

SE 5.12C: Slam Dunk
Concept Page for Teachers

Objective: (5.12C) Identify the physical characteristics of the Earth and compare them to the physical characteristics of the Moon.

Scientific question: How can we compare the physical characteristics of the Earth with those of the Moon?

Background information: This lab examines the differences and similarities between the Earth and the Moon. One obvious difference is size. The diameter of the Earth at its equator is 12,756 km, while the diameter of the Moon is only 3,474 km, or about a fourth as large of a diameter as that of the Earth. The force of gravity on the surface of the Moon is 1/6 of the force of gravity on the surface the Earth, meaning you would weigh one-sixth as much on the Moon as you do on Earth. Your mass would remain the same but your weight would be much lighter. This would also mean that everyone in your class would be able to slam dunk a basketball on the Moon! So if you had a moon rock, its mass would be the same on the Earth as on the Moon, but it would weight six times more on the Earth than it does on the Moon.

The orbit of the Moon around the Earth, and the Earth's orbit around the Sun, is another source of comparative data. The Moon orbits the Earth every 27.3 days. Because the Earth is moving in its own orbit of the Sun during these 27.3 days, it takes a total of 29.5 days for the Moon to return to the same position in the sky as seen from the Earth.

There are other differences between the physical characteristics of the Earth and the Moon as well. The Earth has an atmosphere, while the Moon does not. When standing on the Moon, because of its lack of atmosphere, the sky always looks black, instead of being blue like the Earth's sky looks. The Earth rotates on its axis once per day, whereas the Moon is "locked" into a position where one side stays toward the Earth while it orbits the Earth. The surface of the Moon is covered with craters. While there are a lot of craters on the surface of the Earth, most are not visible due to the effects of wind, rain, erosion, foliage, and other natural phenomena which have changed or covered the shape of the craters.

The biggest difference between the Earth and the Moon is the abundance of life on the Earth, and the complete lack of life on the Moon. The two most important reasons for this difference are that the Moon has neither liquid water nor an atmosphere.

Points to clarify with students: You may have heard the expression "the dark side of the Moon". This expression is actually a misnomer. As the orbit of the Moon takes it around the Earth, every surface on the Moon is, at some point during its orbit, illuminated by the Sun. Thus there actually is no "dark side" of the Moon.


Vocabulary: gravity, planet, satellite or moon, atmosphere


Gravity – the force that holds us to the surface of the Earth, keeps the Moon in orbit around the Earth, and the Earth in orbit around the Sun.

Planet –a large body that maintains its orbit around the Sun, has a nearly round shape, and has cleared the neighborhood around its orbit

Satellite or moon –a body in the solar system, generally smaller than a planet, which maintains an orbit around a planet


Atmosphere – layer of gases that surround a planet or large moon

Materials list:  A regulation size basketball, a tennis ball, at least 35 meters of string (must be somewhat strong like kite string), two pair of scissors for cutting the string, and two tape measures that measure in centimeters / meters or two meter sticks.

Classroom Introduction for Students:  Do you ever look up in the sky at night and see the Moon? What kinds of things have you noticed as you've looked at the Moon? (*Sometimes it is a full Moon, sometimes just a sliver, sometimes it is very bright, occasionally it looks red...*) Today we are going to talk about the differences between physical characteristics of the Earth and the Moon before we do our lab. What are some of the **similarities** between the Earth and the Moon that we already know? (The teacher may choose to record these on a chart or overhead as students generate this list. You will probably need to re-direct students to stay focused on the physical characteristics, as the students will want to list things like we have pizza restaurants on the Earth but not the Moon. Continue to emphasize that we are comparing in more general terms.)

Good job. Now tell me some of the **differences** between the physical characteristics of the Earth and the Moon. (Again, the teacher may choose to capture this information on a chart or overhead for use later. Use the "Background Information" section above to fill in any gaps.)

Now we are going to actually model the orbit of the Moon around the Earth, so that we can compare their size and distance from each other.

Procedure:  Ask a student to cut a piece of string that is 26 meters long. Have another student cut a piece of string that is 7 meters 19 centimeters long. Take your students, the basketball, tennis ball, and two pieces of string outside or into a gym.

Assign a student to take the basketball into the center of your available area, and hold it about a meter above the ground or gym floor. Have two students take the seven meter piece of string. One of these students should hold one end of the string above the basketball, at about the center of the basketball. The second student will then stretch the string out to its full 7.19 meter length, keeping the string parallel to the ground. Ask one of your tallest students to take the tennis ball and hold it at the end of the 7.19 m string, at the opposite end from the basketball. Tell the students that at this scale, if the basketball represents the Earth, then the tennis ball is very close to the correct scale of the Moon at that distance.

Next ask the student with the Moon (tennis ball) to take two very large steps (about 1.5 meters), keeping hold of both the string and the tennis ball. It is important to keep the string somewhat tight. From the top down looking at the basketball, the Moon student should move in a counter clockwise direction, mimicking the Moon's rotation around the Earth. Have the students count their steps.

Two steps will approximately equal one Earth day. If you wish you can have the basketball student rotate the basketball one rotation, counter-clockwise from the top, while keeping it in place. It should take approximately 58 steps for the Moon student to orbit the Earth. Students can visually see the Earth rotating while the Moon simultaneously orbits the Earth.

Next have two students stretch the 26 meter string from roughly the center of the basketball, out across the Earth and Moon model until the string is fully extended. Tell the students that at this scale, the 26 m of string represents the diameter of the Sun. Be sure to clarify to students that we have switched from talking about orbits, to looking at the relative size of the objects (not their position). This lab should give the students a good impression of how the Earth and Moon are similar, how they are different, and the scale of their place in the solar system.

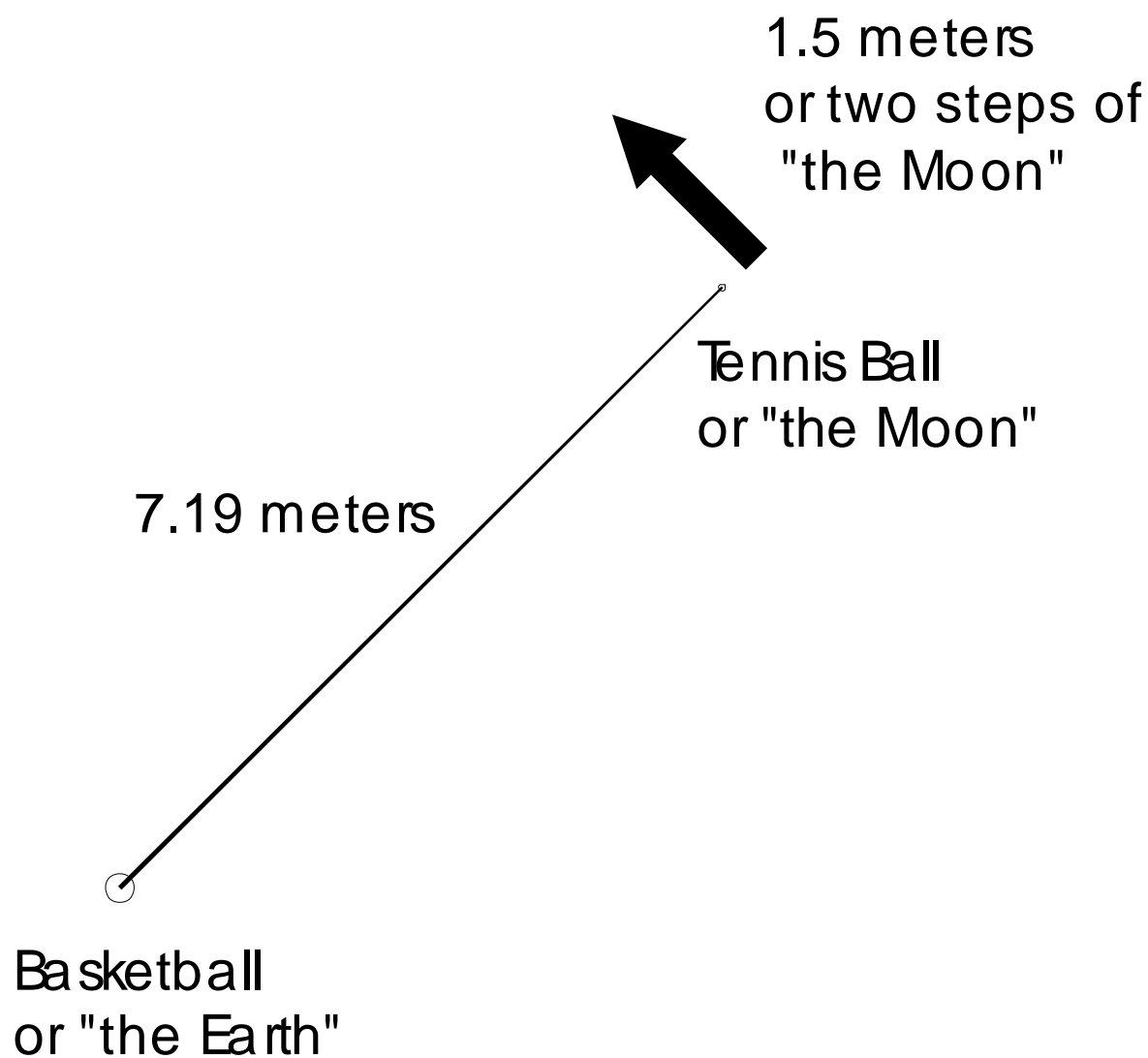


Figure 1. Earth and Moon Orbit Model