Perfect Little Planet Educator Guide

Clark Planetarium Education Department

Questions or comments can be directed to the Clark Planetarium Education Department at clarkeducation@slco.org.

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Activities for the Imagination

The objectives of these activities are: to learn about Earth and other planets, use language and art skills, encourage use of libraries, and help develop creativity. The scientific accuracy of the creations may not be as important as the learning, reasoning, and imagination used to construct each invention.

Invent a Planet

Students may create (draw, paint, montage, build from household or classroom items, whatever!) a planet. Does it have air? What color is its sky? Does it have ground? What is its ground made of? What is it like on this world?

Invent an Alien

Students may create (draw, paint, montage, build from household items, etc.) an alien. To be fair to the alien, they should be sure to provide a way for the alien to get food (what is that food?), a way to breathe (if it needs to), ways to sense the environment, and perhaps a way to move around its planet.

Invent a Rocket Ship

Students may create (draw, paint, montage, build from household or classroom items, whatever!) a rocket ship. How is it powered? How do they provide for the human environment? Have students research basic human needs: food, air, water, temperature.

"Vision is the art of seeing things invisible."

- Jonathan Swift

"Without this playing with fantasy no creative work has ever yet come to birth. The debt we owe to the play of imagination is incalculable."

- Carl Gustav Jung

"Grown-ups never understand anything for themselves, and it is tiresome for children to be always and forever explaining things to them."

- Antoine de Saint-Exupery in The Little Prince

Word Search

Name: ________________________

T	A	S	U	N	A	R	U	S	H
A	E	V	Z	E	E	W	U	T	Y
S	R	M	A	L	N	N	R	R	S
T	S	E	O	N	G	A	U	Z	A
E	U	Y	T	C	E	C	W	Q	T
R	N	A	D	I	R	D	A	E	U
O	E	B	N	E	P	S	S	L	R
I	V	O	M	W	M	U	R	Z	N
D	O	P	L	U	T	O	J	A	D
M	Z	E	N	U	T	P	E	N	M

SUN

JUPITER

MERCURY

SATURN

VENUS

URANUS

EARTH

NEPTUNE

MOON

PLUTO

MARS

COMET

ASTEROID

Word Search KEY

T	A	S	U	N	A	R	U	S	H
A	E	V	Z	E	E	W	U	T	Y
S	R	M	A	L	N	N	R	R	S
T	S	E	O	N	G	A	U	Z	A
E	U	Y	T	C	E	C	W	Q	T
R	N	A	D	I	R	D	A	E	U
O	E	B	N	E	P	S	S	L	R
I	V	O	M	W	M	U	R	Z	N
D	O	P	L	U	T	O	J	A	D
M	Z	E	N	U	T	P	E	N	M

Two Astronomy Games

We are going to play two astronomy games, one that is called “Small and Large”, and another called “Near and Far”.

Small and Large

1. Organize the students into small groups.
2. Make a copy of the set of ‘Small and Large” pictures (the set with “BEARS”) for each group of students.
3. Cut out the individual pictures (the students may do this), but keep them together as a “set”.
4. Give each group of students a set of ‘Small and Large” pictures.
5. Instruct the students to place the pictures in order from smallest to largest. Allow up to 5 minutes and encourage logical discussion based on current knowledge.

   HINTS
   You can give one or more hints as needed. The letters below correspond to the letters representing the images.
   A. The distance between the Sun and Earth is 400 times greater than the distance between the Moon and Earth.
   C. The length of the Space Shuttle is 37 meters (121 feet).
   G. The diameter of Mars is around half that of Earth.
   H. The galaxy in this image cannot be our Milky Way because we are able to see the entire galaxy. It is not possible to travel outside of our galaxy to obtain an image like this one.

6. Observe the order that each group has chosen before giving the solution. It is usually best to talk through all answers one at a time, starting from the beginning (don’t reveal all the answers at once). Pause now and then to ask students why one object is larger or smaller than another.

Near and Far

1. Make a copy of the set of ‘“Near and Far” pictures (the set with “AN EAGLE”) for each group of students.
2. Cut out the individual pictures (the students may do this), but keep them together as a “set”.
3. Give each group of students a set of “Near and Far” pictures.
4. Instruct the students to place the pictures in order from nearest to the surface of Earth to farthest from the surface of Earth. Allow up to 5 minutes and encourage logical discussion based on current knowledge.

   HINTS
   A. The distance between the Sun and Earth is 400 times greater than the distance between the Moon and Earth.
   B. This galaxy cannot be our galaxy (the Milky Way) because we are able to see the entire galaxy. It is not possible to travel outside of our galaxy to obtain an image like this one. If you can see the spiral structure of a galaxy, it is certain to be outside of our own galaxy.
   C. Auroras are found in the highest regions of the atmosphere.
   E. Usually, jet airplanes fly in the stratosphere, at more than 10 kilometers (6 miles) above the surface of Earth.

F. The Space Shuttle can visit the Hubble telescope to do maintenance or make repairs. The Space Shuttle cannot visit the Moon.
H. The stars of the constellations that we can see in the sky are located in our galaxy (the Milky Way).
I. Earth orbits the Sun at a distance of 1 AU (Astronomical Unit). Saturn orbits the Sun at a distance of 10 AU.

5. Observe the order that each group has chosen before giving the solution. It is usually best to talk through all answers one at a time, starting from the beginning (don't reveal all the answers at once). Pause now and then to ask students why one object is larger or smaller than another. You have probably witnessed the Sun rising and setting over the horizon. The Moon also moves across our sky, changing its phases over the course of a month. In this book we will compare the similarities and differences of the Sun, Earth and Moon by their appearance, size and distance from the Earth.

Two Astronomy Games KEY

SOLUTION "Small and Large"

(smallest to largest)

F. BEAR
C. SPACE SHUTTLE
D. MOON
G. MARS
B. EARTH
J. JUPITER
A. SUN
E. THE SOLAR SYSTEM
H. GALAXY

SOLUTION "Near and Far"

(nearest to farthest)

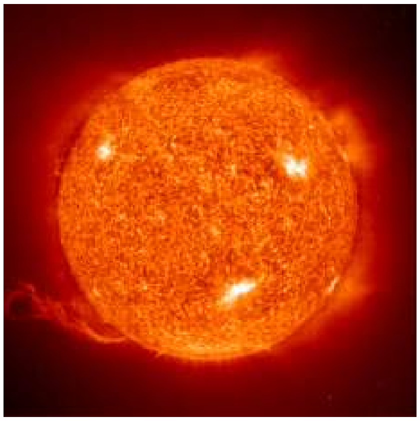
G. AN EAGLE
E. JET AIRPLANE
C. AURORAS
F. HUBBLE SPACE TELESCOPE
D. MOON
A. SUN
I. SATURN
H. STARS OF THE BIG DIPPER
B. A GALAXY

FREQUENTLY ASKED QUESTIONS

- Why do the Sun and the Moon appear to be the same size in the sky?
  - The diameter of the Sun is 400 times greater than that of the Moon, but the Sun is 400 times farther from Earth than the Moon. That is why you can see a total eclipse of the Sun, during which the Moon blocks the light from the Sun.
- What are the differences between a planet and a star?
  - A star is much bigger and more massive.
  - A star shines with its own light; a planet reflects the light from a star.
  - Planets orbit around stars.
- What is the difference between our solar system and a galaxy?
  - Our solar system has a star at its center called the Sun. There are nine planets that orbit around the Sun. The Sun is the only star in our solar system. On the other hand, there are more than a hundred billion suns (stars) in a galaxy like the one pictured.
- How far from Earth's surface are auroras?
  - Auroras are found from 95 to 190 kilometers (about 60-120 miles) above the Earth's surface.
- How far from Earth's surface is the Hubble telescope?
  - The Hubble telescope orbits around Earth at a distance of 600 kilometers (373 miles).

- How far from Earth is the Moon?
    - The Moon is about 400,000 kilometers (250,000 miles) from Earth.
- How far from Earth is the Sun?
    - The Sun is 1 Astronomical Unit (AU) = 150,000,000 kilometers (93 million miles) from Earth.
- How far from Earth is Saturn?
    - From 9 AU to 11 AU. It depends on which side of the Sun that Saturn is on, relative to Earth.
- How far is the Big Dipper from Earth?
    - That depends on the star. The brightest stars of this constellation are between 70 and 100 light-years from Earth. A light year is about 10 trillion kilometers (6 trillion miles). 10 trillion = 10,000,000,000,000
- How far is the galaxy in the image from Earth?
    - This galaxy, NGC 4414, is 60 million light years from Earth.

"TWO ASTRONOMY GAMES" was created by Cherilynn Morrow, PhD, of the Space Science Institute. Dr. Morrow's Powerpoint version of "Two Astronomy Games" (with instructions) is available on the website of the Space Science Institute.
http://www.spacescience.org/education/instructional_materials.html



A. SUN

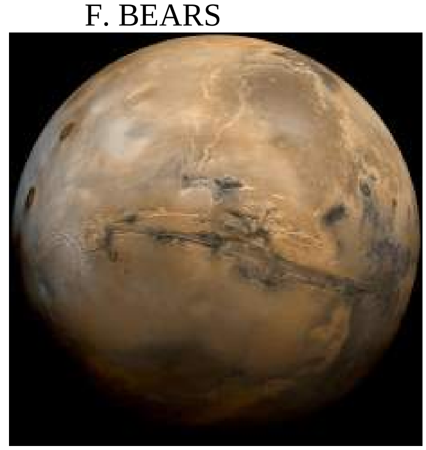
B. EARTH

J. JUPITER

H. GALAXY

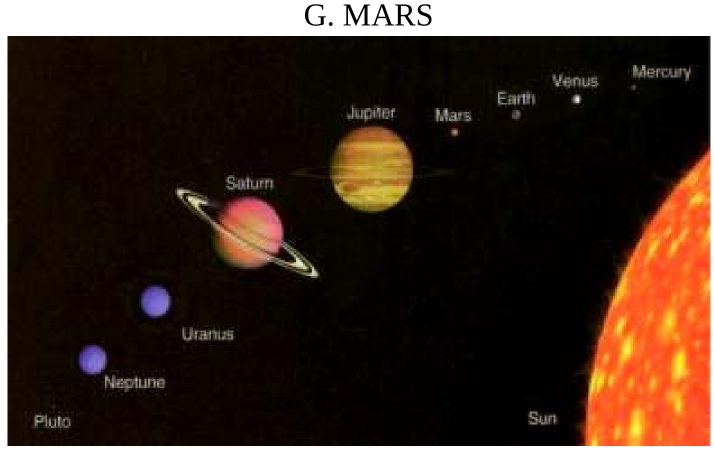
F. BEARS

C. SPACE SHUTTLE

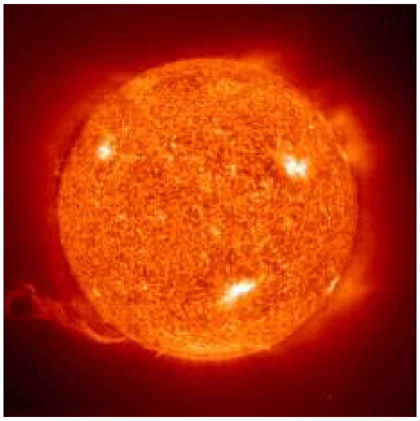


G. MARS

D. MOON



E. THE SOLAR SYSTEM



A. SUN

G. AN EAGLE

I. SATURN

B. A GALAXY

E. JET AIRPLANE

F. HUBBLE SPACE TELESCOPE

H. STARS OF THE BIG DIPPER

D. MOON

C. AURORAS

A Toilet Paper Solar System Scale Model

Objective: This is a great activity to allow students to visualize and compare distances between planets. This activity has a strong student cooperation component.

Students will use toilet paper squares as a standard measurement unit of 10 million miles to create a scale model of distances in the solar system. Students will discover the large distances between planets.

Materials:

- index cards
- a roll of toilet paper with at least 300 sheets (400 sheets if Pluto is included)
- marker
- ruler (if desired)

A space with a length of 100 feet is needed (130 feet if Pluto is included). Breezy days will make this activity difficult if done outside. As an alternative on a windy day, have students pace off the distances and mark the planets with colored sidewalk chalk.

Procedure:

Ahead of time: Write the names of the Sun and each planet on index cards.

Utilizing the information from the Toilet Paper Distance Table, have the students create their toilet paper solar system model. (Note: the number of squares of toilet paper listed by each planet is the distance from the Sun not the distance from the previous planet).

1. Have students count out the appropriate squares of toilet paper needed to reach each planet. Each square of toilet paper represents 10 million miles. They will need to either estimate the distance for the final fraction of a square or use a ruler to measure it. (One square of toilet paper is about 10 cm or 4 in on a side, so every 0.1 sheet is about 1 cm). For example, Mercury with a distance of 3.6 sheets would be 3 full sheets plus 6 cm into the fourth sheet.
2. Mark the location of each planet.
3. Select a student (or small group of students) to represent each planet. The Sun should be represented by a student (or small group of students) holding the "Sun" index card. As the model is created each student (or small group of students) should stand at the appropriate planet location with their planet index card.

Toilet Paper Planet Distance Table

Planet	Distance from Sun	Distance Needed
Mercury	3.6 sheets of toilet paper	36 centimeters (14.2 in)
Venus	6.7 sheets of toilet paper	67 centimeters (26.5 in)
Earth	9.3 sheets of toilet paper	93 centimeters (36.6 in)
Mars	14.2 sheets of toilet paper	1.42 meters (4 feet 8 in)
Jupiter	48.4 sheets of toilet paper	4.84 meters (15 feet 10 in)
Saturn	88.8 sheets of toilet paper	8.88 meters (29 feet 2 in)
Uranus	178.6 sheets of toilet paper	17.86 meters (58 feet 7 in)
Neptune	280 sheets of toilet paper	28 meters (91 feet 10 in)

Dwarf Planet		
Pluto	367.5 sheets of toilet paper	36.75 meters (120 feet 7 in)

A Toilet Paper Solar System Scale Model

This activity demonstrates to students the enormous distances in our solar system.

Materials:

- Tape Measure/ Meter Stick(s)
- Yellow Poster-board/Paper or Chalk
- 10 Popsicle sticks
- A copy of "The Solar System (Planet Sizes to scale)"
- Glue or Tape
- Scissors

On this scale the Sun is 53 cm. in diameter. To make a representation of the Sun, cut out a circle 53 cm. (20.75 in.) in diameter in the yellow poster-board/paper, or use chalk to draw a 53 cm. diameter circle on the ground. Cut out the picture of each planet and tape or glue it to a Popsicle stick. Place each planet at the distance from the Sun given below.

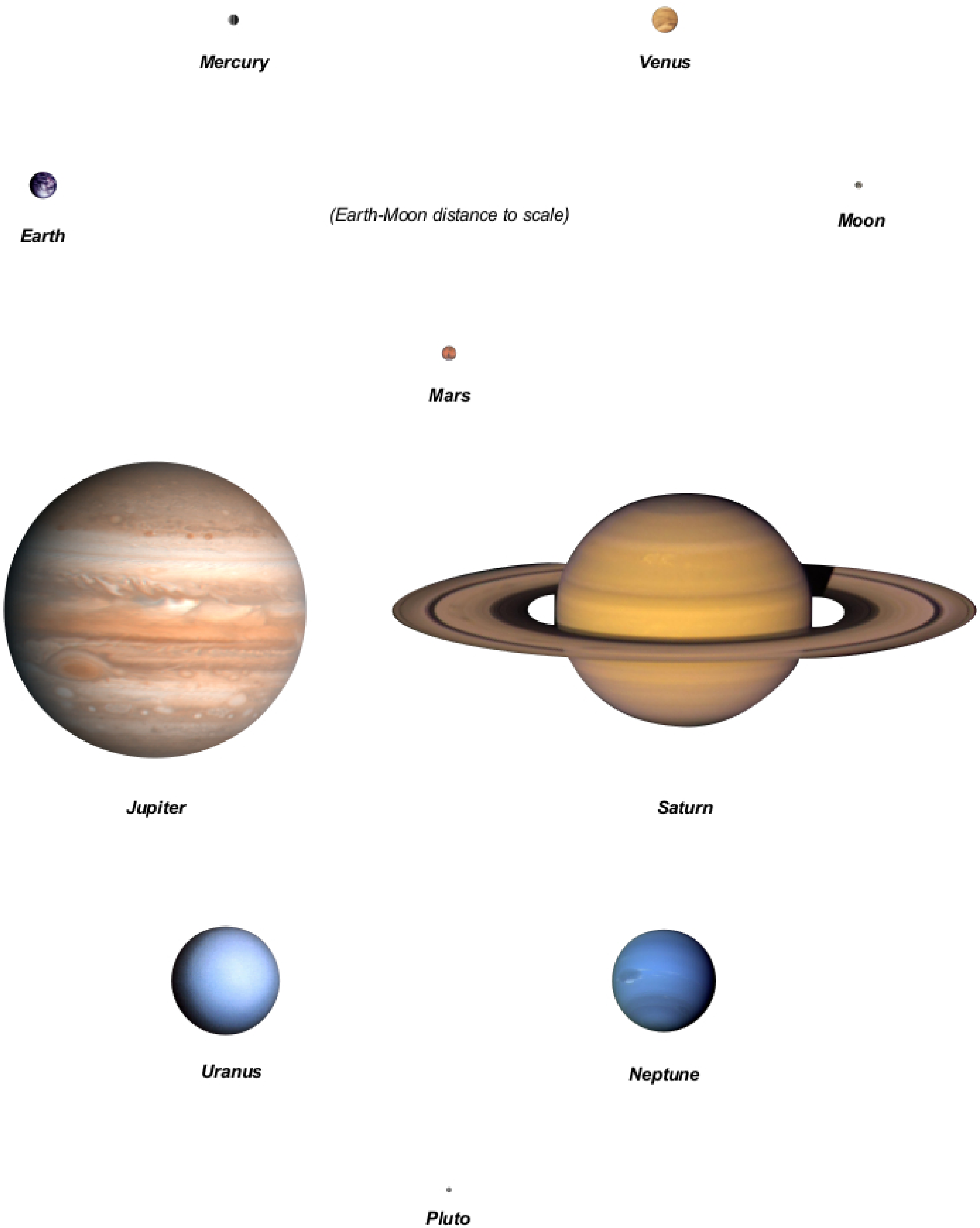
Planet	**Distance from Sun**		
Mercury	22 meters	72 feet	
Venus	41 meters	135 feet	
Earth	57 meters	187 feet	
Mars	87 meters	285 feet	
Jupiter	297 meters	973 feet	
Saturn	545 meters	1787 feet	(about 0.5 km or 1/3 mile or 2 3/4 blocks)
Uranus	1095 meters	3594 feet	(about 1 km or 7/10 mile or 5 1/2 blocks)
Neptune	1716 meters	5630 feet	(about 1.7 km or 1.1 miles or 8 1/2 blocks)
Pluto	2254 meters	7395 feet	(about 2.2 km or 1.4 miles or 11.2 blocks)

It is important to have the students walk at least as far as Jupiter. This will give them a "feel" for the large distance to the outer planets. If the activity ends at Jupiter, point out that Saturn is almost twice as far from the Sun as Jupiter.

Additional suggestions:

- At the beginning of the activity, have students guess:
  - the size of the Sun.
  - the distance of each planet.
- If yellow poster-board or paper is used for the Sun, tape the circle upright on something so that it can be seen from each planet. Then, have the students note the apparent size of the Sun as seen from each planet. (This is how large the sun would actually appear from each planet).

The Solar System
(Planet sizes to scale)



Solar System Models in Dough

SKILLS: Process: classify, measure, observe, compare, analyze, conclude; research: manipulate, gather

OBJECTIVE: Students will understand and comprehend the relative sizes and masses of the bodies of the Solar System.

BACKGROUND INFORMATION: Teachers, please provide the following definitions for students and discuss. The state or form of matter can be determined by what an object's shape and volume are like.

- MATTER: The material of which all things in the universe are made. Anything that takes up space is made of matter.
- STATES OF MATTER;
  - Solid: Has a certain shape and volume of its own. ex: desk, chair, book
  - Liquid: Has a certain volume but has no shape of its own. A liquid can change shape. ex: water, milk
  - Gas: Has no shape or volume of its own. ex: air
- VOLUME: The amount of space matter takes up.
- MASS: The amount of matter or "stuff" in an object

MATERIALS: Each student/group will need: at least one, preferably two lumps of clay or play dough (recipe below), dull knife, paper covering for work space, solar system fact sheet.

PLAY DOUGH RECIPE:

- 1 cup flour
- 1/4 cup salt
- 2 Tbsp cream of tartar

Mix ingredients in a medium saucepan. Combine and add to the above:

- 1 cup water
- 2 tsp food coloring
- 1 Tbsp oil

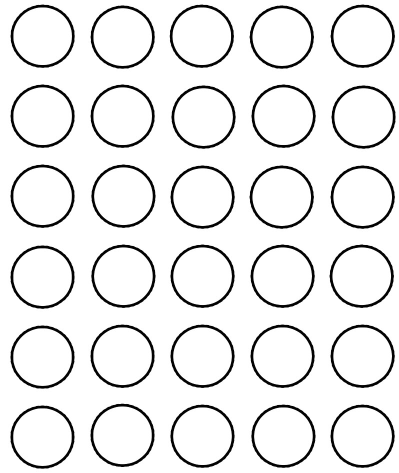
Cook over medium heat, stirring constantly, for five minutes. When it forms a ball, turn out and kneed on a lightly floured surface. Store in an airtight container.

PROCEDURE:

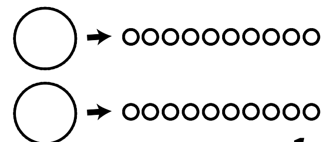
Part 1: VOLUME

The student will:

1. Divide the clay into 30 equal pieces. See 1-A
2. Predict how many pieces will be needed to make the volume of each of the planets and their moons. Which planets are the biggest?
3. Divide two of the pieces into ten equal pieces. See 1-B
4. Separate the pieces into the following groups: 18, 10, 8/10, 7/10, and any crumbs left over on the work space, knife or hands.
5. Form the groups into five balls which represent the volume or size of each planet.
    a. Jupiter: 18
    b. Saturn: 10
    c. Uranus: 8/10
    d. Neptune: 7/10
    e. Remaining crumbs: Mars, Earth, Venus, Mercury, Pluto and moons.
6. Arrange the planets in their proper order according to distance from the Sun. Write labels on the paper below them for reference during the discussion.



1 - A

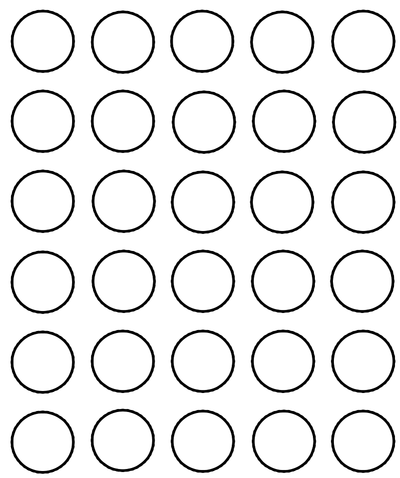


1 - B

PART 2: MASS

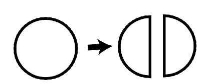
The student will:

1. Divide the clay into 30 equal pieces. See 2-A
2. Predict how the mass will be distributed to make the planets. Which planets are the most massive and by how much? The least?
3. Divide one of the pieces into halves. See 2-B. Set aside one half while dividing the second into ten (1/20) pieces. Divide one of those ten into three. See 2-C. Combine one of these with one of the ten to make a 1/15 piece.
4. Separate the pieces into the following groups: 21, 6, 1, 1, 1/15, 1/20, crumbs
5. Form groups of pieces into 6 balls which will represent the mass contained in each planet.
    a. Jupiter: 21
    b. Saturn: 6
    c. Neptune: 1
    d. Uranus: 1
    e. Earth: 1/15
    f. Venus: 1/20
    g. Mars and Mercury: crumbs (If we could divide into small enough pieces - Mars: 1/140, Mercury: 1/270)

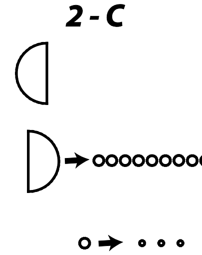


2 - A

2 - B



2 - C



6. Arrange the planets in their proper order according to distance from the Sun. Write labels on the paper below them for reference during the discussion.

PART 3

The teacher may lead the students to further discussion and analysis:

1. Compare the masses of the planets, considering how closely the result matches the predictions. Who was surprised?
2. How are the results different between part one and two? What is being measured in each part?
   a. Answer: Part 2 shows how much stuff it takes to make the actual planet while Part 1 shows how much room that stuff takes up. Elements at different pressures and temperatures take up different amounts of space. Most solids take up less space than liquids and even less than gasses.
3. Looking at the mass model, classify the planets as “giants” or “midgets” by making notes next to their labels. Does this same classification fit when looking at volumes? How may it be different? (the midget planets are composed mostly of metal and silicate “rock” and have solid surfaces). The gas giants, however, are hydrogen and helium gas surrounding liquid metallic hydrogen under extremely high pressure from the dense atmospheres. The primary elements which compose the gas giants are lighter, less dense. The result is four huge planets with a lot of mass, and four small planets whose smaller amount of mass is much more compact.
4. How does the mass of each planet make it different? What difference does volume make? (The mass and diameter of a planet determines how much gravity a planet has).
5. The sun contains so much volume that it would take 557 lumps of dough to represent its size and 733 lumps would be needed to represent the mass.
6. Find the volumes of the planets on a Solar System chart or other source. What does this number tell you about the planet? Does this match your model?
7. Find the masses of the planets on a Solar System chart or other source. What does this number tell you about the planet? Does this match your model?

CLARK PLANETARIUM SOLAR SYSTEM FACT SHEET

Data provided by NASA/JPL and other official sources. This handout ©July 2013 by Clark Planetarium (www.clarkplanetarium.org).

May be freely copied by professional educators for classroom use only. The known satellites of the Solar System shown here next to their planets with their sizes (mean diameter in km) in parenthesis. The planets and satellites (with diameters above 1,000 km) are depicted in relative size (with Earth = 0.500 inches) and are arranged in order by their distance from the planet, with the closest at the top. Distances from moon to planet are not listed.

Mercury
(no natural satellites)

Venus
(no natural satellites)

Earth
- Moon (3,475)

Mars
- Phobos (22.2)
- Deimos (12.4)

Ceres
(975 km, 2.77 AU)
(Dwarf Planet)

Jupiter
- 1- Metis (44)
- 2- Adrastea (16)
- 3- Amalthea (168)
- 4- Thebe (98)
- 5- Io (3,643.2)
- 6- Europa (3,121.6)
- 7- Ganymede (5,262)
- 8- Callisto (4,820.6)
- 9- Themisto (9)
- 10- Leda (18)
- 11- Himalia (160)
- 12- Lysithea (38)
- 13- Elara (78)
- 14- S/2000 J 11 (4)
- 15- Carpo (3)
- 16- S/2003 J 3 (2)
- 17- S/2003 J 12 (1)
- 18- Euporie (2)
- 19- S/2003 J 18 (2)
- 20- Orthosie (2)
- 21- Euanthe (3)
- 22- Thyone (4)
- 23- S/2003 J 16 (2)
- 24- Mneme (2)
- 25- Harpalyke (4)
- 26- Hermippe (4)
- 27- Praxidike (6.8)
- 28- Thelxinoe (2)
- 29- Helike (4)
- 30- Iocaste (5.2)
- 31- Ananke (28)
- 32- S/2003 J 15 (2)
- 33- Herse (2)
- 34- S/2003 J 9 (1)
- 35- S/2003 J 19 (2)
- 36- Eurydome (3)
- 37- Arche (3)
- 38- Autonoe (4)
- 39- Pasithee (2)
- 40- Chaldene (3.8)
- 41- Kale (2)
- 42- Isonoe (3.8)
- 43- Aitne (3)
- 44- S/2003 J 4 (2)
- 45- Erinome (3.2)
- 46- Taygete (5)
- 47- Carme (46)
- 48- Sponde (2)
- 49- Kalyke (5.2)
- 50- Pasiphae (58)
- 51- Eukelade (4)
- 52- Megaclite (6)
- 53- Sinope (38)
- 54- Hegemone (3)
- 55- Aoede (4)
- 56- Kallichore (2)
- 57- S/2003 J 23 (2)
- 58- S/2003 J 5 (4)
- 59- Callirrhoe (7)
- 60- S/2003 J 10 (2)
- 61- Cyllene (2)
- 62- Kore (2)
- 63- S/2003 J 2 (2)

Saturn
- 1- S/2009 S1 (1)
- 2- Pan (26)
- 3- Daphnis (7)
- 4- Atlas (32)
- 5- Prometheus (100.2)
- 6- Pandora (83.8)
- 7- Epimetheus (119)
- 8- Janus (177.6)
- 9- Aegaeon (1)
- 10- Mimas (397.2)
- 11- Methone (3)
- 12- Anthe (1)
- 13- Pallene (4)
- 14- Enceladus (498.8)
- 15- Telesto (24)
- 16- Tethys (1,059.8)
- 17- Calypso (19)
- 18- Dione (1,118)
- 19- Helene (32)
- 20- Polydeuces (4)
- 21- Rhea (1,528)
- 22- Titan (5,150)
- 23- Hyperion (266)
- 24- Iapetus (1,436)
- 25- Kiviuq (14)
- 26- Ijiraq (10)
- 27- Phoebe (220)
- 28- Paaliaq (19)
- 29- Skathi (6.4)
- 30- Albiorix (26)
- 31- S/2007 S 2 (6)
- 32- Bebhionn (6)
- 33- Erriapo (10)
- 34- Siarnaq (40)
- 35- Skoll (6)
- 36- Tarvos (15)
- 37- Tarqeq (7)
- 38- Greip (6)
- 39- Hyrrokkin (8)
- 40- S/2004 S 13 (6)
- 41- S/2004 S 17 (4)
- 42- Mundilfari (7)
- 43- Jarnsaxa (6)
- 44- S/2006 S 1 (6)
- 45- Narvi (7)
- 46- Bergelmir (6)
- 47- Suttungr (5.6)
- 48- S/2004 S 7 (6)
- 49- S/2004 S 12 (5)
- 50- Hati (6)
- 51- Bestla (7)
- 52- Farbauti (5)
- 53- Thrymr (7)
- 54- S/2007 S 3 (5)
- 55- Aegir (6)
- 56- S/2006 S 3 (6)
- 57- Kari (7)
- 58- Fenrir (4)
- 59- Surtur (6)
- 60- Ymir (18)
- 61- Loge (6)
- 62- Fornjot (6)

Uranus
- 1- Cordelia (40.2)
- 2- Ophelia (42.8)
- 3- Bianca (51.4)
- 4- Cressida (79.6)
- 5- Desdemona (64)
- 6- Juliet (93.6)
- 7- Portia (135.2)
- 8- Rosalind (72)
- 9- Cupid (24)
- 10- Belinda (80.6)
- 11- Perdita (20)
- 12- Puck (162)
- 13- Mab (10)
- 14- Miranda (471.6)
- 15- Ariel (1,157.8)
- 16- Umbriel (1,169.4)
- 17- Titania (1,577.8)
- 18- Oberon (1,522.8)
- 19- Francisco (22)
- 20- Caliban (72)
- 21- Stephano (32)
- 22- Trinculo (18)
- 23- Sycorax (150)
- 24- Margaret (20)
- 25- Prospero (50)
- 26- Setebos (47)
- 27- Ferdinand (21)

Neptune
- 1- Naiad (58)
- 2- Thalassa (80)
- 3- Despina (148)
- 4- Galate (158)
- 5- Larissa (192)
- 6- S/2004 N1 (20?)
- 7- Proteus (416)
- 8- Triton (2,706.8)
- 9- Nereid (340)
- 10- Halimede (61)
- 11- Sao (40)
- 12- Laomedeia (40)
- 13- Psamathe (38)
- 14- Neso (60)

Pluto
(Dwarf Planet)
- Charon (1186)
- Nix (60?)
- Hydra (50?)
- Kerberos (13-34?)
- Styx (??)

Haumea
(1150 km, 51 AU)
(Dwarf Planet)
- Namaka (114)
- Hi'iaka (310)

Makemake
(1500 km, 59 AU)
(Dwarf Planet)

Eris
(2800 km, 97 AU)
(Dwarf Planet)
- Dysnomia (150)

All four Jovian planets, or "gas giants" have rings.

		Mercury	Venus	Earth	Moon	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto (included here for historical reasons)	Sun
Average Distance from Sun	Millions of Kilometers	57.91	108.21	149.60	.3844 from Earth	227.94	778.30	1,429.39	2,875.04	4,504.45	5,915.80	39.95 trillion km to nearest star
	Light Travel Time	$3^{m}13^{s}$	$6^{m}1^{s}$	$8^{m}19^{s}$	1.3^{s} from Earth	$12^{m}40^{s}$	$43^{m}16^{s}$	$1^{h}19^{m}28^{s}$	$2^{h}39^{m}50^{s}$	$4^{h}10^{m}25^{s}$	$5^{h}28^{m}53^{s}$	4.22y to nearest star
	Astronomical Units	0.3871	0.7233	1.0000	0.0026 from Earth	1.5237	5.203	9.555	19.218	30.110	39.545	267,032 to nearest star
Length of Year	Period of Orbit	87.969d	224.701d	365.256d	27.32d to orbit Earth	1.8809y	11.862y	29.458y	84.022y	164.774y	248.0y	226 million y to orbit galaxy
Length of Day	Period of Rotation	$58^{d}15^{h}31^{m}$	$243^{d}0^{h}26^{m}$R	$23^{h}56^{m}04^{s}$	$27^{d}7^{h}43^{m}$	$24^{h}37^{m}23^{s}$	$9^{h}55^{m}30^{s}$†	$10^{h}47^{m}06^{s}$†	$17^{h}14^{m}24^{s}$R†	$16^{h}6^{m}36^{s}$†	$6^{d}9^{h}18^{m}$R	25-35d†
		y=years d=days h=hours m=minutes s=seconds R=retrograde †=Depending on latitude ?=Exact value not known										
Average Orbital Velocity	Kilometers per second	47.87	35.02	29.79	1.023	24.13	13.06	9.66	6.81	5.44	4.75	217.35 around center of galaxy
	Kilometers per hour	172,339	126,074	107,225	3,683	86,865	47,029	34,781	24,527	19,595	17,096	782,460 around center of galaxy
Equatorial Diameter	Kilometers	4,879.4	12,103.6	12,756.28	3,474.8	6,792	142,984**	120,536**	51,118**	49,528**	2,390	1,392,000
	Sun = 1	0.0035	0.0087	0.0092	0.0025	0.0049	0.1027**	0.0866**	0.0367**	0.0356**	0.0017	1.0
	Earth = 1	0.383	0.949	1.0	0.2724	0.532	11.209**	9.449**	4.007**	3.883**	0.187	109
Mass	Earth = 1	0.0553	0.8150	1.0	0.0123	0.1074	317.83	95.163	14.536	17.149	0.0022	332,946
Volume	Earth = 1	0.0562	0.857	1.0	0.0203	0.151	1,404.70	763.59	63.09	57.72	0.0066	1,300,000
Mean Density	Grams per cubic centimeter Water = 1	5.43	5.24	5.515	3.35	3.94	1.33	0.69	1.27	1.64	2.0	1.41
Surface Gravity	Earth = 1	0.378	0.905	1.0	0.166	0.379	2.53	1.07	0.905	1.14	0.062	27.96
Escape Velocity	Kilometers per hour	15,300	37,303	40,249	8,553	18,080	214,300	127,700	76,700	84,600	4,300	2,223,000
Temperature Extremes	High °C/K	425 / 698	462 / 735	58 / 331	127 / 400	17 / 290	20,000*	12,000*	6,000*	6,000*	-210 / 63	15,000,000*
	Low °C/K	-173 / 100	462 / 735	-88 / 185	-173 / 100	-143 / 130	438 / 711**	407 / 680**	346 / 619**	347 / 620**	-235 / 38	4,000**
		*Core **At 1 atmosphere (altitude where barometric pressure equals Earth's barometric pressure at sea level—1013 mb)										
Atmosphere	Principal Gases	O_2, Na, H_2, He	CO_2, N_2	N_2, O_2	none	CO_2, N_2, Ar	H_2, He	H_2, He	H_2, He, CH_4	H_2, He, CH_4	CH_4, N_2, CO	H_2, He
# of Known Satellites		0	0	1	-	2	63 plus rings	62 plus rings	27 plus rings	13 plus rings	5	8 planets 5 dwarf planets
Eccentricity of Orbit	Circular Orbit = 0	0.2056	0.0068	0.0167	0.0549	0.0934	0.0485	0.0555	0.0464	0.0095	0.2491	—
Inclination of Equator	To Planet's Orbital Plane	0.01°	177.36°	23.44°	6.68°	25.19°	3.13°	26.73°	97.77°	28.32°	119.6°	7.25° Sun's equator to ecliptic
Inclination of Orbit to Ecliptic		7.0°	3.39°	0 (by definition)	5.2°	1.85°	1.31°	2.49°	00.77°	1.77°	17.15°	—