Activity 1: How Big, How Far: The Earth and Moon

The Earth and Moon have been called a "double planet". In this activity you will discover how big (or small) and how close (or far away) the moon really is.

Materials

Earth globe – as large as you have available
Ball of string – with individual strings about 5 times the diameter of the globe for each student
Balloons (round) – can be inflated to at least a fourth of the diameter of the globe you have chosen.
Measuring tape or meter stick for each group of students

Activity

1. Inflate your balloon until you think it is the size that the Moon would be if the Earth were only as big as the globe in the classroom. Do not tie your balloon, but hold onto it tightly.

2. Watch as your teacher stretches a string around the equator of the Earth globe. The length of this string equals the globe's circumference.

4. The moon's diameter is a fourth of the diameter of the Earth. So the moon's circumference is also a fourth of the Earth's circumference. Watch as your teacher folds the Earth circumference string in fourths. The result is the circumference of the moon balloon. Your teacher will measure the length of the folded string to find the circumference of the moon balloon.

5. Use your string to measure the circumferences of your balloon. Use a measuring tape or meter stick to determine how long your circumference is. Then calculate the difference between your circumference and the correct answer. Record your answers below.

6. Adjust the size of your balloon until it is the correct size compared to the Earth globe.

7. Now place your balloon at the correct scale distance from the Earth globe. Make your best guess about how far away the moon should be. Using a measuring tape, measure how far away your balloon is from the Earth globe. Record it below.

8. The moon balloon should be at a distance that it 9.5 times the circumference of the Earth globe. Multiply the Earth circumference string length by 9.5. Now use a measuring tape to measure how far your balloon is from the Earth globe. Subtract to find the difference between your distance and the correct distance. Record it on the table below.

Your balloon circumference: _____ The correct circumference: _____ Difference: _____

Your balloon distance: _____ The correct distance: _____ Difference: _____

9. Make a drawing on notebook paper showing the Earth and moon at the correct relative sizes and distances.

Activity 2: Lunar Olympics

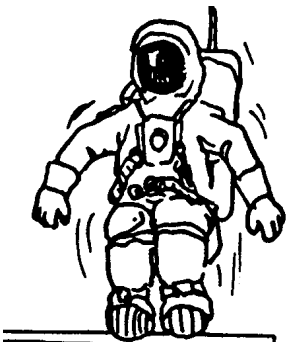
The Moon has a weaker gravity pull on its surface than the Earth does. Discover how your Earth-trained muscles will make you a super star athlete.

Materials: measuring tape, classroom books

Activity

How high could you jump?

Stand next to a wall and reach as high as you can. With a piece of tape, mark how high you can reach. Measure this height with a tape measure. This is your reach. Then jump and mark how much higher your hand can touch with another piece of tape. Measure the difference in heights between your jumping height and your reach. Fill in the table below.



On Earth:

Reach: _____ Jumping height: _____

Jumping height – Reach = _____

Take this number and multiply it by 6. Add this number to your reach. This will be how high you can jump on the moon. Fill in the table below.

On the Moon:

Reach (same as on Earth): _____

Jumping height – Reach (6 times the Earth value): _____

Jumping height (value above + reach): _____

Could you dunk a basketball on the moon? _____

How much can you lift?

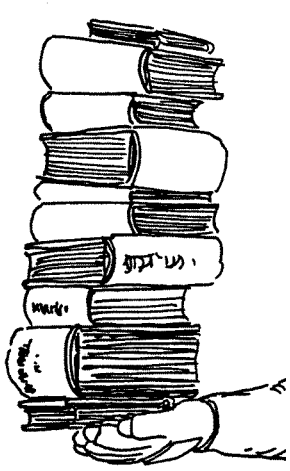
Sit in a chair with your back against the back of the chair and your hands in your lap. Ask a friend to place three textbooks in your hands. Try to life these books about 20 centimeters. If you can lift them, add more books, one at a time.

What is the greatest number of books that your hands can lift?

_____

On the Moon you could like six times as many books.

How many books co0uld you lift on the Moon? _____



Imagine how strong you would feel if you could lift that many books with just your hands.

What sports would be the most fun on the moon? When would you have to change the rules?

What would happen if you were born on the moon with only the muscle strength you need for the moon and decided to go to Earth?

Activity 3: Keeping Cool on the Moon

The moon has no atmosphere. The human body must be surrounded by air. To explore the Moon, astronauts must have a spacesuit that is like a balloon. The suit is inflated with air and does not leak. Even the gloves must be pressurized.

Materials: rubber glove and nylon glove

Activities

Wear a rubber glove for at least five minutes. Keep you hand moving the whole time by picking up objects or just opening and closing your fist.

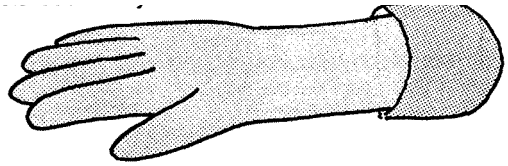
How does your hand feel after five minutes?

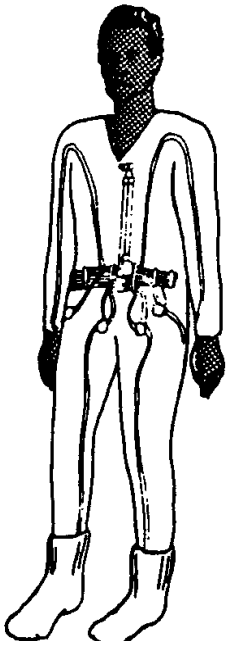
Why?

Take your hand out of the glove and wave it around in the air. How does it feel?

Why?

Put a nylon glove on and then add the rubber glove. Exercise the hand again for five minutes. What effect does the nylon glove have?





Astronauts wear nylon gloves under their pressurized gloves when they leave their spacecraft or moon bases. Astronauts also wear a nylon undergarment with little tubes in it. Cool water is pumped through the tubes. Why is this suit needed?

Activity 4: Designing a liquid cooling garment (LCG)

Outside of their spacecraft on the Moon, astronauts must wear a pressurized spacecraft, which protects the whole body from vacuum conditions. This suit contains several layers: a liquid cooling garment, a pressure garment, and a thermal micrometeoroid garment. The thermal micrometeoroid garment keeps in the astronaut's body heats and protects the pressure garment from any rips. The pressure garment is inflated to about four pounds per square inch (psi). (Sea level atmospheric pressure on Earth is 14 psi). Like a balloon, this garment does not leak air. Beneath the pressure garment is a Liquid Cooling Garment.

The Liquid Cooling Garment is made of nylon with little tubes sewn into it. These tubes are worn next to the body. Water is circulated through the tubes.

Activity
Materials
Thin plastic aquarium tubing, funnel, pan, ice water, and thermometer

1. To simulate this effect, wrap thin plastic tubing around a student's arm many times, as the drawing shows. The tubing must be warn next to the skill at all times, but be sure that it doesn't hinder circulation.

2. Another students places a funnel into the top of the tube and pours ice water through the tubing very slowly. The water is caught in a pan at the elbow.

3. Record the water temperature at the funnel and at the elbow.

Water temperature at the funnel: _____ Water temperature at the elbow: _____

What causes the water to change temperature?

4. Disconnect the funnel and beaker from the tubing, but leave the tubing in place around the student's arm. Tape the ends of the tubing so that the tubing will not move.
5. Ask the student to run as fast as possible in place for five minutes. Then repeat the first part of the experiment – dripping the water slowly through the tubing. Record temperature readings again.

Water temperature at funnel: _____ Water temperature at elbow: _____
6. Compare the change in water temperature with the first experience. Explain the difference.

7. Why would an astronaut want to regulate the temperature or speed of the water flowing through the tubes of the Liquid Cooling Garment?

Activity 5: Designing a Lunar Colony

Lunar colonies must house people and all of the supplies that people need. This list tells what each person in your colony will need each day,

Material	Amount Needed for One Person
Oxygen	0.83 kg per person per day
Food preparation water	1.86 kg per person per day
Clothing wash water	12.47 kg per person per day
Hand wash water	1.81 kg per person per day.
Shower water	3.63 kg per person per day
Bathroom flush water	0.49 kg per person per day
Food solids	0.73 kg per person per day
Food water	0.45 kg per person per day
Food packaging	0.45 kg per person per day
EVA oxygen	0.55 kg per person for an 8-hour EVA
EVA water	4.39 kg per person per 8-hour EVA

How many people do you want to live in your lunar colony? _____
EVA means Extra Vehicular Activity.
How many people will work outside the colony each day? _____

How many kilograms of oxygen will you need each day? _____

How many kilograms of food will you need (including packaging)? _____

How many kilograms of water does your lunar colony need each day? _____

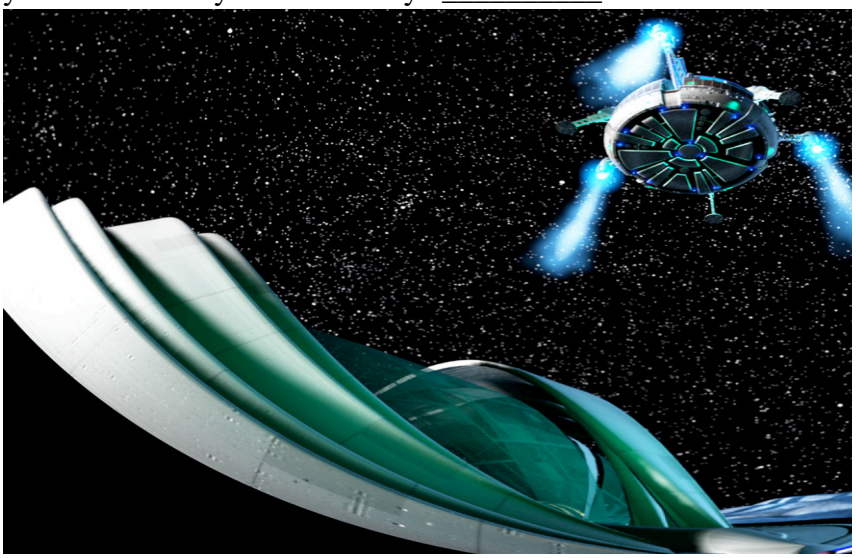
How could you reduce the amount of water, food, and oxygen needed?

_____

How would a greenhouse help?_____

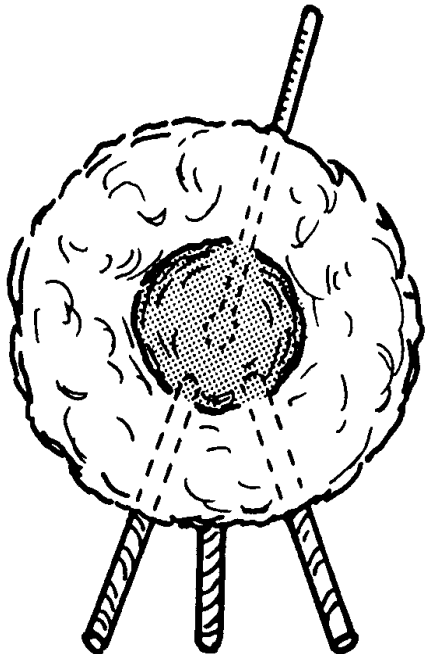
What other needs will your colony have?

_____



Activity 6: the Effects of a Blanket of Air

The Earth has a thick atmosphere. In this project, you will investigate the effect of an atmosphere on the surface below.



Materials;
2 balls of clay
2 thermometers
a roll of cotton
straws

Form the clay balls around the bulbs of the thermometers.
Wrap cotton around one of the balls (about an inch thick)
Support both balls with three straws making a tripod
Place both balls on their straw stands in a freezer for 5 minutes.
Remove both balls immediately and record their temperatures
Return the balls to the freezer and repeat the procedure, but leave the balls in for 10 minutes. Finally repeat the experiment by leaving the balls in the freezer for a whole hour.
Record your findings below.

Time	**Temperature Of Uncovered Ball**	**Temperature Of Cotton-Covered Ball**
5 minutes in freezer	_____	_____
10 minutes in freezer	_____	_____
60 minutes in freezer	_____	_____

How did the cotton affect the cooling rate of the clay? _____

Do the two balls eventually reach the same temperature? _____
Why?

Why don't the Earth and Moon reach the same temperature?

Repeat this experiment, but cover the moon ball with 10 times as much cotton as the Earth ball. Now it represents Venus. See what the effect of a thicker atmosphere is.

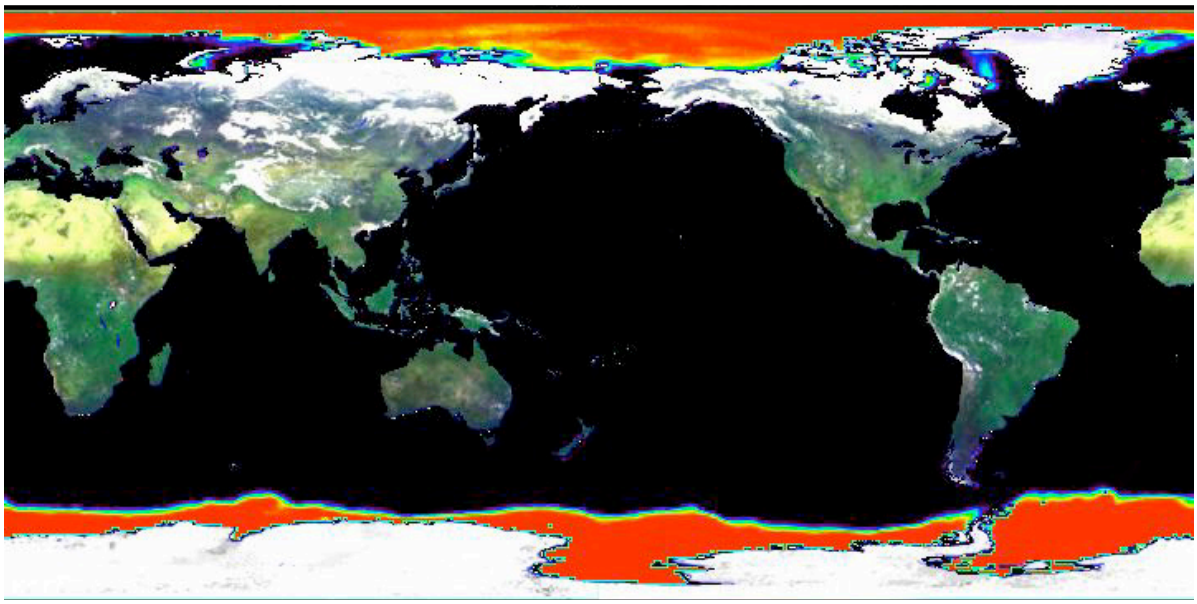
Activity 7: Ice Age – Keeping Warm

About 10,000 years ago, the Earth was in an Ice Age and ice covered much more of the planet.

Materials

Earth globe or map

Activity



The map above shows where ice is in July today. Only the white areas represent ice.

Using a globe for reference, list the European countries that were covered in ice during the ice age, but are ice-free in the summer now.

List the states in the United States and the provinces of Canada that were ice-covered in the last ice age, but are ice-free in the summer now.

Activity 8: Watching Mt. Etna

Astronauts can watch volcanoes erupt from space and will someday be able to watch the eruptions from the moon. See what you can discover in this photograph from the International Space Station.

Materials
Metric ruler

Activity
Italy is a country that looks like a boot. The boot is kicking a triangular island called Sicily. Label Italy and Sicily on the map.

Mt. Etna lies on the eastern side of Sicily. In this photo, it is releasing smoke. Label Mt. Etna.

From the smoke plume, which way is the wind blowing?

_____

The Italian peninsula is about 1,145 km (about 710 miles) long from the Alps Mountains in the north to the tip, with a maximum width of about 240 km (about 150 miles).

Using these lengths for reference, estimate how far the smoke plume from Mt. Etna extends.

There is another famous volcano in Italy, called Mt. Vesuvius. This volcano erupted in 79 BCE and buried the towns of Herculaneum and Pompeii. Mt. Vesuvius is near the west coast of Italy --- about 2/3rds of the way down the Italian Peninsula. It is cloud covered – see if you can find it.

Estimate how far it is from Mt. Vesuvius to Mt. Etna _____

Mt. Vesuvius and Etna are on a subduction zone. The African plate is moving northward at about one inch (2-3 cm) per year and is slowly closing the Mediterranean basin. As it moves to the north, the African plate is pushed beneath the Eurasian plate. Volcanoes are a result of this pressure below the surface.

Activity 9: IMPACT

About 10,000 tons of space particles fall to Earth every year. Most are very small and burn up high in the atmosphere. But a few particles are very large and can do tremendous damage.

Activity

The chart below describes how often an impact occurs. Use it to answer the questions below.

Size	**Impact Frequency**	**Effect**
1mm to 1 cm (sand grain/pebble)	every second (thousands per day)	bright "shooting star", destroyed in the atmosphere
1 – 50 cm (rock)	every hour (over 10 per day)	fireball, most destroyed in the atmosphere
0.5 0 1 meter (microwave oven)	every day	bolide (brilliant fireball), most destroyed in the atmosphere
1-10 meters (car or truck)	once per decade	stony or icy boulders destroyed in the atmosphere, iron boulders can crash through a roof or damage a car
10 – 50 meters (house)	every hundred years	local disaster, equivalent to several Hiroshima-sized bombs
50-100 meters (football field)	1-2 every 1,000 years	regional disaster, equivalent to the Meteor Crater or Tunguska event (about 15 megatons of TNT)
100 m – 1 km (small village)	once in 50 to 100 thousand years	continent-size disaster, equivalent to thousands of megatons of TNT
1-10 km (small city)	once in 50 to 100 million years	mass extinction, threat to all life (millions of megatons of TNT)
over 10 km	less than once in a billion years	threat to the continued habitability of the present

How many sand grains fall to Earth each year? _____

How many oven-size objects fall each year? _____

In a hundred years, how many truck-size objects fall to Earth? _____

In a thousand years, how many house-size objects fall to Earth? _____

In a thousand years, how many football-field size objects fall to Earth? _____

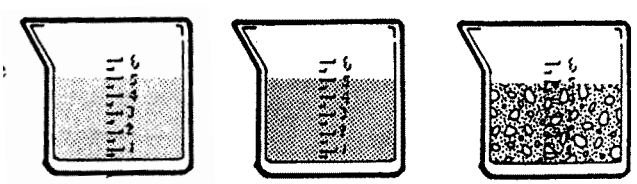
What are the chances that an object large enough to cause a disaster could fall this year?

Activity 10: World of Water

The Earth's surface is over 2/3rd oceans. All of this water affects Earth's weather in many ways – especially the temperature.

Materials

Three clear beakers of the same size
Water, loose sand, and topsoil
Thermometer
Access to a freezer



Activity

In three beakers of the same size, place equal volumes of water, loose sand and moist topsoil. Allow the three beakers to sit in a warm room until all three substances are at the same temperature. Place all three beakers in a freezer for five minutes. Record the temperature of the contents of each beaker while still in the freezer. Leave the beakers in the freezer until they are at the same temperature. Then return them to room temperature and record their temperatures after five minutes. List your data below.

Beaker	**Temperature** in room	**Temperature** after 5 min. in freezer	**Temperature** after 5 min. in room
Water-filled	_____	_____	_____
Sand-filled	_____	_____	_____
Soil-filled	_____	_____	_____

Which substance cools off the most quickly? _____

Which substance cools off the most slowly? _____

Which substance warms up the most quickly? _____

Which substance warms up the most slowly? _____

Which parts of the Earth have very rapid changes in temperature? _____
Why do you predict this?

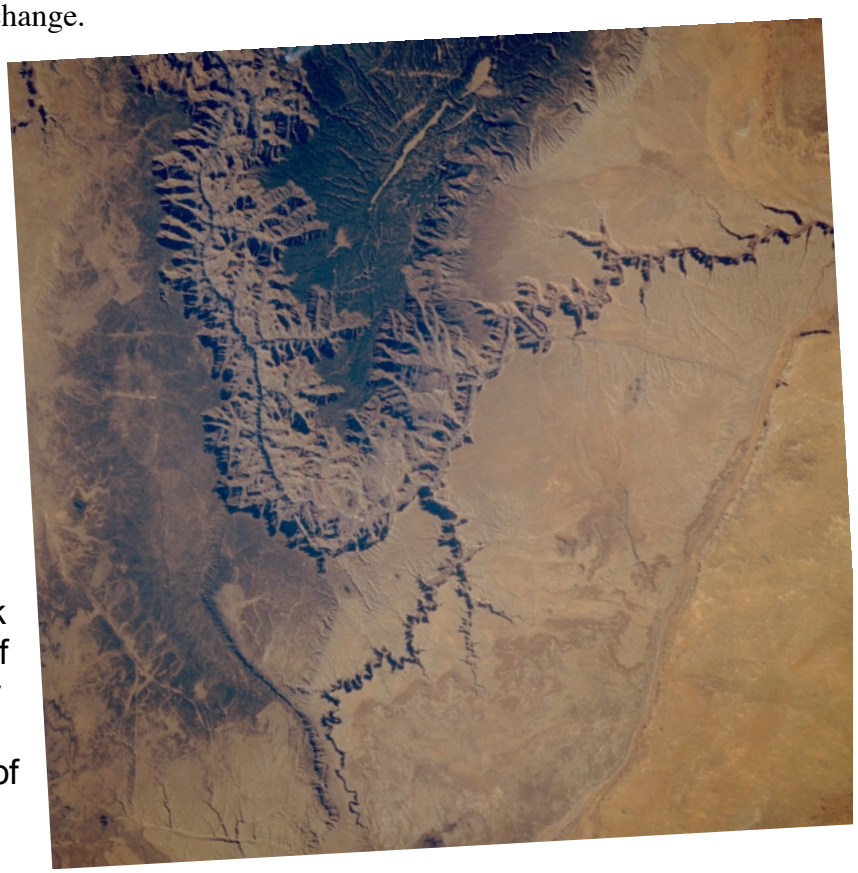
Which parts of the Earth experience less daily temperature change? _____
How do you know this?

Activity 11: Following the Grand Canyon

Over time, rivers create canyons. We can use photographs taken from the surface and from space to understand how canyons form and change.

Activity

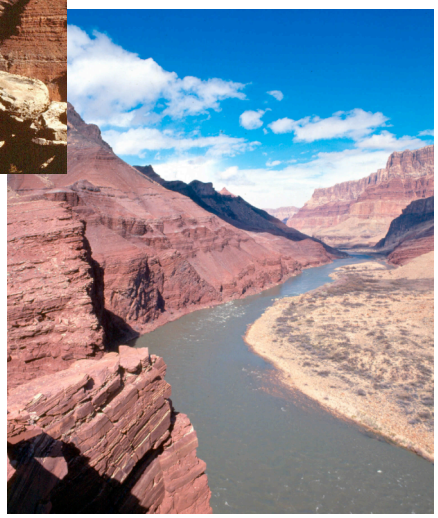
This photograph shows the Grand Canyon of the Colorado River from its beginning at the upper right of the image. The photograph is rotated so that north is straight up on the page.



The Colorado River turns south, makes a bend and turns north. As the Colorado River turns, the northwest-flowing Little Colorado River joins it from the east. The dark forested, elevated land north of the bend in the Colorado River is the Kaibab Plateau. The North Rim is the southern tip of this plateau.

Use a colored pencil to trace the Colorado River as it crosses the photograph from east to north. Then label the Little Colorado River. Finally label the Kaibab Plateau and the North Rim.

This image was made looking south from the North Rim. The Colorado River carved out this entire canyon over millions of years. Find the white rock in the cliffs in the distance. It is at the same height from one plateau to the next. This was once one flat plane with the land carved away over time by the river. The photo to the right is the Colorado River today. Dams and irrigation have reduced it in size. Do you think it is still changing the canyon's shape?



Activity 12: Picnic on the Moon

What things would you pack for a picnic outside on the Moon? Think about how the moon is different from the Earth.

Activity

You can choose from these items in planning your picnic. Place the items on one of the two lists below.

Baseball and bat	bathing suit	bicycle pump	drums
Yo-yo	telescope	fishing pole	fan
Flashlight	insect repellent	pitcher of lemonade	kite
Playground slide	playground swings	umbrella	shovel
Slingshot	sunglasses		

Things I Could Use on the Moon		Thing I Could Not Use on the Moon	
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Think about what you would like to do outside on the Moon. Make a third list: "Other Things I Would Like to Have on a Picnic" Describe what you would do with each of these items.

Item	What I Would Do With It
_____	_____
_____	_____
_____	_____
_____	_____