do you think you have saliva in your mouth?
- Do you think your body could digest food if you didn’t have saliva? Why or why not?
- Do you think digestion requires chemical reactions? Why or why not?
- Do you think chemical reactions happen in your mouth? Why or why not?

II. Experiment 7: What’s in Spit?

In this experiment students will investigate the part of the digestive process carried out by proteins in saliva. Have the students read the experiment before writing an objective and hypothesis.

EXPERIMENT

An example **Objective:** We will investigate what saliva does to bread.

An example **Hypothesis:** We will be able to test changes in the bread by using iodine.

1. Have the students break the bread into several small (bite size) pieces.

2. Students will chew one piece of bread for 30 seconds, another piece for 1 minute, and a third for several minutes. Have them set a timer for each.
3. After each chewing time is up, have the students spit the chewed bread onto a piece of wax paper and use a marker to record the length of time it was chewed.

4. Have the students place one small piece of unchewed bread next to each piece of chewed bread.

5. Have the students put a drop of iodine on each of the pieces of bread, both chewed and unchewed.

6. Have them record their results in the chart provided. They should observe that the color resulting from the iodine reacting with the bread that has been chewed for longer times is not as black as with unchewed bread or bread that has not been chewed as much.

7. Have the students collect saliva by spitting into a cup several times. Then they will take two small pieces of bread and soak both in the saliva. They can add more saliva to the cup if needed.

8. Have the students place each piece of soaked bread on a separate piece of wax paper and put one in the refrigerator and leave one out at room temperature.

9. After 30 minutes, have the students test each piece of bread by putting a drop of iodine on each.

10. Have them record their results. The refrigerated bread should turn more black than the unrefrigerated bread because the cold temperature slows the chemical reaction.

### III. Conclusions

Have the students review the results they recorded for the experiment. Have them draw conclusions based on the data they collected.

### IV. Why?

Read this section of the *Laboratory Notebook* with your students. Discuss any questions that might come up.

### V. Just For Fun

Have the students repeat the experiment with celery, kale, or another green vegetable. The iodine should not change color. Have them test one or more other vegetables or fruits. Following are some expected results, but any vegetables or fruits can be tested:

- **Color change:** apple, banana, pasta, potato, yam
- **No color change:** celery, kale, spinach, green bell pepper

Have the students draw conclusions from their results.
Experiment 19

Lunar and Solar Eclipses

Materials Needed

- basketball
- ping-pong ball
- flashlight
- empty toilet paper tube
- tape
- scissors
- a dark room
- student-selected objects
Objectives

By modeling lunar and solar eclipses, students will explore Earth and its interaction with the Moon and the Sun.

The objectives of this lesson are to have students:

- Learn about the relative positions and orbits of the Earth, Sun, and Moon.
- Observe how using a model can help with understanding Earth and its position in space.

Experiment

I. Think About It

Read this section of the Laboratory Notebook with your students.

Ask questions such as the following to guide open inquiry:

- Do you think you think a lunar eclipse happens every time there is a full moon? Why or why not?
- If a solar eclipse is happening, do you think it can be seen from anywhere on Earth? Why or why not?
- Do you think lunar eclipses tell you anything about the Earth and the Moon? Why or why not?
- What do you think a lunar eclipse would look like if Earth were square?
- What do you think a solar eclipse would look like if the Moon were square?

II. Experiment 19: Lunar and Solar Eclipses

In this experiment students will use a basketball, ping-pong ball, and flashlight to model how lunar and solar eclipses occur.

Have the students read the entire experiment.

Objective: Have the students write an objective. For example:

- To examine the difference between lunar and solar eclipses.

Hypothesis: Have the students write a hypothesis. For example:

- The ping-pong ball must be in direct alignment with the flashlight to make a shadow on the basketball.
EXPERIMENT

The objective of the experiment is for the students to see how a shadow is cast by an object passing between either the Moon and the Sun or the Earth and the Sun. This exercise can be performed by more than one student at a time, with the basketball, flashlight, and ping-pong ball each held by a student.

1. In a dark room, students will place the basketball on one end of an upright empty toilet paper tube.

2. Have students shine a flashlight on the basketball from several feet away. Then they will place the flashlight on the floor so that it still shines on the basketball.

3. Have the students hold the ping-pong ball between the flashlight and the basketball so that a shadow is cast on the basketball.

   It may take some time to find the location of the ping-pong ball that will result in a shadow falling on the basketball. Have the students note where they must place the ping-pong ball in respect to the flashlight in order to create a shadow. The ping-pong ball cannot be too high or too low, but needs to be in direct alignment with the flashlight.

4. - 5. Have the students move the ping-pong ball upward and then downward until no shadow is cast on the basketball in either position.

6. Students will now move the ping-pong ball around the basketball to model the orbit of the Moon around the Earth. Have them observe where the ping-pong ball needs to be in order for the basketball to cast a shadow on the ping-pong ball and where the ping-pong ball needs to be to cast a shadow on the basketball. Also have them note the position of the ping-pong ball when no shadows are cast.

Results

Have the students repeat Step 6 several times, making different orbits. Have them draw and label the results of several orbits, noting the position of the balls and where and whether shadows were cast. An example follows.
III. Conclusions

Have the students review the results they recorded for the experiment. Have them draw conclusions based on the data they collected.

IV. Why?

Read this section of the Laboratory Notebook with your students. Discuss any questions that might come up.

V. Just For Fun

Students can do both Part A and Part B or choose one.

Part A: Students will use the same experimental setup to model how day and night occur on the Moon. Have the students put a mark on the ping-pong ball to identify the side of the Moon that always faces Earth and have them observe how light travels around the surface of the “Moon,” creating day and night.

Part B: Students are to think of different configurations of planet(s), moon(s), and sun(s) that might occur in different solar systems. They can either use their experimental setup to make models or do this as a thought experiment with words and drawings. Encourage them to come up with changes of their own. Let them use their imagination freely even if you know their ideas are improbable. Have them record their results.
Exploring The Building Blocks of Science

Book 5
Lesson Plan

Rebecca W. Keller, PhD
LESSON PLAN INSTRUCTIONS

This Lesson Plan is designed to accompany Exploring the Building Blocks of Science Book 5 Student Textbook, Laboratory Notebook, and Teacher’s Manual. It is designed to be flexible to accommodate a varying schedule as you go through the year’s study. And it makes it easy to chart weekly study sessions and create a portfolio of your student’s yearlong performance. The PDF format allows you to print pages as you need them.

This Lesson Plan file includes:

• Weekly Sheets
• Self-Review Sheet
• Self-Test Sheet
• Sticker Templates

Materials recommended but not included:

• 3-ring binder
• Indexing dividers (3)
• Labels—24 per sheet, 1.5” x 1.5” (Avery 22805)

Use the Weekly Sheets to map out daily activities and keep track of student progress. For each week you decide when to read the text, do the experiment, explore the optional connections, review the text, and administer tests. For those families and schools needing to provide records of student performance and show compliance to standards, there is a section on the Weekly Sheets that shows how the content aligns to the National Science Standards.

To use this Lesson Plan:

• Print the Weekly Sheets
• Print Self-Review Sheets
• Print Self-Test Sheets
• Print the stickers on 1.5” x 1.5” labels
• Place all the printed sheets in a three-ring binder separated by index dividers

At the beginning of each week, use the squares under each weekday to plan your daily activities. You can attach printed stickers to the appropriate boxes or write in the daily activities. At the end of the week, use the Notes section to record student progress and performance for that week.
Here is a sample of a normal week.

The recommended sequence is:
1. Read the student textbook on the first day.
2. Do the laboratory experiment on the second day.
3. Pick one or more connections to explore on the third day.
4. Do the self-review sheet on the fourth day.
5. Administer the self-test or another exam on the fifth day.

Here is a sample of a week with other activities:

1. Find at least one day to READ the text.
2. Find a day to perform the EXPERIMENT.
3. Find a day to do the REVIEW or TEST.

Any activity that is missed can be rescheduled for the following week. However, keep to the main sequence of reading the text, doing the experiment, and reviewing what has been covered. If an activity needs to be missed, choose the CONNECTIONS or SELF-TEST.
**LESSON PLAN — Exploring the BUILDING BLOCKS of SCIENCE BOOK 5**

**CHAPTER 3: MATTER**

<table>
<thead>
<tr>
<th>Week ___________</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
</table>

**Objectives**

- To have students explore matter and the atom.

**Educational Standard***

- Content Standard B: Physical Science: Grade 5-8
  - Matter is made of atoms and atoms are composed of protons, neutrons, and electrons.


**Activity**

- □ Laboratory Experiment 3
- □ Other _____________________

**Connections**

- □ History  
  - Look up the history of the atom. When was the idea for the atom first proposed, and when was this idea supported by scientific evidence? Create a timeline to explain.

- □ Philosophy  
  - Explain how ideas about the atom were challenged by different philosophers.

- □ Art, Music, Math  
  - Discuss how the note is the basic building block for music.

- □ Technology  
  - Look up the instrument called the **scanning tunneling microscope** and discuss how this instrument can visualize atoms.

- □ Language  
  - Look up the word **element** in a dictionary or encyclopedia. Discuss the meaning of the word **element** as it applies to states of matter.

**Assessment**

- □ Self-review
- □ Self-test
- □ Other _____________________

**Notes**
# Lesson Plan — Exploring the Building Blocks of Science Book 5

## Chapter 7: The Chemistry of Life

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

### Objectives
- To introduce students to the basic chemistry of living things.

### Educational Standard*
- Content Standard C: Life Science: Grade 5-8
  Organisms have different structures (and molecules) that serve different functions for survival.


### Activity
- □ Laboratory Experiment 7
- □ Other _____________________

### Connections
- □ History Explore the history of biochemistry. When did scientists first start looking at the molecules that drive living things?
- □ Philosophy Explore how reductionism (the idea that something can be defined by its parts) has shaped the way we think about life.
- □ Art, Music, Math Explore how illustrations and movies about cells help us understand how they work.
- □ Technology Discuss how modern technology has helped us isolate and study different molecules in living things.
- □ Language Look up the word metabolism in a dictionary or encyclopedia. Discuss the meaning of the word metabolism.

### Assessment
- □ Self-review
- □ Self-test
- □ Other _____________________

### Notes
LESSON PLAN — Exploring the BUILDING BLOCKS of SCIENCE BOOK 5

CHAPTER 19: EARTH IN SPACE

Week ___________

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

☐ Objectives  To introduce students to the Earth's place in space.

☐ Educational Standard*  

Content Standard D: Earth and Space Science: Grade 5-8  
Earth is the third planet from the Sun in a system that includes the Moon and seven other planets.


Activity

☐ Laboratory Experiment 19
☐ Other _____________________

Connections

☐ History  Explore how our understanding of Earth as a spherical shape was confirmed in modern times.

☐ Philosophy  Explore how misconceptions about Earth's shape could easily occur (e.g., Because Earth is so large, it seems flat).

☐ Art, Music, Math  Discuss how math helps us divide our time into years, months, days, hours, minutes, and seconds.

☐ Technology  Discuss how modern technology has helped us measure Earth's rotation.

☐ Language  Look up the word obliquity in a dictionary or encyclopedia. Discuss the meaning of the word obliquity.

Assessment

☐ Self-review
☐ Self-test
☐ Other _____________________

Notes
SELF-REVIEW

Think about all of the ideas, concepts, and facts you read about in this chapter. In the space below, write down everything you’ve learned.

Date _______________  Chapter ________________________________

__________________________________________________________________________

__________________________________________________________________________

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__________________________________________________________________________
Imagine you are the teacher and you are giving your students an exam. In the space below, write 5 questions you would ask a student based on the information you learned in this chapter.
READ

REVIEW

EXPERIMENT

CONNECTIONS

TEST

READ
Welcome to your study notebook

This notebook is your place to record anything you want as you learn about atoms, forces, rivers, stars, plants, molecules, viruses, volcanoes and all the other amazing facts and concepts we call science.

There are questions and suggestions. Some are serious and some are whimsical. If you don’t like them, cross them out and create your own.

Just explore what you think about all the topics you are learning and try not to get too worried about writing down the “right” answers. This is an opportunity for you to explore what YOU like.

There are places in this notebook that are unscripted and have little instruction. There are also questions that just dangle on the edges of the page. That’s OK. Just record, draw, or paste images that you think apply. Add extra pages as you like. Answer the questions and suggestions in a way that makes the most sense to you. Most of real science is unscripted and making discoveries has no set of instructions. Just play with it. You’ll be fine and you might find out something unexpected and amazing.

This notebook is not meant to be graded. So parents and teachers, just let it go. Don’t grade this notebook or make your student “turn it in.” If your student wants to share all they are learning great! If not, let that be OK too.
CHAPTER III

Draw an atom the way you understand it.
Pick two elements of the periodic table. Research everything about those elements and record below what you discover.

**Element:**

**Element:**
Choose one of the elements you researched. What is something you can make with this element? What other elements do you need?

**Element:**

**Thing:**

Outline your process for creating this thing.

*What do you need?*
Draw the thing! Label its features!

Can you explain why your element is used to create the thing you designed?
CHAPTER VII

Write a story about molecular machines.
Think of the cell as being like a factory. Make a map of the cell as if it were a factory. Include each of its workers and details about its purpose.
Why does a cow need the sun?

Would you rather be....

an Energy Molecule

or

a Molecular Machine

a Structural Molecule
CHAPTER XIX

Do we live on the back of a wanderer?

Draw the Sun and Earth together as they are in space.
Create a chart of the Lunar cycles. (moon's rotation)
What is the story of the Moon and the Sea?

Who is Maria?
Building Blocks of Science Book 5
Midterm 1 Chapters 1-11, 30 questions, 10 points each
Sample questions Chapters 3 & 7

4. The atomic weight of an atom is... (10 points)
   ○ Too tiny to be detected.
   ○ Very close to the sum of the number of electrons and protons available for bonding.
   ○ Not useful.
   ○ Equal to the number of electrons.
   ○ Very close to the sum of the number of protons and neutrons.

5. In an atom, the atomic number is... (10 points)
   ○ The number of protons in the nucleus.
   ○ Equal to the atomic weight.
   ○ The sum of the number of protons, neutrons, and electrons in the atom.
   ○ The number of atoms in a molecule.
   ○ A randomly assigned consecutive number used to put atoms in order.

6. In an atom the number of electrons always equals the number of neutrons. (10 points)
   ○ True
   ○ False

16. Match the term with its description. (10 points)

   _____ Metabolism
   a. The conversion of energy into food.

   _____ Metabolic pathway
   b. The conversion of food into energy.

   _____ Glycolysis
   c. The order that must be followed by chemical reactions in cells, with one chemical reaction leading to another.

   _____ Photosynthesis
d. All of the chemical processes your body uses to stay alive.

17. Check the statements that are true for proteins. (10 points)
   ○ Proteins have no jobs to do in a cell, they just provide structure.
   ○ Proteins perform a wide variety of jobs for the cell.
   ○ A protein is a special type of biological molecule made of long chains of molecules that can fold into a variety of shapes.
   ○ If a protein does not fold properly, it won't function.
   ○ Proteins never contain atoms from the HCNOPS group.

18. A plant cell has a stiff outer wall made of cellulose, and an animal cell has a lipid bilayer cell membrane that holds the cell together. (10 points)
   ○ True
   ○ False
Building Blocks of Science Book 5
Midterm 1 Chapters 1-11, 30 questions, 10 points each
Sample questions Chapters 3 & 7

4. Very close to the sum of the number of protons and neutrons.

5. The number of protons in the nucleus.

6. False

16. d, c, b, a

17. Proteins perform a wide variety of jobs for the cell. A protein is a special type of biological molecule made of long chains of molecules that can fold into a variety of shapes. If a protein does not fold properly, it won’t function.

18. True
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Midterm 2 Chapters 12-22, 30 questions, 10 points each
Sample questions Chapter 19

22. Which statements about the Sun are true? (10 points)
- Works like a candle.
- A celestial body in space.
- Orbits the Earth.
- Gives us energy in the form of light and heat.
- Affects tides, weather, and the magnetic field.
- Provides Earth with power.
- Has no effect on Earth's weather.

23. A lunar eclipse can occur when... (10 points)
- The Moon passes between the Sun and the Earth.
- All the planets are lined up correctly.
- The green cheese gets moldy.
- The Moon passes directly behind the Earth.
- The new moon starts to get old.

24. The seasons occur because... (10 points)
- Earth is tilted on its axis causing either the North Pole or the South Pole to get more sun depending on where Earth is in its orbit.
- Earth spins on its axis.
- Earth's orbit brings it closer to and farther from the Sun, making Earth warmer and cooler.
- Solar winds cool the Earth as they blow past.
- Eclipses block heat from the Sun.

Answer Sheet

Building Blocks of Science Book 5
Midterm 2 Chapters 12-22, 30 questions, 10 points each
Sample questions Chapter 19

22. A celestial body in space., Gives us energy in the form of light and heat., Affects tides, weather, and the magnetic field., Provides Earth with power.

23. The Moon passes directly behind the Earth.

24. Earth is tilted on its axis causing either the North Pole or the South Pole to get more sun depending on where Earth is in its orbit.
Building Blocks of Science Book 5
Final Quiz Chapters 1-22, 40 questions, 10 points each
Sample questions Chapters 3, 7, 19

3. The periodic table of elements: (Check all that apply.) (10 points)
   - Is no longer used because Mendeleev devised it in 1869.
   - Is arranged according to the chemical properties of the elements.
   - Shows the atomic weight of each element.
   - Is organized by atomic number, the number of protons in the nucleus of the element.
   - A chart used by chemists that categorizes the elements (atoms) and shows their characteristics.
   - Is organized in a logical manner but does not help chemists predict how different elements will interact.

4. Protons, neutrons, and electrons make up an atom, with protons having a positive charge, neutrons having no charge, and electrons having a negative charge. (10 points)
   - True
   - False

11. Match the term with its description. (10 points)

   _____ Energy molecules
   a. Provide energy for chemical reactions.

   _____ Structural molecules
   b. Atoms that make up most biological molecules.

   _____ Molecular machines
   c. Hold different parts of the cell together.

   _____ Information and storage molecules
   d. Give the cell instructions for how to grow and when to die.

   _____ HCNOPS group
   e. Move other molecules, break down unwanted molecules, and make molecules.

12. DNA and RNA... (10 points)
   - Do not provide any information for the cell to know what function to perform.
   - Are exactly the same as each other.
   - Are special types of biological molecules that are used by the cell to store and transfer information.
   - In plants, are used to collect sunlight for photosynthesis.
   - Are not used very much by cells.
35. Match the term with its description. (10 points)

_____ Full moon
   a. The imaginary line around which the Earth rotates.

_____ Orbital obliquity
   b. Occurs when the Moon is on the opposite side of Earth from the Sun.

_____ Northern and southern lights
   c. Gives us the seasons.

_____ New moon
   d. Caused by solar storms that charge particles in space.

_____ Moon
   e. Occurs when the Moon is between the Earth and the Sun.

_____ Axis
   f. A celestial body that orbits a planet.

36. To be classified as a planet, a celestial body... (Check all that apply.) (10 points)
   - Must orbit a sun.
   - Must be made of rock, like Earth.
   - Must have cleared its orbit (has no other celestial bodies in the same orbit with it).
   - Must have enough mass to have its own gravity.
   - Must not be in a solar system.
   - Must have life on it.
Building Blocks of Science Book 5
Final Quiz Chapters 1-22, 40 questions, 10 points each
Sample questions Chapters 3, 7, 19

3. Is arranged according to the chemical properties of the elements., Shows the atomic weight of each element., Is organized by atomic number, the number of protons in the nucleus of the element., A chart used by chemists that categorizes the elements (atoms) and shows their characteristics.

4. True

11. a, c, e, d, b
12. Are special types of biological molecules that are used by the cell to store and transfer information.

35. b, c, d, e, f, a
36. Must orbit a sun., Must have cleared its orbit (has no other celestial bodies in the same orbit with it), Must have enough mass to have its own gravity.