UNIT 6

<u>Our Solar System</u>

6.1 Planets

6.2 Dwarf planets and other solar system bodies

6.3 Planet Projects

Our Solar System at a Glance Reading

Introduction:
When the ancients studied the night sky, they noticed that five "stars" moved with respect to the others. They called them "planets," from the Greek word for "wanderer," and kept careful records of their motions. These records eventually enabled astronomers to figure out why they moved as they did: the planets, including our Earth, orbit around the sun. over the years, telescopes have revealed the existence of three other planets, too faint to have been seen by the ancients, bringing the total number to eight (including earth).

Question: What is our solar system?

Background: *(write a few things that you already know pertaining to about the question above)*

Vocabulary:
Terrestrial
Jovian
Comet
Meteor
Meteoroid
Meteorite

Materials:
This reading

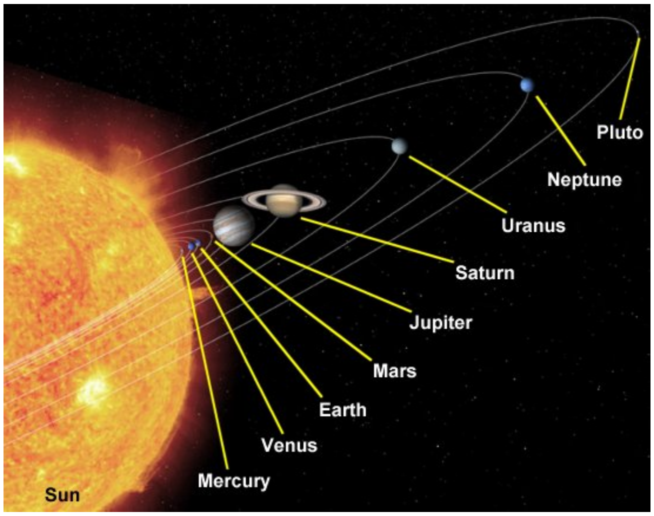
Procedure:
Read through the following passage.

In space, most (90%) of all stars are actually double-star systems in which two stars orbit each other. This close orbit prohibits any planets from forming. Our solo star system gave way for planets to form. It is thought by astronomers that had the material that formed the outer (Jovian) planets been closer together and coalesced into one giant planet that there may have been enough material to start nuclear fusion and create a double star. Had this happened, Earth would have been pulled into one of the stars and our solar system as we know it would not have existed.

The planets, instead, formed at the same time as the infant Sun, about 4.6 billion years ago, as a giant cloud of interstellar gas and dust contracted. Most of the material fell into the center of the cloud, becoming the Sun, but some was left behind in a disk circling the young star. Over time, small grains of dust in the disk collided and stuck together. As they grew larger, they pulled nearby material toward them, increasing their size even more. Eventually they became large chunks, which collided and merged together, until planet-sized objects existed. The planets then "swept up" the remaining material, pulling the leftover gas and dust toward them, leaving the space between the planets largely empty.

This scenario for the formation of the planets helps explain observed similarities between them. All the planets all orbit around the Sun in the same direction (counterclockwise, as seen from above the north pole of the Sun), and with the exception of Venus and Uranus, all rotate on their axis in a counterclockwise direction. Similarly, all the planets circle the Sun in very nearly the same plane. All this can be explained because the planets formed out of the same rotating disk.

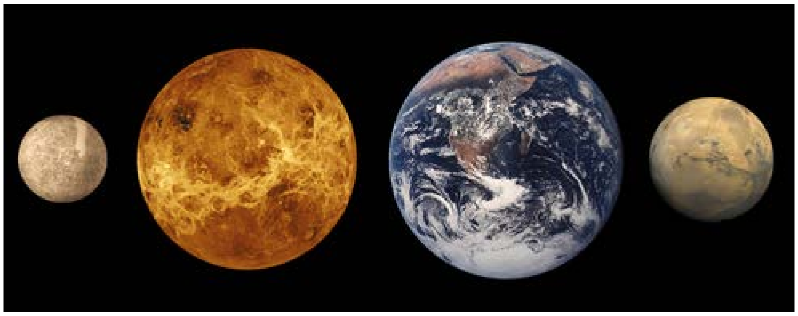
The scenario can also explain their differences, primarily, why the terrestrial planets are small and rocky, while the Jovian ones are gassy giants. In the inner part of the solar system, heat from the sun made it too hot for most of the gas in the disk to condense into a solid. Only small amounts of high-density materials like rock and metals could condense, resulting in small, rocky planets. Farther out in the disk, temperatures were cool enough that a lot of ice formed. Thus that outer planets grew quickly, enabling them to become quite big. When they got sufficiently large, they pulled vast amounts of gases like hydrogen and helium toward them, providing the extensive gaseous atmosphere in these planets. The terrestrial planets never got large enough, and the temperature in the inner parts of the disk was too high to trap the same gases.



Please note that although size is proportional , distance is not correct in the model shown above

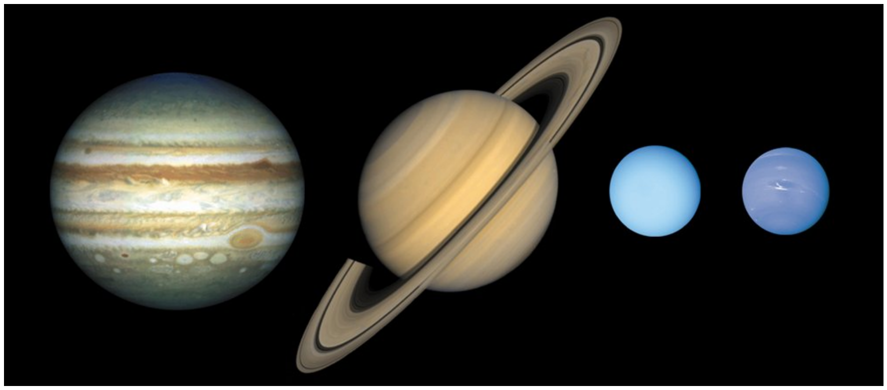
Due to this, the planets basically come in two different types; the Inner, terrestrial planets, and the outer, Jovian (or gas-giant) planets. The terrestrial planets-Mercury, Venus, Earth and Mars-are small, dense, rocky worlds. They all have solid surfaces, and all are located in the inner part of the solar system. Mercury, closest to the sun and smallest of the terrestrial planets, has no appreciable atmosphere. Venus, a neat twin in size to the earth, has a very thick atmosphere composed of primarily carbon dioxide gas, with surface air pressures 90 times greater than those on Earth. The thick air traps heat from the sun, in much the same way greenhouse keep warm despite cold temperatures outside; temperatures at the Venusian surface are over 800'F. if you're ever unfortunate enough to land on Venus, you could be almost simultaneously asphyxiated, crushed and burned up the instant you step out of your spaceship!

Mars also has a carbon-dioxide atmosphere, but it is extremely thin, only about one percent as thick as Earth's. The thin air doesn't retain heat well, and surface temperatures range from a frigid -220'F on a cold winter night to 70'F at the equator on a hot, summer day. Mars has polar ice caps, and what look like dry streambeds, leading many researchers to surmise that at some time in the very distant past, Mars may have had a thicker atmosphere and running water on its surface.

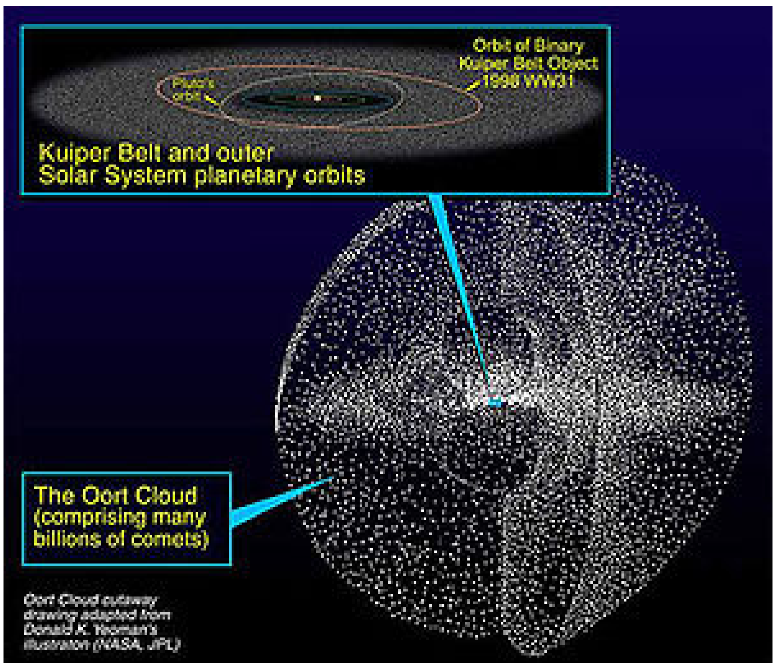


The Jupiter and the other "Jovian" planets in the outer solar system Jupiter, Saturn, Uranus and Neptune have no solid surface on which you can stand, they are gas giants large (eleven Earths could fit across Jupiter's equator), rapidly, rotating, with very low-density. Saturn's density, in fact, is so low that if you had a bathtub large enough filled with water, the planet would flout! When we look at Jovian planets, we see the tops of clouds. All show complicated wind patterns and immense " storm center" like Jupiter's famous great red spot except for Uranus, which has an almost featureless cloud deck (perhaps because its interior is cooler than the other Jovian planets). As you go deeper into their atmosphere, the gases get thicker and thicker, until finally they turn into a liquid. At their centers, is an Earth-sized rocky core.

Unlike the terrestrial planets, the Jovian giants are circled by rings of icy particles. Saturn’s is, by far, the most beautiful an extensive, complex system of billions of tiny particles orbiting Saturn’s equator. The others’ rings are much thinner and fainter. Astronomers think the rings are debris, perhaps from collisions involving their moons, captured by the giant planets’ gravity. All of the Jovian planets have many moons; several (Jupiter’s Ganymede and Callisto, and Saturn’s titan) are at least as big as, if not bigger than, the planet mercury!

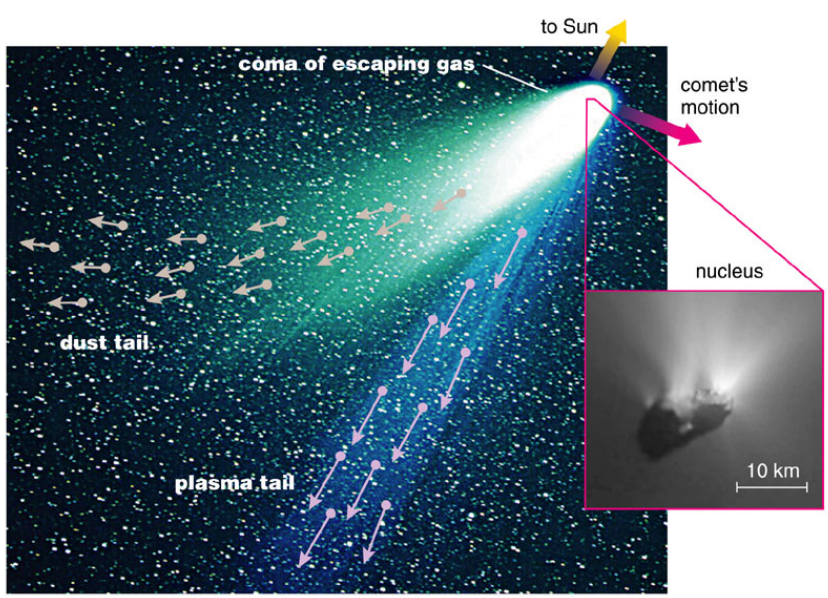


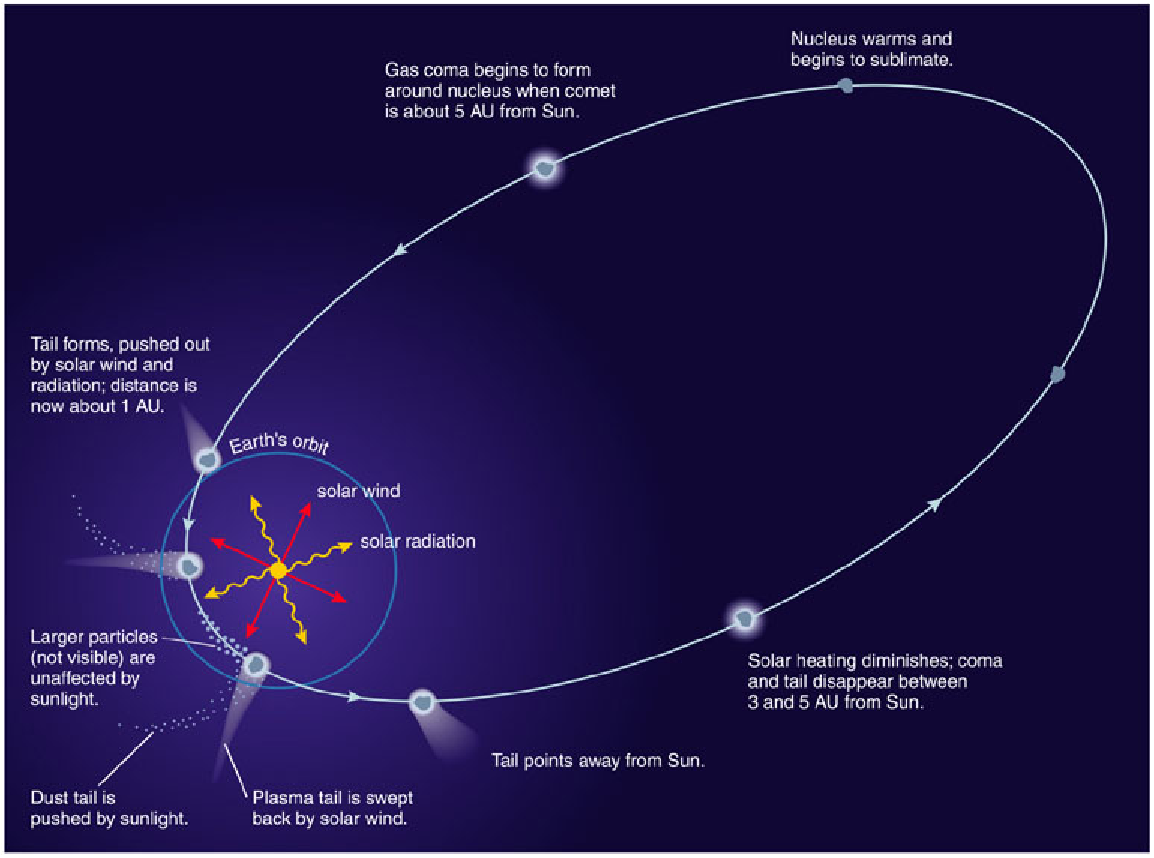
The Oort Cloud



It can be assumed that beyond the Jovian planets lie the vastness of space, but that would only be partly true. When our Sun and eight planets were forming, some dust, ice, and rocks weren’t accreted but still are captured by the Sun’s gravitational pull. These asteroids and comets (dirty chunks of ice) orbit the sun in highly eccentric orbits (more than 50,000 AU from the Sun) that may pull the object within the orbit of the eight planets once every 10,000 years! The very large region beyond the orbit of the Jovian planets in which these objects orbit is called the Oort Cloud.

Due to the extremely eccentric orbit of some comets, they only come close to the sun once every few hundred or even thousands of years. When it does, the solar wind from the Sun strips away the outer layers of ice and dust in a spectacular show. This stripping of the outer material of the comet leaves a tail that is visible from here on Earth. It is important to note that the tail does not trail the comet but rather points away from what causes the tail, the Sun.

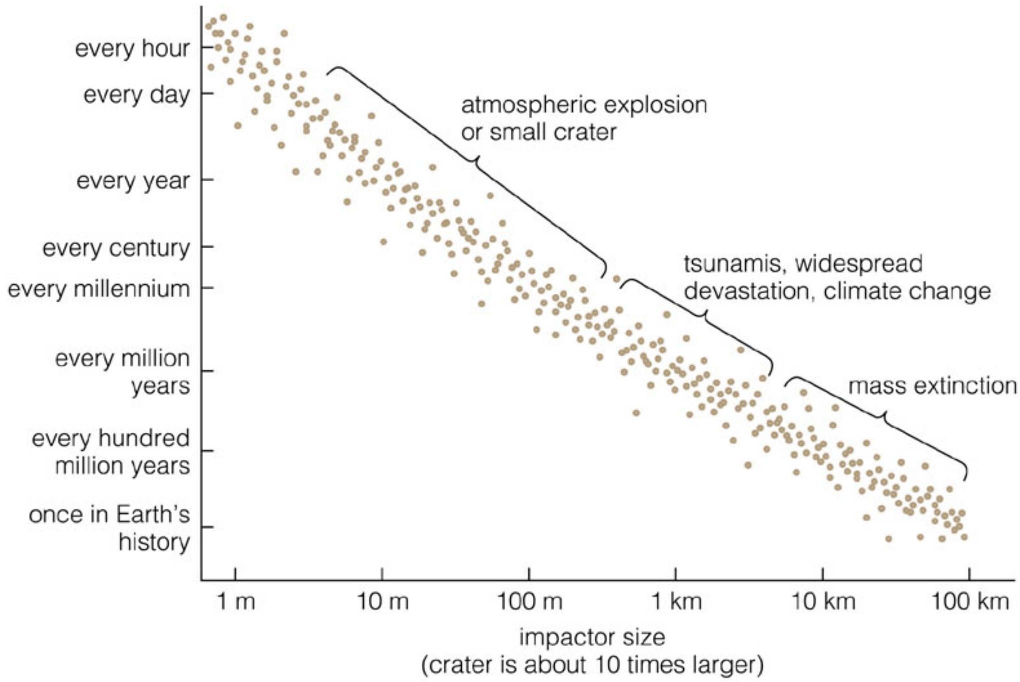




Meteors and Asteroids

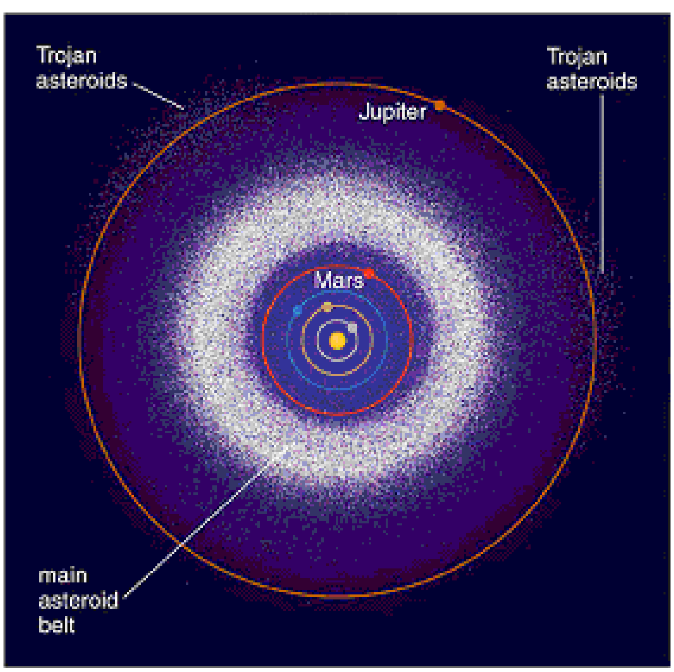
In between the planets, dust and chunks of rocks and ice (often the remnants of comets), called meteors that are also orbiting the Sun. Occasionally, these meteors get sucked into the Earth's gravitational pull when they come to close to it. When they reach about 60 miles above the surface of the Earth, they start to come into contact with the air in the Earth’s atmosphere. When this happens, they heat up due to the friction and at this point are known as meteoroids. When meteoroids burn up, we on the ground can sometimes see a brief streak of light known by non-astronomers as a "shooting stars." Every once in a while, a meteor will be big enough to weather its fiery descent and land on Earth, where it earns the title "meteorite."

As you can see in the graph on the next page, meteors enter the Earth’s atmosphere every hour of every day. Almost all meteorites are small are little to no impact on the Earth, Even if larger meteorites were to smack into Earth, 70% of the Earth’s surface is covered in water and only about half of the remaining land is even habitable by humans. However, occasionally sizable meteorites *do* smash into the Earth. Some are thousands of meters in diameter and hit the Earth traveling thousands of kilometers per second. A series of large meteorites are thought to have caused multiple mass extinctions throughout Earth’s history, including the one that wiped out the dinosaurs.



Asteroids are also known as "minor planets." They are made up of much of the same stuff as planets, but they are much smaller. The four largest known are spherical or ball-shaped, like the Earth, and have diameters of between 100 and 500 miles.

The Asteroid Eros is more than 40 km long.



In comparison to Earth's moon, which has a diameter of about 2100 miles, even the largest asteroids are still pretty small. The rest of the asteroids range in diameter all the way down to less than 5 miles across. Asteroids with diameters of 30 miles or less no longer have enough gravity to pull themselves into a spherical shape.

Most asteroids orbit the Sun between Mars and Jupiter. Although some asteroids have sizes comparable to some moons in our solar system, these are not moons because they only orbit the Sun, and not any planets, as the moons do.

The largest asteroids are called planetoids and are Ceres, which can be found in the asteroid belt between Mars and Jupiter, Pluto (with its moon Charon) and Eris which can be found beyond Neptune in the Oort Cloud.

Analysis:

Answer the following questions on lined paper in complete sentences which restate the question in your answer.

1. Why were the planets called "wonderers?"
2. What evidence is there that our solar system formed from a disk of dust and rocks?
3. Draw a Venn Diagram comparing and contrasting the two categories of planets.
4. Would it be possible to send a person to Venus? Why/why not?
5. Would it be possible to send a person to Mars? Why/why not?
6. Describe the layers of Jupiter.
7. Would it be possible to send a person to Jupiter? Why/why not?
8. Is not having two stars a good thing or bad? Why so?
9. Why do you think the space between the planets relatively empty?
10. Which planets' rotation differs from our here on Earth? How do they differ?
11. Comets are often referred to as "dirty snow balls." Why is this analogy only partly true?
12. What is the Oort cloud and what can be found there?
13. Draw a three-way Venn Diagram comparing meteors, meteoroids, and meteorites.
14. Where do comets originate?
15. What causes the tail on a comet?
16. How size meteorite would it take to cause a mass-extinction?
17. Why are larger objects in our solar system spherical in shape while smaller objects are not?
18. What would you still like to know about our Solar System?

13 Greatest Discoveries – Astronomy
(This video can also be watched at http://videosift.com/video/100-Greatest-Discoveries-Astronomy)

Write out a chart similar to the one shown below x13 for each of the 13 greatest discoveries in Astronomy. Then fill in the chart as we watch the video.

#1 What?	Who?	When?
Interesting info:		

#2 What?	Who?	When?
Interesting info:		

#3 What?	Who?	When?
Interesting info:		

#4 What?	Who?	When?
Interesting info:		

Solar System Webquest

Question: What do you want to more about our solar system?

Background: *(write a few things that you already know pertaining to about the question above)*

Vocabulary:
Solar system
Planets
Moons
Asteroids
Dwarf planets

Materials: Computer, Internet access, lab sheet

Procedure:

1. Go to: http://www.nasm.si.edu/ceps/etp/

2. Click on the titles listed and then select a topic that you would like to know more about.

3. Next to the numbers, write facts from the reading that you find most interesting.

Discovery – select one topic within and write 2 facts about each

Tools of exploration – select two types and write 2 facts about each

Comparing the planets – select one of the features and write 2 facts about it

Comets – select one of the red topics and list 2 facts from it

Our solar system – select two topics and write 2 facts about each

Mercury – select two topics and write 1 fact from each

Venus – select two topics and write 1 fact from each

Earth – select two topics and write 1 fact from each

Mars – select two topics and write 1 fact from each

Asteroids – select two topics and write 1 fact from each

Jupiter – select two topics and write 1 fact from each

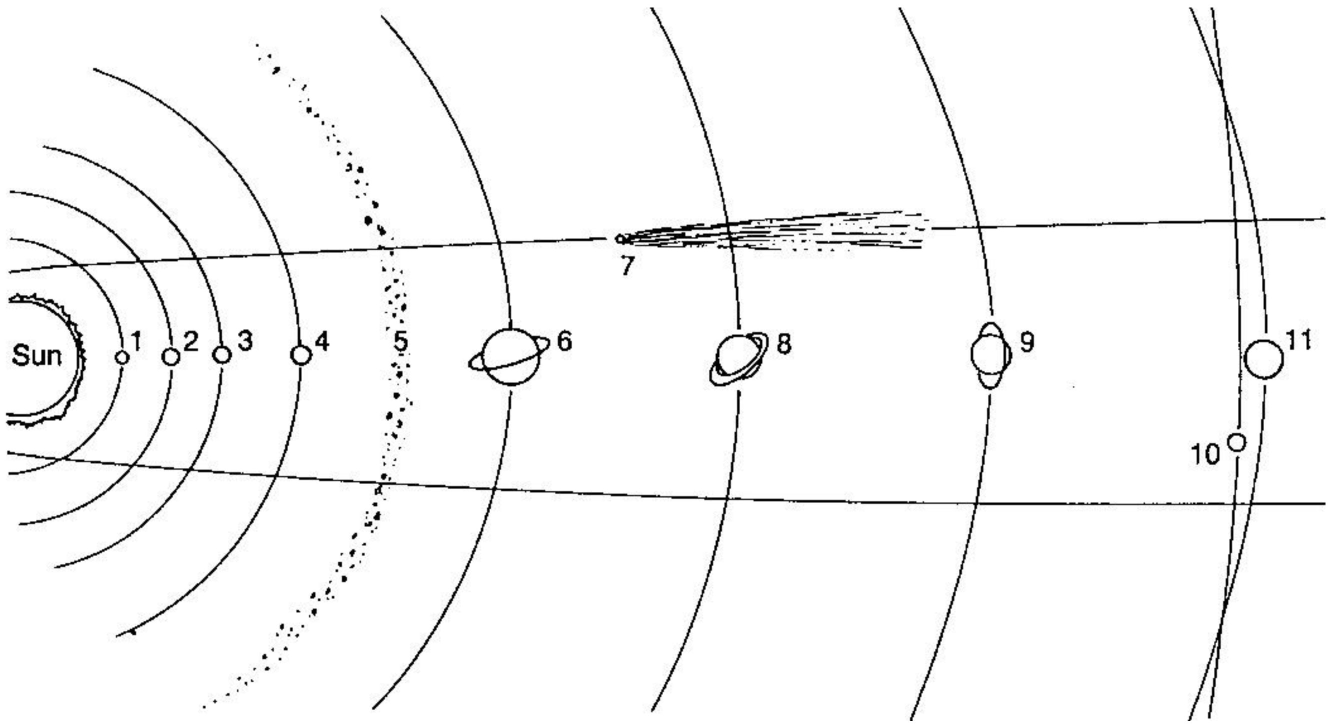
Saturn – select two topics and write 1 fact from each

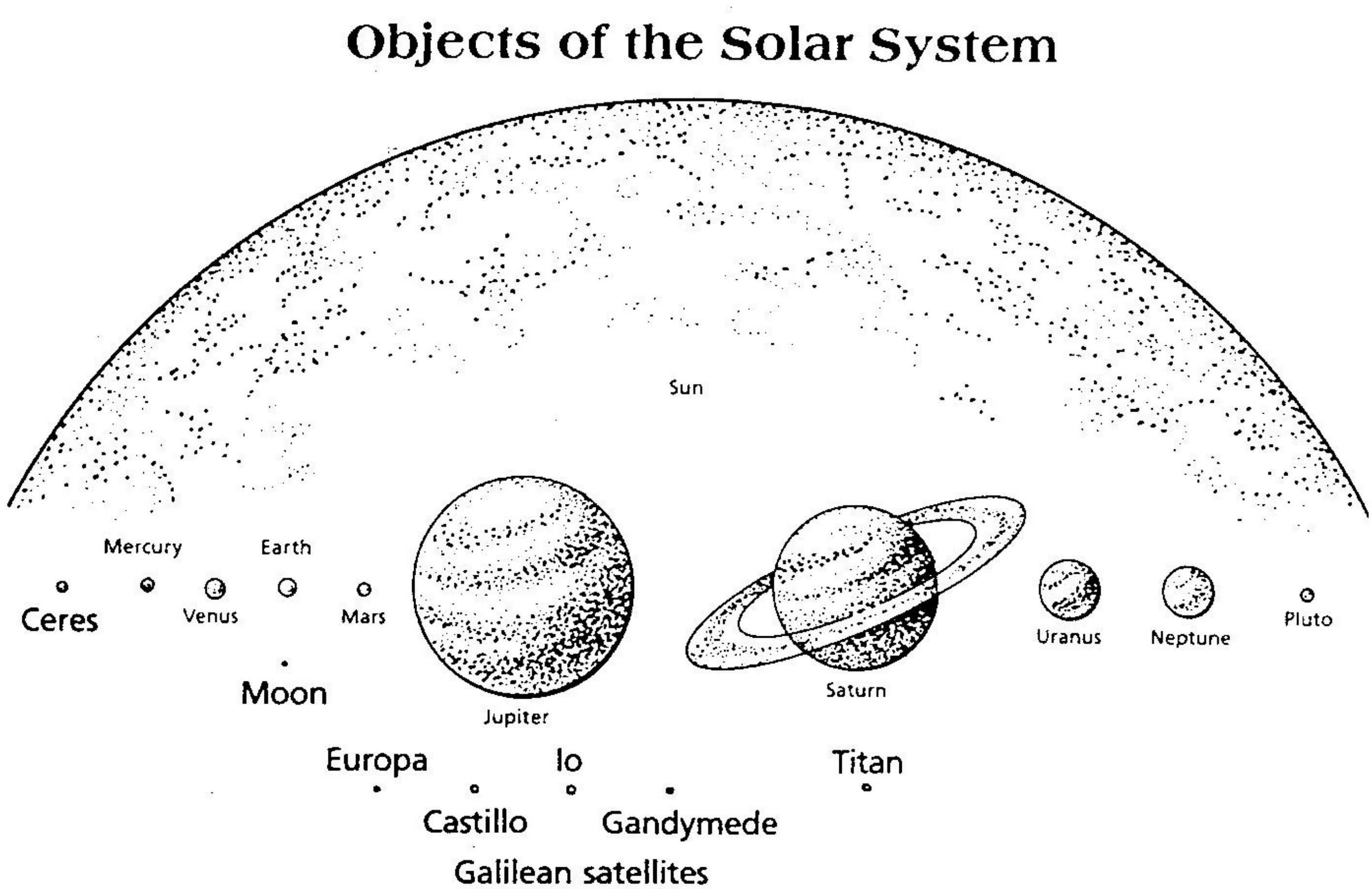
Uranus – select two topics and write 1 fact from each

Neptune – select two topics and write 1 fact from each

Pluto and Dwarf Planets – select two topics and write 1 fact from each

Draw the diagram below and label each numbered item in the picture:





Journey to the Edge of the Universe – NatGeo *(This video can also be watched on YouTube)*
Our Solar System (1st part of video -stop at 42:45)

Answer the following questions on a separate sheet of paper. You do not need to answer them in complete sentences. Questions are spaced out with enough time for you to answer each (1-3 minutes apart).

1. From your prior knowledge, what is the order of the 8 planets from the Sun outward?
2. How many humans have walked on the Moon?
3. Although Venus is roughly the same size and mass as Earth, how is it different?
4. What has caused the extremely high temperatures on Venus?
5. What may have caused Mercury to lose its outer layers?
6. What does the sun turn matter into?
7. What causes a comet's tail?
8. What is meant by the "Goldilocks" conditions?
9. What things don't exist on Mars to support life as we know it?
10. What evidence is there on Olympus Mons that shows that it might be dormant?
11. What do the existence of new gullies tell us about Mars?
12. What are found in a large belt after the orbit of Mars?
13. How big is Jupiter in comparison to the other planets?
14. What are the multi-colored spots on Jupiter's moon Io
15. What might be causing the ice on Europa to be melted underneath?
16. How big are the chunks in Saturn's rings?
17. Even though it has rivers, oceans, and rain, how is Saturn's moon Titan different than Earth?
18. If the solar system was a one mile wide model, where would Uranus be from the Sun?
19. What is Neptune doing to its moon Triton?
20. What is farthest natural thing that we have been able to find in our solar system? How long does it take to orbit the Sun?
21. Why does Stephen Hawking feel it was a bad idea to "roll out the welcome mat" to other possible life forms?
22. What did you find most interesting about what you learned today?
23. What would you still like to know about our Solar System?

Scale Model of the Solar System Lab

Introduction:
Sizes and distances in the Solar System are difficult to visualize. The distance from the Sun to Earth is 150 million km. The diameter of Jupiter is 140 thousand km. Both of these measurements are so much larger than anything you ever see that they are difficult to imagine. But there is another way of thinking about the Solar System that is much simpler. It involves reducing all the sizes by the same amount: for example, dividing all the sizes and distances by two. These new values can be used to make what is known as a scale model.

Examples of scale models are all around. Model railroads are scale models of trains. A globe is a scale model of Earth. Figure 1 on the next page shows a scale model of the relative sizes of the planets, but their relative distances are not drawn to scale. The advantage of scale models is that they allow us to determine the distance and size of the true object. All that is needed is the scaling factor that was used in making the model. For example, if the wheels of a model car are 10 cm in diameter and the wheels of a real car are 70 cm, then the scaling factor is 70:10 or 7. Now, any size in the real car can be determined by looking at the model car. If the door of the car is 20 cm long, the door of the real car is 20 x 7 .or 140 cm long. Johannes Kepler built a scale model of the Solar System almost 300 years ago using the best estimates for size and distance available at his time. As his base scale, he used what would later become known as the Astronomical Unit, the distance between the center of mass of the Sun and the center of mass of the Earth-Moon system. Once the true length of an AU was found (150 million km), the scaling factor could be determined and the rest of the distances calculated.

Question: How much space is there really between the planets?

Background: *(write a few things that you already know pertaining to about the question above)*

Vocabulary:
Scale model
Scaling factor
Astronomical Unit (A.U.)

Materials:
2 meters of accounting tape (paper)
Meter stick
Marker

Procedure:
Read through the following steps and complete them as described.

1. Before starting this activity; picture in your mind what you think a scale model of the Solar System will look like and write a brief description of it. See if the model you build meets your expectations.

2. Measure the longest distance you can use to the nearest meter and record it in Data Table 1. This distance will represent the distance between the Sun and the dwarf planet Pluto (that is 39.4AU or 5.9 billion km).

3. To calculate the distance from the model sun to each model planet, you need to calculate a scaling factor. Determine the scaling factor by dividing the distance from step 2 above by the distance from the Sun to Pluto. Find this distance in Data Table 2. Record the scaling factor in Data Table 1. For example, if the longest distance usable is 78 m, then the scaling factor is 78 m + 39.3 AU.= 1.98 m/AU

4. Multiply the scaling factor from step 3 by the actual distance from the Sun to each of the planets in AU Use the distances in Data Table 2. Record the answer in the column labeled "scale distance from Sun."

5. Measure out a length of paper equal to the scale distance to Mercury from the Sun. Draw a dot and write "Mercury" on it. From that point continue measuring the same string out to Venus and mark that spot on the string. Continue doing this for all the planets out to Pluto.

6. Continue doing this for each of the planets.

Draw data tables similar to the ones below on your paper.
Data table 1

Largest usable distance (the length of your paper in cm)	Distance to Pluto (in A.U.)	Scaling Factor

Data Table 2

Planetary body	Distance to Sun (A.U.)	Distance to planet (kilometers)	Scale distance from sun (in cm)	Actual diameter (kilometers)
Sun	n/a	n/a	n/a	1,391,980
Mercury	0.39	58,000,000		4,880
Venus	0.72	108,000,000		12,100
Earth	1	150,000,000		12,800
Mars	1.52	228,000,000		6,800
Jupiter	5.20	778,000,000		142,000
Saturn	9.54	1,430,000,000		120,000
Uranus	19.2	2,870,000,000		51,800
Neptune	30.1	4,500,000,000		49,500
Pluto	39.4 (average)	5,900,000,000		2,300

Analysis:
Answer the following questions on lined paper in complete sentences which restate the question in your answer.

1. Describe what your model looks like. Is this different from what you pictured in your mind in step 1? If so, how?
2. The nearest star to Earth is Alpha Gentauri, 274,332 AU away. How far away from the Sun would this be on your scale model of Solar System distances?
3. What are some of the advantages and disadvantages that you see in using a scale model? Be specific and use examples from this activity.
4. If you were to make a scale model of the Milky Way Galaxy, what scaling factor might you use?
5. How big in diameter would the planet Earth be in cm according to your scale? Show your calculations.
6. Some comets travel upwards to 10,000 A.U. into the Oort Cloud. How far would this be on your scale model? Show your calculations.
7. If the planets are so far apart and so small in comparison, why do you think models and posters of the Solar System are always drawn so close together?
8. The size and distance of the planets in relation to each other are often called one of the biggest misconceptions in Science education. What would you recommend we do to make sure this misconception is never conceived?

Spacebook Project

Question: How do parts of our solar system interact and depend on each other?

Background: *(write a few things that you already know pertaining to about the question above)*

Vocabulary:
Status
Wall post

Materials:
Computer
Internet access
Spacebook rough draft sheet
Spacebook template
Spacebook sign-up sheet

Procedure:

Please note that you may not create a real Facebook account and will not have access to www.facebook.com from here at school.

1. Sign up a planet or planetary body from the lists up at the front of the classroom.

2. Review the rubric and make sure you know what is expected in your final draft. Please pay close attention to how it must be submitted for grading as a hard copy may not be handed in for grading.

3. Fill out the Spacebook rough draft **- A rough draft sheet must be completed before you start working on the digital file.**

4. Have your rough draft okay'ed by the teacher. Be sure to keep a log of where you found your information for your works-cited page.

5. Once your rough draft has been okay'ed, open up the digital file found on the Blackboard site under Unit 6 - Planets.

6. Save the file as your first and last name on your own network (H:) drive or a thumb drive. (ex/ “Bob Smith”)

7. Fill in the template with the information from your rough draft

8. When finished, save the file one last time.

9. In the same folder that you found the original Spacebook template, attach and submit a digital copy of your final draft. Please note that once you submit your final draft you will not be able to make any changes.

Use the rubric below and the back side of this sheet to work out what is needed.

Item	**Description**	**Point value**	**Points earned**
Username	What you signed up for your project. *Ex/ Neptune*	1	
Status	Think of something scientific and clever to put as your status to the other planets.	2	
Wall posts pictures (11)	The pictures of the other solar system bodies that are posting on your wall.	5	
Wall posts (11)	Scientific and factual things that the other solar system bodies would post on your wall.	5	
(On left)		---	---
Photo of self	Photo of what your project is of.	1.5	
Relationship status	Ex/ Earth is in a relationship with Luna its moon	1.5	
Current location	Where in the solar system are you located?	1.5	
Birthday	When was your planet found, first seen through a telescope, or some other important date and what happened on that date.	1.5	
Pictures of friends	Pictures of 6 of your closest (moons, planets, and other space bodies)	6	
Information about self	A statement about who you are (at least 30 words)	5	
Total points available		30	

Solar System Travel Project

Introduction:
You are working for a local advertising firm, who has just found out that NASA has finally discovered a way to travel to the different planets. NASA is planning on allowing companies to take people on trips to these planets. Your boss wants your company to do the advertising for these trips and wants you get a jump on the competition. You need to come up with a way to advertise a trip to the planet you choose.

Question: How would you advertise a trip to another planet?

Background: *(write a few things that you already know pertaining to about the question above)*

Vocabulary: *No new vocab*

Materials:
This project sheet
Computer with internet access

Procedure:
Read through the following passage and include the list of items needed.

My Planet is ________________.

Your boss wants to make sure you include certain things that explain to people what the planet is like before they go there. Remember that you are trying to convince people to go to your planet!!!

You need to include:

1. Size – How big is your planet?
2. Atmosphere – What is the atmosphere like on your planet?
3. Rotation & Revolution – How long does it take for your planet to get around the sun (year) and rotate around itself (day)?
4. Travel Time – How long would it take to travel there from earth? What speed would we have to travel to get there!
5. Distance – How far is your planet from the sun? What effect does that have on your planet?
6. Surface Features – what the surface is going to be like on your planet and what types of activities can be done on those surfaces.
7. Tourist Attractions – what are some exciting features of your planet that visitors may be able to see first hand
8. Weather – what are the temperature, pressure and weather patterns like on your planet.
9. Any Moons on your Planet? – What are their names? Why might they be important to our solar system, or anything interesting about them?
10. Anything else significant about your Planet?

Please remember that you are trying to sell your trip to people and the materials and tone that you take in your digital presentation should reflect that!

Ways you can advertise:

Blog – *Use Edublogs to create a blog*

Must have less than 4 tabs, 3 outside web page links, & 2 video links

Website – *Use Weebly to create a website*

Must have less than 4 tabs, 3 outside web page links, & 2 video links

Video Commercial – *Use Windows Movie Maker or like program to create a comm. video.*

Must narrated and between 30 & 60 seconds in length.

Radio commercial - Use Audacity to create a radio advertisement

Must have a music background, be narrated, and between 30 & 60 seconds long.

Any other ideas you have, Get them APPROVED by your instructor before starting!

Two additional requirements:

1. Make sure you include a works-cited page with at least 6 sources from no less than 2 different types of sources was included. Only sources from reputable sources (.gov, .edu, .mil, .org, or other professional organizations) will be counted as part of grade.

2. With your final project you will need to also submit a self reflection. Your self reflection should, at minimum, include the following:
   -What went well and why?
   -What could have been improved and why?
   -How would you improve the project?
   -What did you truly learn from the project?

Solar System Travel Project Rubric   Name: ________________________

Planet: ______________________________

_______/3	Discussed size correctly
_______/3	Discussed atmosphere correctly
_______/3	Discussed rotation & revolution correctly
_______/3	Discussed travel time correctly
_______/3	Discussed distance from sun and effects correctly
_______/3	Discussed major features of the planet (a.k.a. tourist attractions) correctly
_______/3	Discussed weather and weather patterns correctly
_______/3	Discussed the number of moons/interesting facts about the moons correctly
_______/4	Used neatness and creativity in advertising the trip to the planet
_______/8	"Sold" the trip to possible travelers
_______/4	Works cited page was completed MLA format
_______/6	6 reputable sources from at least 2 different types of sources were included
_______/4	Included self reflection

TOTAL:

_______/50