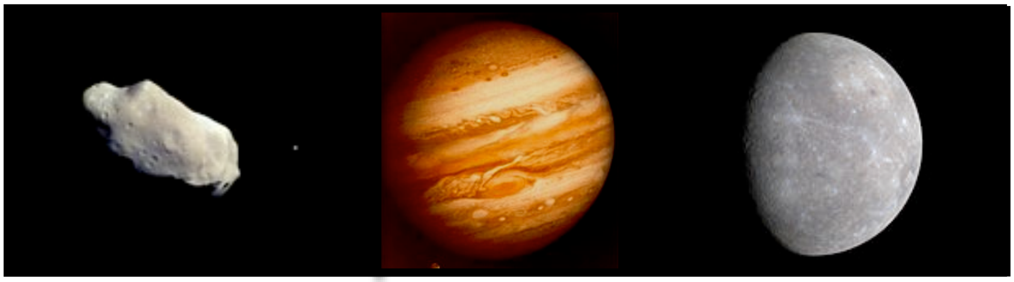
The Planets in the Solar System

There are too many objects in the universe to count. These objects range in size from huge stars to tiny particles of dust. Somewhere between the two extremes are planets. Take Ida, Jupiter, and Mercury as an example.



Ida Jupiter Mercury

All of these objects are big enough to be seen from Earth, but should we classify all three of these objects as a planet? This question has made many people wonder:

How many planets are there in the solar system?

With your group, develop an explanation that can be used to answer this simple, but important, question. Make sure you have good evidence and reasoning to support your explanation. You can record any observations or notes you make as you work in the space below.

Interactive Poster Session

Once your group has developed an explanation that answers this question, prepare a whiteboard that you can use to share and justify your ideas. Your whiteboard should include all the information shown in the diagram at right.

Your Goal What were trying to do?
Your Claim What is your conclusion, explanation or answer to the research question?
Your Evidence and Reasoning How do you know?

To share your work with others, we will be using a **Round-Robin** format. This means that one member of the group will stay at your work station to share your groups' ideas while the other group members will go to the other group one at a time in order to listen to and critique the explanations developed by your classmates.

Remember, as you critique the work of others, you have to decide if their conclusions are valid or acceptable based quality of their explanation and how well they are able to support their ideas. In other words, you need to determine if their argument is ***persuasive and convincing***. To do this, ask yourself the following questions:

- Is their explanation ***sufficient*** (it explains everything it needs to) and ***coherent*** (it is free from contradictions)?

- Did they use ***genuine evidence*** (they organized their data in a way that shows a trend over time, a relationship between variables, or a difference between groups)?

- Did they use ***enough evidence*** to support their ideas (they used more than one piece of evidence and all their ideas are supported by evidence)?

- Is there any ***counterevidence*** that does not support their explanation?

- How well does their explanation ***fit with other theories and laws*** that are used in science to explain or describe how the world works?

- Is their reasoning ***adequate*** (they explain why the evidence was used and why it supports the explanation)?

- Is their reasoning ***appropriate*** (rational and sound)?

Name: ______________________________ Date: _____________

What is your argument? In the space below, write a multi-paragraph essay to persuade another scientist that your claim is valid and acceptable.

Some potentially relevant information about this problem

It is not known with certainty how planets are formed. The ***prevailing theory*** is that they are ***formed during the collapse of a nebula into a thin disk of gas and dust***. A proto-star (proto = early) forms at the core, surrounded by a rotating proto-planetary disk.

Through a process called accretion (sticky collision) dust particles in the disk steadily accumulate mass to form ever-larger bodies. Local concentrations of mass known as planetesimals begin to form, and these accelerate the accretion process by drawing in additional material by their gravitational attraction. These concentrations become ever denser until they collapse inward under gravity to form proto-planets.

When the proto-star has grown massive enough to ignite and form a star, the rest of the disk is removed from the inside outward by photoevaporation, the solar wind, and other similar effects. Thereafter there still may be many proto-planets orbiting the star or each other, but over time many will collide, either to form a single larger planet or release material for other larger proto-planets or planets to absorb.

Some objects in space are spherical shape because of the nature of gravity. The shapes of small objects (like people, houses, mountains, and asteroids) are determined by their physical properties. You can take a rock and cut it into a particular shape and it will pretty much stay that way because it is small. However, if something really big, the force of gravity is great enough to actually change the shape of an object. You can think of gravity as a force that points inward toward the center of a large object so that every part of the surface is pulled evenly toward the center, resulting in a spherical shape.

The basic reason why the ***planets revolve around or orbit the sun*** is that the gravity of the Sun keeps them in their orbits. (*Note*: Rotate is used to describe the spin of planet, for example, the Earth completes one rotation about its axis every 24 hours, but it completes one revolution around the Sun every 365 days.) Just as the Moon orbits the Earth because of the pull of Earth's gravity, the Earth orbits the Sun because of the pull of the Sun's gravity.

Information about some large objects in the solar system

Object	Orbits	Distance from the Sun (in Au)	Shape	Diameter (in km)	Moons	Orbit Eccentricity*	Orbit Inclination	Orbital Zone Clear of Other Similar Sized Objects?
A	The Sun	.4	Sphere	4,879	0	.20	7°	Yes
B	The Sun	.7	Sphere	12,100	0	.01	3°	Yes
C	The Sun	1.0	Sphere	12,700	1	.01	0°	Yes
D	Object C	1.0	Sphere	3,474	0	.05	5°	Yes
E	The Sun	1.6	Sphere	6,800	2	.09	2°	Yes
F	The Sun	2.6	Irregular	580	0	.08	7°	No
G	The Sun	2.9	Sphere	950	0	.08	10°	No
H	The Sun	3.0	Irregular	54	1	.04	1°	No
I	The Sun	3.4	Irregular	570	0	.23	34°	No
J	The Sun	5.4	Sphere	142,984	63	.04	1°	Yes
K	Object J	5.4	Sphere	5,262	0	.01	.2°	No
L	The Sun	10.1	Sphere	120,536	60	.05	2°	Yes
M	The Sun	20.1	Sphere	51,118	27	.04	1°	Yes
N	The Sun	30.4	Sphere	49,528	13	.01	2°	Yes
O	The Sun	49.3	Sphere	2,390	3	.24	17°	No
P	The Sun	51.3	Sphere	946	1	.22	21°	No
Q	The Sun	97.5	Sphere	2,697	1	.44	44°	No
R	The Sun	975.6	Sphere	1,800	0	.85	12°	No

**Note:* Orbit eccentricity values range from 0 (indicates that the orbit is perfect circle) to 1 (indicates that that the orbit is very elongated).

Information about some large objects found in the solar system

Object	Orbits	Distance from the Sun (in Au)	Shape	Diameter (in km)	Moons	Orbit Eccentricity*	Orbit Inclination	Orbital Zone Clear of Other Similar Sized Objects?
Mercury	The Sun	.4	Sphere	4,879	0	.20	7°	Yes
Venus	The Sun	.7	Sphere	12,100	0	.01	3°	Yes
Earth	The Sun	1.0	Sphere	12,700	1	.01	0°	Yes
The Moon	Earth	1.0	Sphere	3,474	0	.05	5°	Yes
Mars	The Sun	1.6	Sphere	6,800	2	.09	2°	Yes
Vesta	The Sun	2.6	Irregular	580	0	.08	7°	No
Ceres	The Sun	2.9	Sphere	950	0	.08	10°	No
Ida	The Sun	3.0	Irregular	54	1	.04	1°	No
Pallas	The Sun	3.4	Irregular	570	0	.23	34°	No
Jupiter	The Sun	5.4	Sphere	142,984	63	.04	1°	Yes
Ganymede	Jupiter	5.4	Sphere	5,262	0	.01	.2°	No
Saturn	The Sun	10.1	Sphere	120,536	60	.05	2°	Yes
Uranus	The Sun	20.1	Sphere	51,118	27	.04	1°	Yes
Neptune	The Sun	30.4	Sphere	49,528	13	.01	2°	Yes
Pluto	The Sun	49.3	Sphere	2,390	3	.24	17°	No
Orcus	The Sun	51.3	Sphere	946	1	.22	21°	No
Eris	The Sun	97.5	Sphere	2,697	1	.44	44°	No
Sedna	The Sun	975.6	Sphere	1,800	0	.85	12°	No

* *Note:* Orbit eccentricity values range from 0 (indicates that the orbit is perfect circle) to 1 (indicates that that the orbit is very elongated).