

LESSON 1 MATERIALS

HOW BIG? HOW FAR? HOW OLD?

THE LESSON IS ON PAGE 7 OF THIS ISSUE. ON OUR WEBSITE, YOU'LL FIND A PRINT-READY RECORD SHEET FOR STUDENTS. GO TO SMITHSONIANEDUCATION.ORG/UNIVERSE.



★ **THE PLEIADES** A CLUSTER OF STARS
IN OUR GALAXY



🦖 **STEGOSAURUS**



☾ **THE MOON**



☀ **THE SUN**



🌀 **THE WHIRLPOOL GALAXY**

THE PLEIADES



SIZE 60 TRILLION MILES ACROSS
DISTANCE 2,400 TRILLION MILES
AGE 100 MILLION YEARS

The Pleiades, or “Seven Sisters,” are visible to the naked eye. The one hardest to see has been called the “Lost Pleiad.” In Greek mythology, she married a mortal, Sisyphus, and forever after hid her face in shame.

IMAGINE that a powerful alien telescope is cruising at the distance of the Pleiades. It has its sights on planet Earth. It is so many light-years away that the planet it sees is our planet in the past. How long in the past?

HINT The speed of light is 6 trillion miles a year.

ANSWER KEY



SUN 8 minutes. **PLUTO** 248 times the difference between the student's age and 16. **MILKY WAY** 200 billion divided by Earth's population (about 7 billion). **PYRAMID** 2.5 tons. **SATURN** 16.5 miles wide. **PLEIADES** 400 years. **HUBBLE** The Earth itself as Hubble orbits it. **MOON** Forever. The timing of the Moon's rotation on its axis and its rotation around Earth means that we never see one side of it. **STEGOSAURUS** One second. **WHIRLPOOL** The Milky Way. It's impossible to get a bird's-eye view of the galaxy in which we live. The picture on the Milky Way card is an artist's rendering. **EARTH** The southern hemisphere or any location therein (Argentina, Australia, etc.).

THE MOON



SIZE 2 THOUSAND MILES DIAMETER
DISTANCE 240 THOUSAND MILES
AGE 4.5 BILLION YEARS

The words *moon* and *month* have the same root. Our months are based on the Moon's orbit around us.

IMAGINE that you are an astronaut who has landed on the far side of the Moon. You know that the Moon revolves around Earth every 29.3 days. And you know that the Moon turns on its axis every 29.3 days. How long would you have to wait to get a look at your home planet?

HINT The far side is sometimes called the “dark side” of the Moon.

STEGOSAURUS



SIZE 14 FEET TALL, 30 FEET LONG
DISTANCE —
AGE 150 MILLION YEARS

Most scientists agree that the dinosaurs died out after an asteroid hit the Earth and drastically changed the climate, 65 million years ago. The asteroid, 6 miles wide, left a crater 90 miles wide. The crater was identified in Mexico in 1990.

IMAGINE that a dinosaur has spotted the asteroid as it enters the atmosphere, 18 miles above the Earth. The asteroid is falling at 66 thousand miles an hour. How much time does the dinosaur have to contemplate the situation?

THE WHIRLPOOL GALAXY



SIZE 600 THOUSAND TRILLION MILES ACROSS
DISTANCE 200 MILLION TRILLION MILES
AGE 12 MILLION YEARS?

The Whirlpool is a spiral galaxy, like our own Milky Way. These galaxies revolve around their center in the form of “spiral arms.”

IMAGINE that you're controlling the Hubble Space Telescope and you want to take a picture of the spiraling arms of a galaxy. You can't decide between the Whirlpool and the Milky Way. And then you remember: it's impossible to get a full view of one of them. Which one is it?

HINT The Hubble is in the orbit of Earth, 350 miles above us.

THE SUN



SIZE 875 THOUSAND MILES DIAMETER
DISTANCE 93 MILLION MILES ON AVERAGE
AGE 4.5 BILLION YEARS

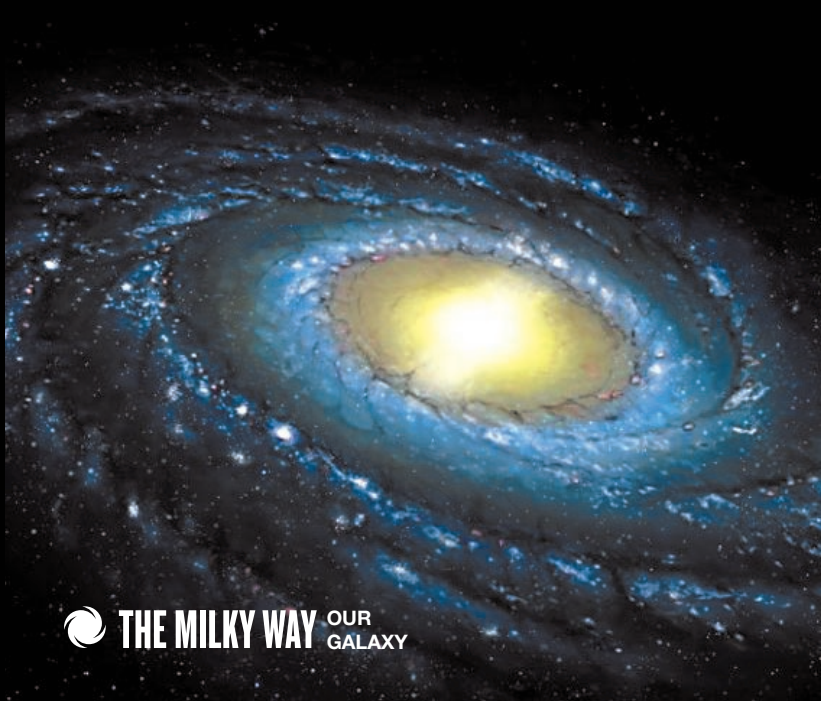
Astronomers use the average distance from the Earth to the Sun as a unit of measurement, called an “astronomical unit” or “AU.”

IMAGINE that you are sitting on a hill and watching the end of a sunset. The Sun is about to disappear below the horizon. Light travels 186 thousand miles per second. If light came to us “live,” how long would you have been sitting in the dark?

HINT An AU equals 8 minutes in light-years.



☾ SATURN



☾ THE MILKY WAY OUR GALAXY



☾ HUBBLE DEEP FIELD A CLUSTER OF GALAXIES



● PLUTO



▲ GREAT PYRAMID OF GIZA



● THE EARTH

THE MILKY WAY



SIZE 600 THOUSAND TRILLION MILES ACROSS
DISTANCE —
AGE 12 BILLION YEARS?

It's estimated that there are **200 billion stars** in our galaxy, the **Milky Way**.

IMAGINE that everybody on Earth has been given an equal number of stars in the Milky Way—to name them, to keep track of them in the sky, whatever. According to the estimate, how many stars do you have?

HINT Look up the number of people on Earth.

SATURN



SIZE 75 THOUSAND MILES DIAMETER
DISTANCE 120 MILLION MILES AT CLOSEST
AGE 4.5 BILLION YEARS

Galileo called Saturn's rings the "ears" of the planet. They were barely visible through his telescope, and no wonder. These bands of floating particles, **150 thousand miles wide**, are as little as **30 feet thick**.

IMAGINE the rings of Saturn as a CD and the 30-foot thickness of the rings reduced to the 1 millimeter thickness of a CD. How wide would the CD be?

CAUTION! Metric conversion ahead.

PLUTO



SIZE 1.4 THOUSAND MILES DIAMETER
DISTANCE 2.6 BILLION MILES AT CLOSEST
AGE 4.5 BILLION YEARS

It takes Pluto **248 times longer** to orbit the Sun than it takes the Earth.

IMAGINE that you live on Pluto and the driving age is 16—in Pluto years. In Earth years, how long would you wait to get your license?

HINT A year is one revolution around the Sun.

HUBBLE DEEP FIELD



SIZE 600 MILLION TRILLION MILES ACROSS
DISTANCE 30 BILLION TRILLION MILES
AGE 12 BILLION YEARS?

This picture of deepest space came from the Hubble Space Telescope. Hubble did not get great pictures because it traveled closer to the galaxies, but because it traveled outside of the light and distortions of our atmosphere. It is in orbit **350 miles above us**.

IMAGINE that you are operating the Hubble and trying to get a picture. In one direction, something is blocking your view of half the sky. What is it?

EARTH



SIZE 8 THOUSAND MILES DIAMETER
DISTANCE —
AGE 4.5 BILLION YEARS

Like most classroom globes, the Earth itself is tilted. Its constant tilt of **23.5 degrees** is the reason for our seasons. In the northern hemisphere, we get the most exposure to the Sun on **June 21, the first day of summer**. We get the least on **December 21, the first day of winter**.

IMAGINE that it's December 21 and you're texting a friend. You write: *have a gr8 summer!* Where does your friend live?

GREAT PYRAMID OF GIZA



SIZE 455 FEET TALL, 755 FEET WIDE AT BASE
DISTANCE —
AGE 4.5 THOUSAND YEARS

The Great Pyramid is the largest of the pyramids of Egypt. If weighed, it would come in at **5.75 million tons**.

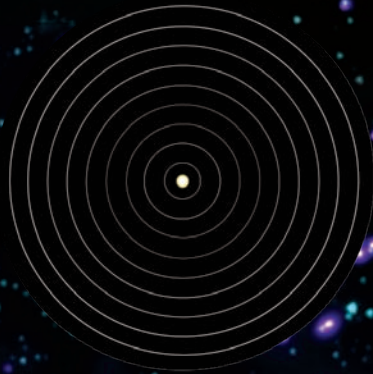
IMAGINE that you are an ancient Egyptian working on the Great Pyramid. You are hauling a block of stone up the side. It is one of the 2.3 million blocks needed to complete the pyramid. All are equal in size and weight. How much does your block weigh?

HINT It weighs as much as the average mid-size car.

LESSON 2 MATERIALS

THE TWO-INCH UNIVERSE

GO TO SMITHSONIANEDUCATION.ORG/UNIVERSE FOR A NEW
INTERACTIVE IN WHICH STUDENTS CREATE SCALE MODELS OF THE
UNIVERSE AND MEASURE SCALED DISTANCES USING ONLINE MAPS.



INFORMATION KEY



EARTH



MOON



**SOLAR
SYSTEM**



SUN



**ANDROMEDA
GALAXY**



MILKY WAY



EARTH Size: 8 thousand miles diameter. **MOON** Size: 2 thousand miles diameter. *Distance from Earth:* 240 thousand miles (1 light-second). **SUN** Size: 875 thousand miles diameter. *Distance from Earth:* 93 million miles (8 light-minutes). **SOLAR SYSTEM** Size: 7 billion miles (10 light-hours) across. **MILKY WAY** Size: 600 thousand trillion miles (100 thousand light-years) across. **ANDROMEDA GALAXY** Size: 1.3 million trillion miles (220 thousand light-years) across. *Distance from Milky Way:* 15 million trillion miles (2.5 million light-years).