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LESSON 1

WHAT IS ASTRONOMY?



wisdom from above

There is order to our universe, and once you start to understand that order, science will not be a class, but rather a means to recognize your Creator's signature throughout creation.

For since the creation of the world His invisible attributes, His eternal power and divine nature, have been clearly seen, being understood through what has been made, so that they are without excuse.

Romans 1:20



Welcome

When you look up at the night sky, what do you see? Everything that you can see around you and up in the sky, and even things that you *can't* see, are part of our universe. The universe is everything that exists! That includes all of the planets (even Earth), stars, galaxies, and intergalactic space.

*Isn't God as high as the heavens?
And look at the highest stars—how lofty they are!*
Job 22:12

The study of outer space is called **astronomy** (uh strahn' uh me). The word *aster* means star, while *onomy* means knowledge of. The word *astronomy*, then, means knowledge of the stars. Many years ago, the only word used for every object in outer space was *aster* or star. In other words, every light in the night sky was called a star. We still use the word *astronomy* to talk about the study of everything in space, even though the way we use it today means more than just studying the stars.

*There is one glory of the sun, and another glory of the moon, and another glory of the stars;
for star differs from star in glory.* 1 Corinthians 15:41

An **astronomer** is someone whose job is to study the stars, the planets, and everything else in outer space. You are going to be an amateur (beginner) astronomer this year because you will be studying the universe as you take this course.



The Night Sky

Have you ever been out in the countryside at night far away from city lights? On a clear night in the countryside, you can see many thousands of stars in the sky. It's truly a miraculous sight, and it is called the *Milky Way*. It's the galaxy we live in. At the center of the picture to the right, 2 bright objects are visible. The brightest is the planet Jupiter, while the other is the star Antares. The red laser beam points to the center of our galaxy. You will learn more about our galaxy later in this course.



The night sky on a clear night away from city lights.

think about this

The Bible tells us that God made the stars and Moon to give us light at night and a calendar to follow. He also uses the night sky to give us signs to mark important events. Scientists have also learned that the planets, stars, and many other things in space help to keep life going on Earth.

“Then God said, ‘Let there be lights in the expanse of the heavens to separate the day from the night, and let them be for signs and for seasons and for days and years; and let them be for lights in the expanse of the heavens to give light on the earth’; and it was so.” Genesis 1:14–15



It's easy to confuse planets and stars.

Stars and Planets

Not everything you see in the night sky that shines like a star actually is a star. Some of the brightest objects in the night sky (besides the Moon), for example, are planets. Stars appear to twinkle in the sky, but planets do not twinkle. There are also stars that appear to move rapidly across the sky and then disappear. We call them shooting stars, but they are not stars at all. They are meteors (mee' tee orz). We will talk more about all of these later.

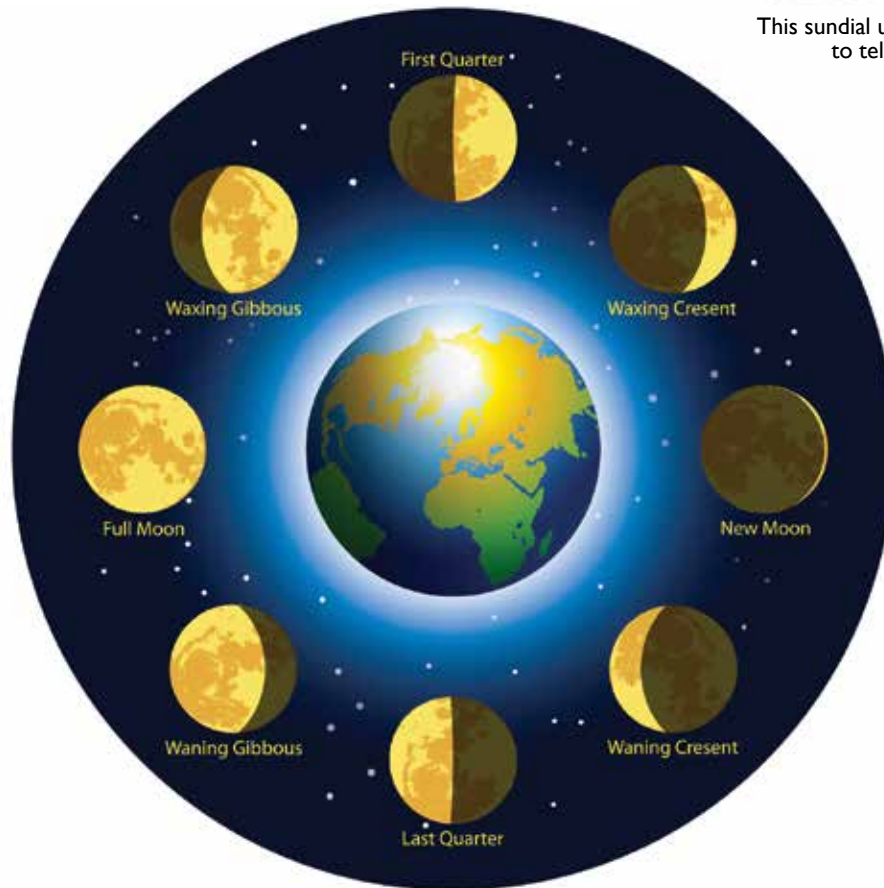
Tell someone in your own words what the universe is. Can you remember what the word *astronomy* means?

Clocks, Calendars, and Seasons

Did you know that the sun, Moon, planets, and stars in the sky help us tell time, create our calendar with days and years, and help us know the timing of the seasons? It's true! Many years ago, before people had clocks and calendars, they told the time of day by the position of a shadow on the ground. They also knew when a month had passed by looking at the shape of the Moon in the night sky.



This sundial uses a shadow to tell time.



Phases of the Moon.



Stonehenge

There is an ancient stone structure in southern England called Stonehenge. Many believe that ancient people used it to tell when spring had arrived. They judged the season by the position of the sun in relation to the large stones that make up the structure. Knowing when the seasons arrive helped them to time the planting and harvesting of crops.





The man-named patterns of stars in the night sky are called **constellations** (kahn' stuh lay' shuns). Ancient people knew which constellations would be in the sky in each season of the year—winter, spring, summer, or fall. They also used the constellations to mark what year it was and how many years had passed since an event. The picture here is very old. It shows the constellations around the central sun. The corners show the 4 turning points of the year. Many years ago, then, before we had calendars in our homes, the night sky marked the passage of time.

Take a moment to tell someone in your own words what you have learned so far. You can use the illustrations to help you remember and to show them examples of what you are talking about.

think about this

A miraculous sign given to man was when God placed a star in the sky over the city of Bethlehem indicating the Savior had come. When wise men from a distant land saw the star, they used the star to navigate their travels to Bethlehem to see and worship Jesus. *“They went their way; and the star, which they had seen in the east, went on before them until it came and stood over the place where the Child was. When they saw the star, they rejoiced exceedingly with great joy. After coming into the house they saw the Child with Mary His mother; and they fell to the ground and worshiped Him. Then, opening their treasures, they presented to Him gifts of gold, frankincense, and myrrh.”* Matthew 2: 9-11

Navigation

A long time ago, the sun, planets, and stars also helped sailors know which direction to sail. This was called **celestial** (suh les' chul) **navigation**. Today sailors use compasses and Global Positioning Systems (GPS). A compass is a device with a needle that always points to the magnetic north. GPS uses satellites in outer space to track your position on Earth. You always know what direction you are going if you have a compass; you know exactly where you are if you have GPS. If you have neither of these, you can still know which direction you are going if you know the positions of the stars!



God's plan for the lights in the sky does not only include mankind.



Astrolabes helped ancient sailors navigate by using the position of the stars.

Scientists have learned that some birds know to fly south for the winter by the constellations. This is called migration. God made a very special way for birds to know when and how to fly south. He created within them a special gift we call **instinct** (in' stinkt). One instinct that God has given birds tells them to look at the constellations to know when to migrate south for the winter and when to migrate back north for the summer. It also tells them how to use the constellations to know which direction they must fly. This is why some birds often fly at night when they migrate.

**Can you explain in your own words about navigating with stars, a compass, and GPS?
Tell someone about the gift of instinct and how some birds use the stars to navigate.
Who else used a star to navigate to a very special event?**

Gravity

Our solar system is made up of the sun, 8 planets and their moons, dwarf planets, asteroids, comets, and meteoroids. Some planets are actually very important to our home planet, Earth. Although their effect is mathematically small, these planets help to fasten Earth in place. They keep Earth from moving too far away from the sun or too close to it. In other words, the planets keep our world steady. You see, the sun pulls on Earth with a force called gravity.



An artist's drawing of our solar system.

Gravity is an invisible force that pulls objects toward each other. When we drop something, it doesn't really fall; it gets pulled down to Earth by gravity. Instead of saying that "it fell," it would be more scientifically correct to say, "It was pulled to Earth." All the planets and their moons have gravity. Larger planets have more gravity than smaller planets.

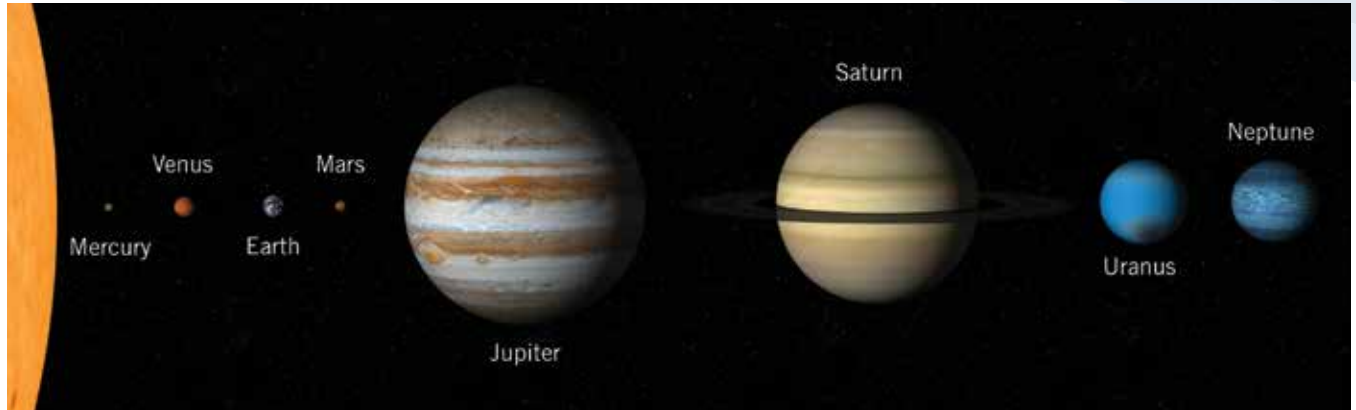
The sun, the largest object in our whole solar system, has the most gravity of all. God placed the planets and sent them to circle (orbit) around the sun at the perfect distance.

If the planet Mercury (mur' kyur ree) were very much closer to the sun, or if the sun were very much larger, Mercury would get pulled into the sun. Instead, it stays exactly where God put it because it has been placed at the right distance from the sun. The pull that planets (and other objects) have on each other is called **gravitational pull**. The sun, Earth, and all of the planets have gravitational pull. Earth's gravitational pull on the Moon keeps the Moon where it is. The Moon's gravitational pull on Earth makes the oceans bulge as it passes by. The sun's gravitational pull keeps the planets in their places in the solar system.

think about this

Isaac Newton was a very important and influential scientist. He once said, "Gravity explains the motions of the planets, but it cannot explain who sets the planets in motion." We must never forget that when we are studying science, we are learning about things of which God already knows because He created them!

Our Solar System



This is a drawing that represents our solar system. Only part of the sun is shown, and each planet is shown along with where it is in relation to the sun. As you can see, Mercury is closest to the sun, while Neptune is farthest from the sun. The relative sizes of the planets are fairly accurate; however, the distance between the planets is not correct.

The 8 planets in our solar system are Mercury, Venus (vee' nus), Earth, Mars, Jupiter, Saturn, Uranus (yur' uh nuhs), and Neptune (nep' toon). This is also the order in which they travel around the sun.

A fun way that many people remember the planets and their order is by using a mnemonic (nih mahn' ik). The first letter of each planet is made into a different word that makes a sentence. Look at this example:

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
My	Very	Educated	Mother	Just	Served	Us	Nachos

Notice that the word underneath each planet begins with the first letter of the planet's name. "My very educated mother just served us nachos" is a silly sentence, but the first letter of each word in that sentence helps you remember the order of the planets.

Activity 1.1

Create Your Own Mnemonic

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
----------------	--------------	--------------	-------------	----------------	---------------	---------------	----------------

For each box below a planet, choose a word that begins with the first letter of that planet. Try to make a sentence that you will remember. It will be easier to remember a sentence that makes sense. You can also have fun creating silly mnemonics. Place them in your notebooking journal.

Can you explain in your own words what you have learned about gravity and the solar system?



An astronaut in a space suit.

Today, a lot of astronomers work for **NASA**. NASA is America's space agency, and it stands for **National Aeronautics and Space Administration**. If you want to be an astronomer when you grow up, you might want to work for NASA. It is also the organization that sends people and spaceships to space. If you like to build and invent things, you could be a NASA engineer. The picture on the next page shows a rocket being built by NASA engineers. See how tiny the engineers at the bottom of the picture are? That gives you an idea of how big the rocket is. Many NASA engineers build spaceships, telescopes, robots, and other useful things for space exploration. As you go through this book, you will learn about NASA spacecraft used to explore the solar system and the universe.

If you become an astronaut, you will probably work for NASA. An **astronaut** is someone who is trained to travel in a spaceship into outer space. Astronauts wear special spacesuits to explore outer space. Maybe one day you will be an astronaut and go to some of the places we will study in this course!

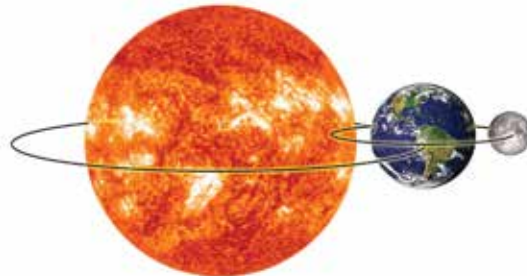
Astronomers and Astronauts

There were many people in history who have helped us understand astronomy better. In the year 1510, a man named **Nicolaus** (nik' oh lus) **Copernicus** (koh pur' nih kus) had the unusual and amazing idea that Earth revolved around the sun. At that time, everyone thought that all the stars and planets revolved around Earth. We now know that Copernicus was correct, even though most people during his time did not believe him.

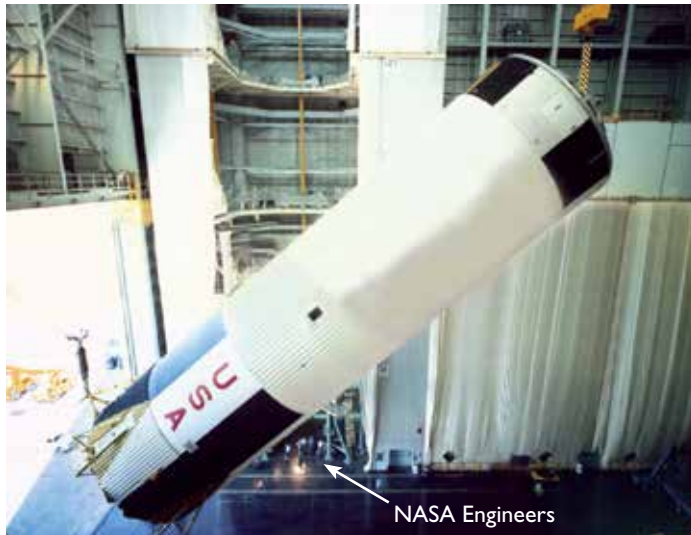
Galileo (gal ih lay' oh) **Galilei** (gal ih lay') was an astronomer who believed Copernicus. He taught how to use telescopes to study the planets and stars, and many of the observations that he made helped scientists understand that Copernicus was right about the sun being at the center of our solar system. Galileo was able to learn a lot of things about our solar system through the wonderful telescopes he built.



In Copernicus's time, everyone thought that Earth was the center of the solar system and that all of the planets and the sun revolved around it.



Copernicus thought that a more elegant arrangement of the solar system would be for the sun to be at the center and for the planets to revolve around the sun.



This is a picture of the *Saturn V* rocket being assembled by NASA engineers. The *V* in *Saturn V* is the Roman numeral 5, which refers to the number of engines in the rocket's first stage.



The Hubble Space Telescope in orbit around Earth.

Have you ever looked through a telescope? You can see a long way off when you do. You will see many pictures that come from telescopes as you study this course. There is an enormous telescope floating up in space that sends pictures back down here to Earth. It is called the Hubble Space Telescope. Even though a telescope will make a planet look like it is much closer, most planets can be seen without a telescope if you know where to look.

Use your own words to tell someone what you know about astronomers and astronauts. Also tell them about NASA and what it does.



NASA has more than a dozen Earth science satellites in orbit. These satellites help NASA scientists study the oceans, land, and atmosphere.

Satellites

Something else you can see in the night sky are satellites. A **satellite** is an object in space that travels in circles around another object. The Moon is a satellite of Earth because it travels in a circle around the planet. So when you are looking up in the sky, you can say, "Oh look! I see a satellite!" as you point at the Moon.

An **artificial satellite** is made by man and sent into space to orbit around Earth. *Artificial* means not natural or something that is made by human hands. Only God makes **natural satellites**. People have sent thousands of artificial satellites to travel around Earth. These satellites do many jobs. Some can look closely at any part of the world and

take pictures for others to see. Some can put a lot more channels on your TV. Some can look at planets and stars far away. Some watch the weather and take pictures so the weatherman can tell us if it is going to rain. Artificial satellites are very important. If you look up into the sky at night and see a small point of light (like a star) that is moving across the sky, you are probably looking at a satellite. You can go to www.apologia.com/bookextras for links to several websites to discover where satellites are above Earth at this very moment. One may even be over your house!

**Can you tell someone what you have learned about satellites?
Are you able to explain the difference between a natural and an artificial satellite?**

Activity 1.2

Build a Model Solar System



Scientists use models to show a concept. The model of the solar system you are going to build will not be to scale, which means that the size of the sun and planets, as well as their distance from each other, will not be exact.

You will need:

- Adult supervision
- Balloons of many sizes and colors
- Construction Paper
- Markers
- Measuring Tape
- Thread, ribbon, or string
- Scissors
- Thumbtacks or tape

You will do:

1. You will start by choosing several balloons, each of which will represent a planet. For each planet, try to choose a balloon with a color that is something like the planet's color. Mercury should be somewhat gray, for example, while Earth should be blue. Use the pictures in this book to help you decide the color for each planet.

(Continued on next page.)

- Once you have chosen a balloon for a planet, slowly blow up the balloon. As you blow it up, measure the distance across the diameter of the balloon at its widest point. Tie the balloon closed when the diameter is close to the number on the chart.

Planet the Balloon Represents	Diameter of the Balloon
Mercury	1 inch
Venus	2 1/2 inches
Earth	2 5/8 inches
Mars	1 3/8 inches
Jupiter	29 1/5 inches
Saturn	25 inches
Uranus	10 5/8 inches
Neptune	10 1/4 inches

NOTE:

If you decide to include the sun, have your student measure 300 inches in order to recognize that the sun's diameter is far larger than any of the planets' diameters.

- If you do not have a long, thin balloon for Saturn's ring, make a circle out of construction paper that will fit around the balloon that represents Saturn.
- Label your planets.
- Tie a string, ribbon, or thread to each balloon, and hang them from the ceiling using thumbtacks or tape. Make sure you hang the balloons in the correct order.



Your solar system model is now complete. Great job!



What Do You Remember?

Why did God create the stars and planets? What are the names of the planets? Do you remember the name of the astronomer who first said that Earth revolves around the sun? What is the name of the astronomer who learned how to study space with a telescope? What is the name of America's space agency and what does it do? What is the difference between a natural and an artificial satellite? What was your favorite part of this lesson?



SUPPLY LIST

Lesson 1

- Adult supervision
- Balloons of many sizes and colors
- Scissors
- Thumbtacks or tape
- Thread, ribbon, or string
- Markers
- Measuring tape (If you do not have a measuring tape, you can use string cut to the lengths listed in the project.)
- Construction paper

Lesson 2

- Adult supervision
- String
- A magnifying glass
- 1 inch pad of butter
- Paper plate
- A flashlight
- A globe (or round ball)
- Small ball (smaller than globe)
- A box
- Scissors
- White paper
- A pin or needle
- Tape
- Aluminum foil

Lesson 3

- Adult supervision
- Small bowl
- Newspaper
- Flour
- Several pebbles of different sizes
- A marble
- A pencil
- 1 T flour
- 1 t salt
- 1 t water
- 1 drop blue food coloring
- 1 drop green food coloring
- 3 drops red food coloring

Lesson 4

- Adult supervision
- 1 T butter or margarine
- 1 T flour
- A small plate
- A Thimble
- Small box
- Strong paper towel
- Tape
- Paper
- 1/4 C water
- 1/4 C flour
- Bamboo skewer (or a long, skinny stick with a point)
- Markers, crayons, or colored pencils
- Ruler (or measuring tape)



Lesson 5

- Adult supervision
- Paper
- Flashlight
- Lamp
- Globe
- A cork
- Permanent marker
- A lid from a yogurt or sour cream container (with high lip.)
- A sewing needle
- A magnet

Lesson 6

- Adult supervision
- Stick
- Lamp
- Lightly-colored ball (like a ping pong ball or white Styrofoam)
- Compact disc (CD)
- 2 magnifying glasses (One should be stronger than the other. Reading glasses will work also.)
- Construction paper
- Tape (Masking tape and duct tape work best.)
- Scissors
- Tape measure
- Paper with writing or an image on it

Lesson 7

- Adult supervision
- Small bowl
- Rocks (optional)
- Alka-Seltzer® tablet
- Red and yellow food coloring
- ½ C flour
- 2 T of salt
- ½ tsp. cooking oil
- 2 T of water

Lesson 8

- Adult supervision
- Paper
- Markers
- Tape
- Large open space

Lesson 9

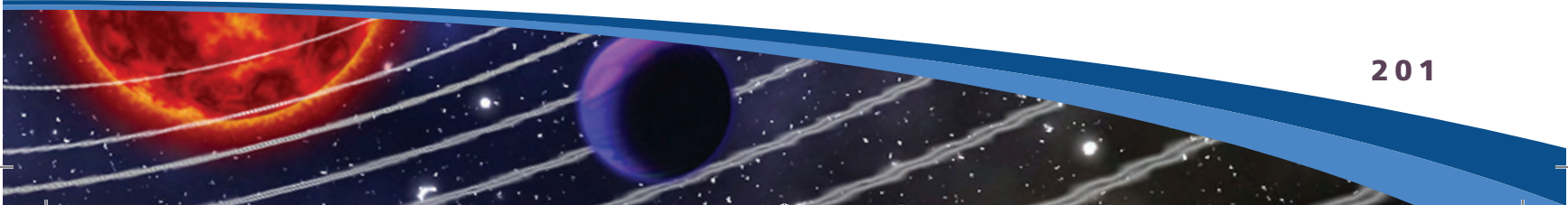
- Adult supervision
- 2 plastic bottles
- Water resistant tape (Electrical or duct tape works best.)
- 1-inch washer
- Water

Lesson 10

- Adult supervision
- Alka-Seltzer® tablets
- Eye protection (such as safety goggles or glasses)
- Empty water bottle
- Water
- Tape
- Paper
- Scissors
- Clay plug
- Paper towel

Lesson 11

- Adult supervision
- A glass jar
- A match
- Ice
- Large Ziploc® bag
- Hot water



Lesson 12

- Adult supervision
- 2 T powdered sugar
- $\frac{1}{2}$ C whipping cream (whole milk or half-and-half will work)
- $\frac{1}{4}$ t vanilla
- 6 T rock salt
- 1 pint-size Ziploc® plastic bag
- 1 gallon-size Ziploc® plastic bag
- Ice cubes

Lesson 13

- Adult supervision
- 2 small balloons
- 10 inches of string
- 2 small rocks (1 inch in diameter)
- Water
- Dirt
- Eye dropper
- Pie plate
- Magnifying glass

Lesson 14

- Adult supervision
- Dark-colored umbrella
- White chalk (or paint)
- Balloon
- Measuring device (such as a ruler or tape measure)
- Cardboard
- Clear plastic wrap
- Tape
- Scissors
- Pen (or marker)

