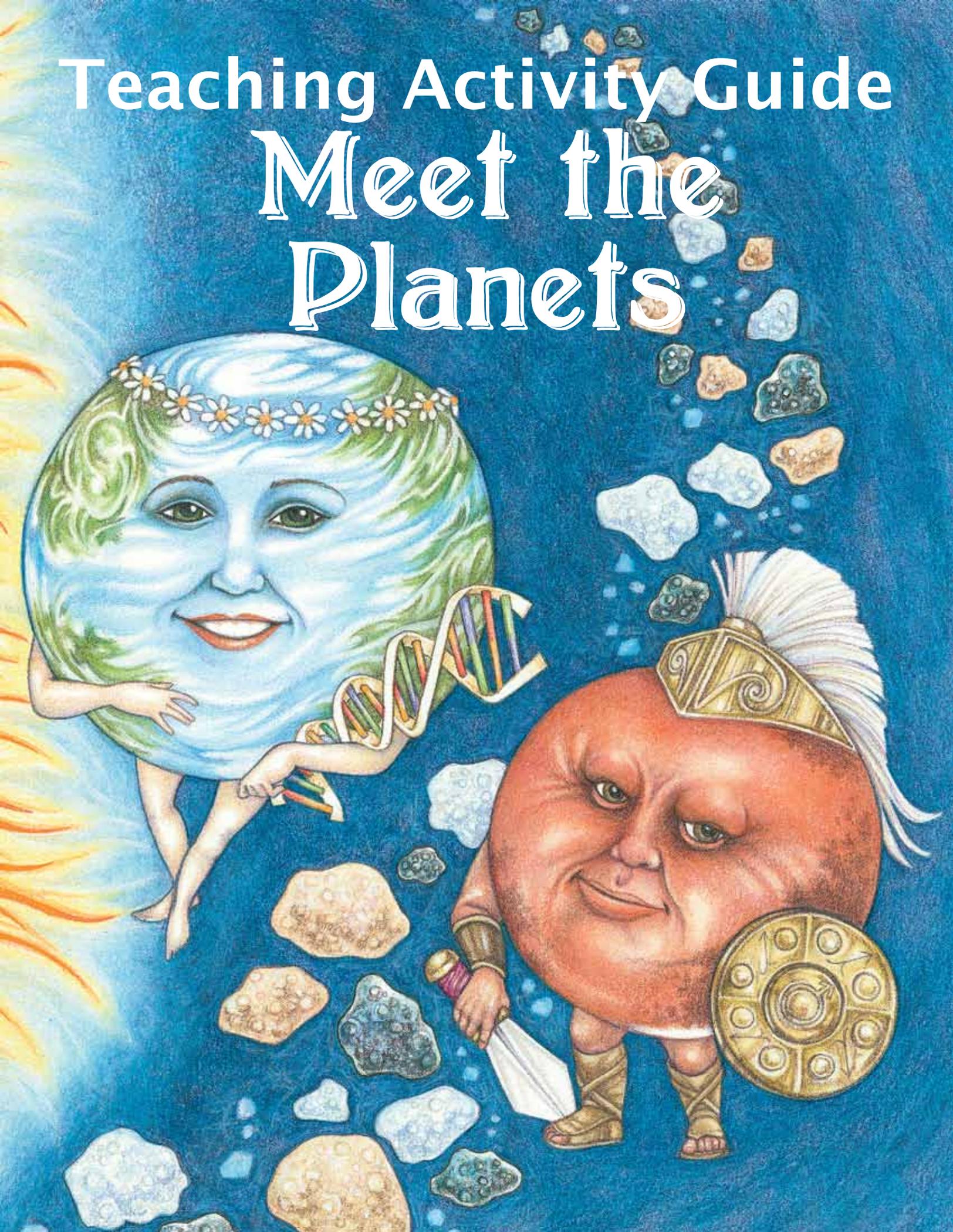


# Teaching Activity Guide

# Meet the Planets



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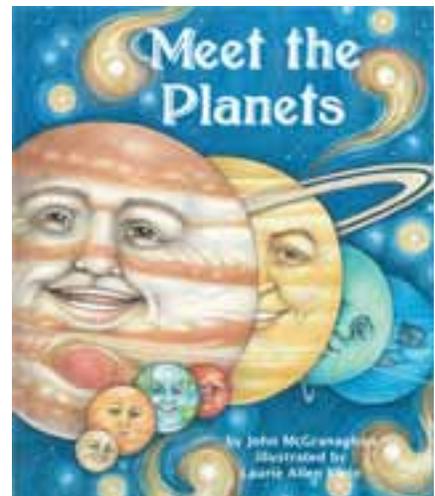
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by John McGranaghan  
illustrated by Laurie Allen Klein

# How to Use This Activity Guide

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There are a wide variety of activities that teach or supplement all curricular areas. The activities are easily adapted up or down depending on the age and abilities of the children involved. And, it is easy to pick and choose what is appropriate for your setting and the time involved. Most activities can be done with an individual child or a group of children.

**Glossary/Vocabulary words:** Words may be written on index cards, a poster board, or on a chalkboard for a “word wall.” If writing on poster board or chalkboard, you might want to sort words into nouns, verbs, etc. right away to save a step later if using for Silly Sentences. Leaving the words posted (even on a refrigerator at home) allows the children to see and think about them frequently. The glossary has some high-level words. Feel free to use only those words as fit your situation.

**Silly Sentence Structure Activity:** Game develops both an understanding of sentence structure and the science subject. Use words from the “word wall” to fill in the blanks. After completing silly sentences for fun, have children try to fill in the proper words by looking for the information in the book.

**Sequence Sentence Strips:** Cut into sentence strips, laminate if desired, and place in a “center.” Have children put the events in order. Children may work alone or in small groups. Cards are in order but should be mixed up when cut apart.

## Planet Card Games:

**Memory Card Game:** Make two copies of each of the sorting card pages and cut out the cards. Or make one copy of the “regular” planets and match to the “personality” planet. Mix them up and place them face down on a table. Taking turns, each player should turn over two cards so that everyone can see. If the cards match, he or she keeps the pair and takes another turn. If they do not match, the player should turn the cards back over and it is another player’s turn. The player with the most pairs at the end of the game wins.

**Who Am I?** Copy and cut out the cards. Poke a hole through each one and tie onto a piece of yarn. Have each child put on a “card necklace” without looking at the planet pictured on it. The card hangs down the back. The children get to ask each person one “yes/no” question to try to guess their planet. If a child does not know the answer, they should say they don’t know. This is a great group activity and a great “ice-breaker” for children who don’t really know each other.

Some suggested or initial “yes/no” questions include:

Am I an inner planet? If the answer is “no,” you know you are an outer planet.

OR

Do I have rings? If the answer is “yes,” you know you are an outer planet, if “no,” you know you are an inner planet.

Do I have moons?

Does life exist on me?

# What Do Children Already Know?

---

Young children are naturally inquisitive and are sponges for information. The whole purpose of this activity is to help children verify the information they know (or think they know) and to get them thinking “beyond the box” about a particular subject.

Before reading the book, ask the children what they know about the subject. A list of suggested questions is below. The children should write down their “answers” (or adults for them if the children are not yet writing) on the chart found in Appendix A, index cards, or post-it notes.

Their answers should be placed on a “before reading” panel. If doing this as a group, you could use a bulletin board or even a blackboard. If doing this with individual children, you can use a plain manila folder with the front cover the “before reading” panel. Either way, you will need two more panels or sections—one called “correct answer” and the other “look for correct answer.”

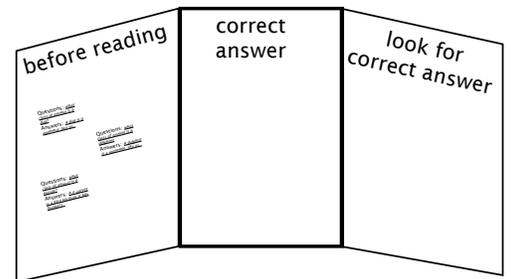
Do the children have any more questions about the subject? If so, write them down to see if they are answered in the book.

After reading the book, go back to the questions and answers and determine whether the children’s answers were correct or not.

If the answer was correct, move that card to the “correct answer” panel. If the answer was incorrect, go back to the book to find the correct information.

If the child/children have more questions that were not answered, they should look them up.

When an answer has been found and corrected, the card can be moved to the “correct answer” panel.



## Pre-Reading Questions

---

How many planets are in our solar system?

What is the name of the planet we live on?

What are the names of the other planets in our solar system?

What are some things you know about some of the other planets?

Do all planets have a moon?

Do any planets have more than one moon?

Around what do the planets revolve?

What is the sun?

What are some other things that are in our solar system?

When did people start studying the night sky?

How do scientists use a telescope to study the planets?

What other ways to scientists study planets or their moons?

# Thinking It Through & Writing Prompts

---

Write a song about the planets or the sun.

Can you think of another title for the book?

Why do you think people used to believe that the Earth was the center of the universe?

What was the first planet to be discovered by a telescope? How were the other planets discovered?

What are some examples of other tools and technology scientists can use to study the planets besides a telescope?

Identify one scientist from the illustrations and describe why his (or her) contribution was important.

There is a lot we still don't know about our solar system. Write about something you want to know about.

## Comprehension Questions

---

What is the competition for?

What are the inner planets and what do they have in common?

List the outer planets and what do they have in common?

How big is the red spot on Jupiter?

What is the planet that is often mistaken for a star?

Which planet is the fastest moving in our solar system?

Which planet's two poles get 42 years of sunlight and 42 years of darkness?

Which planet was named for the Roman King of the sea?

Which planet is slanted?

Which planet is not named after a Greek or Roman god?

# Find in the Art

---

Illustrator Laurie Allen Klein added all kinds of extra things to the art. Descriptions and explanations of who people were, what things are, or even why she used certain colors or layout are explained in the “Answer” section.

## Moons:

Callisto: one of Jupiter’s moons  
Deimos: one of Mars’ moons  
Enceladus: one of Saturn’s moons  
Europa: one of Jupiter’s moons  
Ganymede: one of Jupiter’s moons  
Iapetus: one of Saturn’s moons  
Io: one of Jupiter’s moons  
Mimas: one of Saturn’s moons  
Miranda: one of Uranus’ moons  
Oberon & Titania: two of Uranus’ moons  
Phobos: one of Mars’ moons  
Titan: one of Saturn’s moons  
Triton: one of Neptune’s moons

## Constellations:

Big and Little Dippers  
Cassiopeia  
Cepheus the King  
Draco the Dragon  
Gemini  
Leo the Lion

Stonehenge was built between 2900 BC and 1600 BC, probably by the Druids. This ancient group of stone monuments could have been some kind of astronomical observatory or calendar.



## Planet symbols in the art

## Probes and Spacecrafts

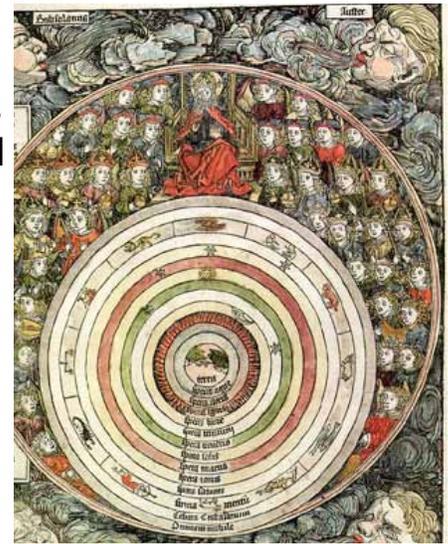
Cassini Space Probe: launched in 2004, this mission is still exploring Saturn and its moons  
Huygens Probe : dropped from the Cassini spacecraft and landed on Titan to transmit data  
Magellan: US planetary probe to Venus in 1994  
Mariner 1: First planetary explorer attempted to fly by Venus in 1962 but veered off course  
Messenger: launched in 2004, this mission is currently exploring Mercury  
Sojourner: a rover that collected samples and data from the Martian surface in 1977  
Venera 14: A Russian probe that landed on Venus in 1982 and sent back photos & data for 57 minutes before melting  
Voyager 2: launched in August, 2007, this spacecraft sent back photos of all of the outer planets

The crowd on the introductory illustration was inspired by the engraving done of the Ptolemaic Universe in 1490. Ptolemy believed that the Earth was the center of the universe and that the sun, stars, and planets all revolved around the Earth. Of course, we now know that the sun is the center of our universe.

The illustrator, Laurie Allen Klein, drew several historical figures (see next page) and paid tribute to: Chinese Astronomers who built observatories and made the earliest known observation of a comet about 2,300 BC.

The Mayans: a pre-Columbian culture in Mexico and Central America that built an astronomical observatory around the year 1,000.

Mrs. Klein enjoys science fiction movies and you'll also find some fun aliens scattered throughout the art!



The layout, and general look, of the Venus page illustration is based on Botticelli's "Birth of Venus." Compare and contrast the two.



Halley's Comet as seen in the Bayeux Tapestry—an 11th or 12th century tapestry showing artistic depictions of the comet from a variety of different cultures and time periods.

A set of 1,670 on-off pulses was transmitted into space sending a message to any intelligent life form that might be out there somewhere. This number is the result of multiplying two prime numbers, 23 and 73, and the message becomes clear when laid out in 73 rows of 23 columns. With black squares for 1s and white squares for 0s, a pictogram is produced.



# People of History in the Art

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Find the people (and one dog) in the art. Why do you think the illustrator put that person in the illustration?

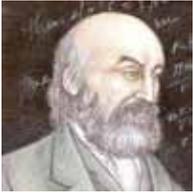
If a year is given for an event or when the person lived, what are some other things that might have been happening about that time?

If desired, put the people on a timeline.

Which person (or people) were among the first astronomers?

Which people were living/star gazing about the same time?

Which people lived in the last 50 to 100 years?



John Couch Adams - 1819 to 1892 - A British mathematician who discovered Neptune mathematically.



Abd al Rahman Al-Sufi - 964 - a Persian astronomer, compiled "The Book of Fixed Stars."



Benjamin Banneker - 1731 to 1806 - 1st African American astronomer, mathematician & scientist who calculated the astronomical tables & predicted an eclipse which was not easy to do at the time.



Subrahmanyan Chandrasekhar - 1910 to 1995 - An astrophysicist who was awarded the Nobel Prize in Physics in 1983 for his studies on the physical processes important to the structure and evolution of stars.



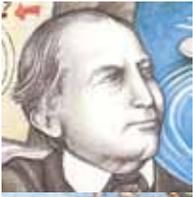
Nicolaus Copernicus - 1473 to 1542 - A Polish astronomer who suggested that the Sun was at the center of the planetary system, not the Earth.



Albert Einstein - 1879 to 1955 - A German physicist whose theories transformed the way we look at time and space.



Galileo - 1564 to 1624 - An Italian astronomer who revolutionized astronomy and proved Copernicus' theory that the Earth revolves around the Sun.



Johann Galle - 1812-1910 - A German astronomer who used Leverrier and Adams' mathematical predictions and is the 1st credited person to see Neptune.



Edmond Halley - 1656 to 1742 - An English astronomer who was the 1st to discover that some comets are regular visitors



Caroline Herschel - 1750 to 1848 - An English astronomer and sister of William Herschel. She was the 1st woman to find a new comet and eventually discovered eight.



William Herschel - 1738 to 1822 - An English musician and astronomer who discovered Uranus.



Gustav Holst - 1874 to 1934 - An English composer known for his orchestral suite, "The Planets."



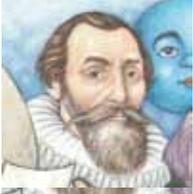
Edwin Hubble - 1889 to 1953 - An American astronomer after whom the Hubble Telescope was named, the 1st to study distant star systems, devised a classification of galaxies according to shape.



Christiaan Huygens - 1629 to 1695 - A Dutch scientist & astronomer who identified and described Saturn's rings.



Hypatia - 415 - female astronomer, astrologer, mathematician



Johannes Kepler - 1571 to 1630 - A German mathematician who formulated three laws of planetary motion.



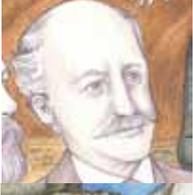
Laika - 1957 - The first living thing (a dog) sent into space on the Sputnik.



Henrietta Leavitt - 1868 to 1921 - An American astronomer whose discovery of a class of pulsating variable stars that helps determine distance between many stars and galaxies changed the theory of modern astronomy.



Urbain Leverrier - 1811 to 1877 - A French mathematician who also discovered Neptune mathematically.



Percival Lowell - 1855 to 1916 - American astronomer who made a beautiful series of drawings of the Martian canals described by Schiaparelli



Magellan - 1480 to 1521 - A Portuguese navigator who commanded the first expedition around the world (although he did not complete the trip). One of the 1st Europeans to see the Magellanic Clouds.



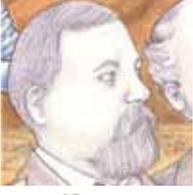
Maria Mitchell - 1818 to 1889 - An American astronomer, the 1st woman since Caroline Herschel to discover a comet, 1st woman member of the American Academy of Arts and Sciences.



Ptolemy - 100 to 178 - Alexandrian Greek philosopher & astronomer who thought Earth was the center of the universe.



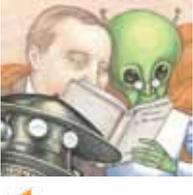
Carl Sagan - 1934-1996 - An American astronomer & astrophysicist who helped develop and assemble the gold record, containing sounds and images of Earth, that was sent on the Voyager space probes.



Giovanni Schiaparelli - 1835 to 1910 - an Italian astronomer who noticed a series of dark lines that looked to form some sort of “network” on the surface of Mars.



Thales - 624 BC to 546 BC - Greek astronomer who predicted a solar eclipse



H. G. WELLS - 1866 to 1946 - English writer, reading a 1st edition copy 1897 copy of his novel, “War of the Worlds,” with a Martian

# Vocabulary Game

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This activity is a very general idea and is designed to get children thinking of vocabulary words that will then be used as the beginning vocabulary list for a science lesson.

Select an illustration from the book and give the children a specific length of time (five minutes?) to write down all the words they can think of about the particular subject. If you do not have classroom sets of the book, it is helpful to project an illustration on a whiteboard. Check Web site ([www.ArbordalePublishing.com](http://www.ArbordalePublishing.com)) for book “previews” that may be used.

The children’s word list should include anything and everything that comes to mind, including nouns, verbs, and adjectives. At the end of the time, have each child take turns reading a word from his/her list. If anyone else has the word, the reader does nothing. However, if the reader is the only one with the word, he/she should circle it. While reading the list, one person should write the word on a flashcard or large index card and post it on a bulletin board or wall. At the end, the child with the most words circled “wins.” And you have a start to your science vocabulary list. Note: if a child uses an incorrect word, this is a good time to explain the proper word or the proper usage.

## Using the Words

---

The following activities may be done all at once or over a period of several days.

- Continue to add words to the vocabulary list as children think of them.
- Sort vocabulary words into nouns, verbs, adjectives, etc. and write what they are on the backs of the cards. When the cards are turned over, all you will see is “noun,” etc. (these can then be used to create silly sentences on the next page).
- Now sort the vocabulary words into more specific categories. For example, nouns can be divided into plants, animals, rocks, minerals, etc. They can be divided into living/non-living, or into habitat-related words.
- Have children create sentences using their vocabulary words. Each sentence could be written on a separate slip of paper.
- Have children (individually or in small groups) sort and put sentences into informative paragraphs or a story.
- Edit and re-write paragraphs into one informative paper or a story.



## Sequence Sentence Strips

---

He's named after the speedy messenger of the gods; now you see him, now you don't . . . meet Mercury!

As the brightest planet seen from Earth, she's often mistaken for a star . . . welcome Venus!

Not too hot, not too cold, her seas and skies have given life to everything from dinosaurs to daisies . . . meet Mother Earth.

Early astronomers thought he looked like blood and named him after the god of war . . . don't mess with Mars.

The is the largest planet in the Solar System . . . the massive, gassive Jupiter

Surrounded by a dazzling display of rings, some say he's the most beautiful planet of all . . . welcome Saturn.

This planet is slanted. . . meet Uranus.

Before telescopes could find this planet, astronomers used math to predict his existence. . . . here comes Neptune.

# Word Search

Find the hidden words. Even non-reading children can match letters to letters to find the words! Easy—words go up to down or left to right (no diagonals). For older children, identify the coordinates of the first letter in each word (number, letter).

	A	B	C	D	E	F	G	H	I	J
1	P	U	N	E	T	B	U	V	E	Q
2	L	M	E	R	C	U	R	Y	S	A
3	A	M	P	D	S	E	A	R	T	H
4	S	A	T	U	R	N	N	M	I	J
5	F	R	U	A	Y	I	U	O	C	U
6	A	S	N	T	J	U	S	O	W	P
7	T	V	E	N	U	S	U	N	U	I
8	R	O	H	G	A	T	W	A	S	T
9	I	L	O	X	U	M	I	L	N	E
10	P	A	T	U	K	Y	U	S	O	R

MERCURY

VENUS

EARTH

MARS

JUPITER

SATURN

URANUS

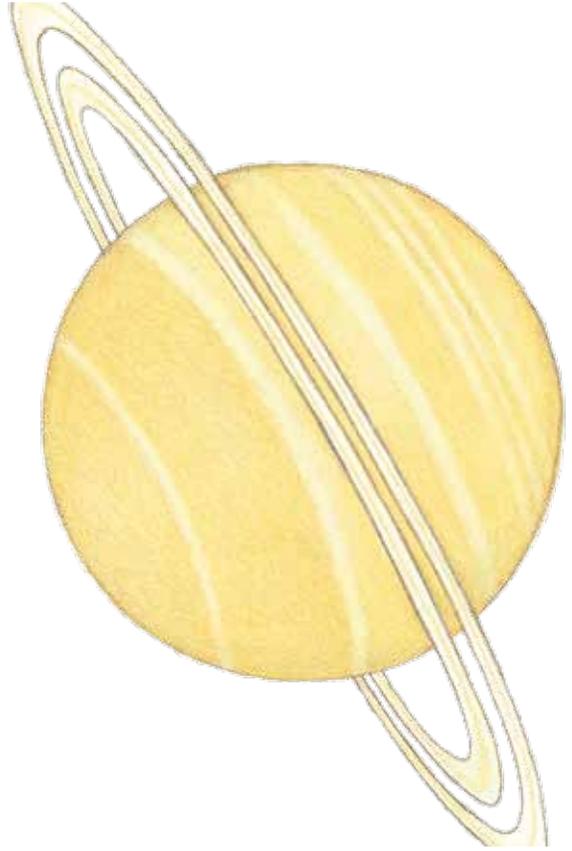
NEPTUNE

MOON

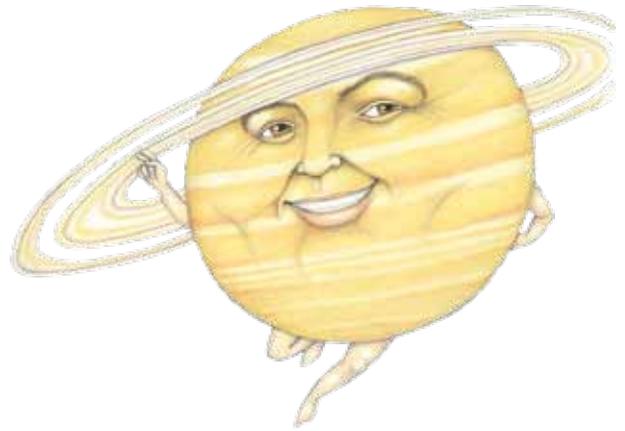
SUN

# Solar System Cards









My favorite planet is:

This is where it is in the solar system:

It has \_\_\_\_\_ moons

Something special about my favorite planet:

What is another of its physical adaptations and how does it help the animal live in its environment?

# Rotation or Revolution?

**rotate:** to turn about an axis or a center, to spin

**revolve:** to move in a curved path around a center or axis, to orbit

The difference between rotating and revolving can be confusing. Can you identify what rotates and what revolves?

1. Does a basketball spinning on someone's finger is rotate or revolve?



2. When you open a door, do you rotate or revolve the doorknob?



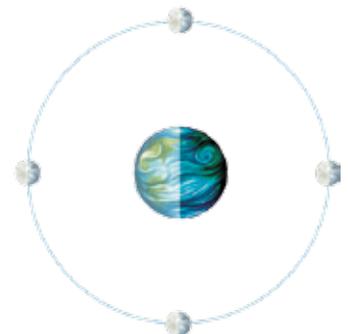
3. Do bike wheels rotate or revolve around their axis?



4. Does the moon rotate or revolve around the Earth?

5. Does the Earth rotate or revolve around the Sun?

6. Does the Earth rotate or revolve around its axis?



Planet		Revolves around Sun*	Rotates on its axis*
Mercury	♀	88 days	59 days
Venus	♀	225 days	243 days
Earth	⊕	365.25 days	one day
Mars	♂	687 days	one day
Jupiter	♃	12 years	10 hours
Saturn	♄	29 years	10 1/2 hours
Uranus	♅	84 years	17 hours
Neptune	♆	165 years	16 hours

\*The rounded lengths of time are shown in Earth time measurements.

Answers: 1) rotate, 2) rotate, 3) rotate, 4) revolve, 5) revolve, 6) rotate

## Rotation

my definition

my drawing

## Revolution

my definition

my drawing

# Inner Planets

my definition

my drawing

# Outer Planets

my definition

my drawing

## True or False?

---

Circle whether you think the statement is true or false:

1. T/F The sun, moon, and other planets all revolve around the Earth.
2. T/F The Earth is the largest planet in the solar system.
3. T/F Our month comes from the length of time it takes the Earth to revolve around the moon.
4. T/F All inner planets are rocky and have oceans.
5. T/F All outer planets are rocky and have rings.
6. T/F Humans could probably live on Mars.
7. T/F Not all planets have moons.
8. T/F Planets, their moons, and the sun are the only thing in the solar system.
9. T/F The sun is a star that gives us heat and light.
10. T/F Our year comes from the amount of time it takes the Earth to rotate around the Sun.

Answers: 1) False, everything revolves around the sun, 2) False, Jupiter is the largest planet in the solar system, 3) False, it comes from the length of time it takes to moon to revolve around the Earth, 4) False, all are rocky but the Earth is the only planet with oceans, 5) False, all the outer planets have rings but are made of gas, not rocks. 6) False, 7) True, 8) False, there are meteors, asteroids, and comets too. 9) True, 10) False, the year comes from the amount of time to revolve around the Sun.

# Which Planet?

Can you identify the planets? The information is found in the book:

1. Which planet is so light it could float?
2. Which planet has winds swirling at over 1,000 mph (note that hurricane force winds start at 74 mph...).
3. Which planet is tilted sideways?
4. Which planet looks red from its iron-rich soil?
5. Which planet has given life to everything from dinosaurs to daisies?
6. Which planet has a red spot the size of two Earths?
7. Which planet is often mistaken for a star?
8. Which planet is not too hot, not too cold, it's just right?
9. Which planet is slanted?
10. Which planet's existence was predicted by mathematicians before it was seen through a telescope?
11. Which planet is named after the Roman god of agriculture (hint: one of our weekend days was named after this same god)?
12. Which planet is named after the speedy messenger of the Roman gods?
13. Which planet is named after the Roman god of war?
14. Which planet was named after the Roman king of the gods?
15. Which planet is named after the Roman god who was Jupiter's grandfather and Saturn's father?



Answers: 1) Saturn, 2) Neptune, 3) Uranus, 4) Mars, 5) Earth, 6) Jupiter, 7) Venus, 8) Earth, 9) Uranus, 10) Neptune, 11) Saturn, 12) Mercury, 13) Mars, 14) Jupiter, 15) Uranus

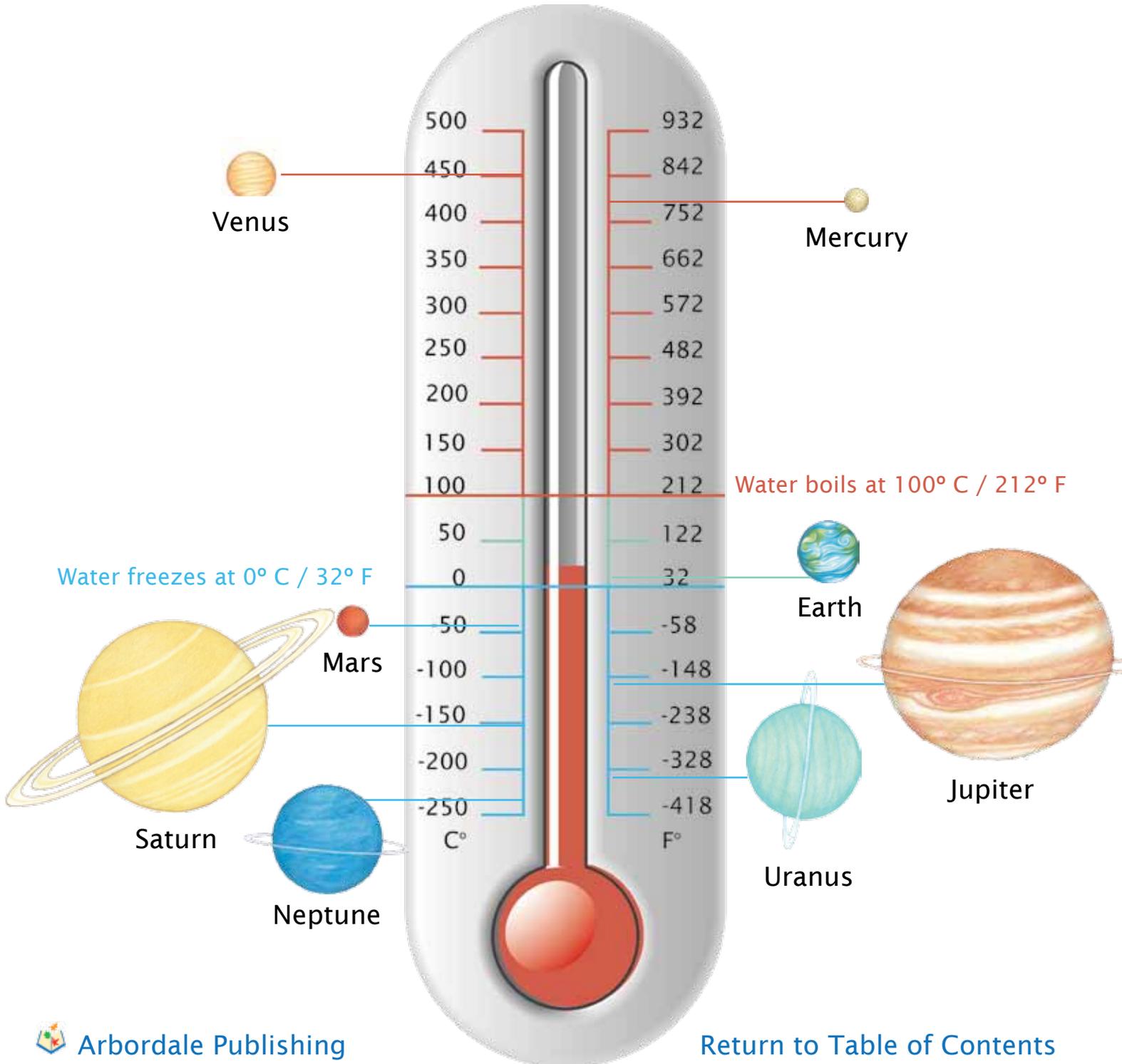
# Temperatures

What is today's outside temperature where you live? Is that hot or cold?

What's the hottest temperature you've ever experienced? What did you do to cool down?

What's the coldest temperature you've ever experienced? What did you do to stay warm?

How do those temperatures compare to temperatures on other planets?



# Scale and Distance

---

This is a really fun project to do with a group of children, but you do need quite a bit of space. If at school, you might be able to do it in a hallway or on the playground. If at home, you will probably need to do it on a sidewalk or road without much traffic.

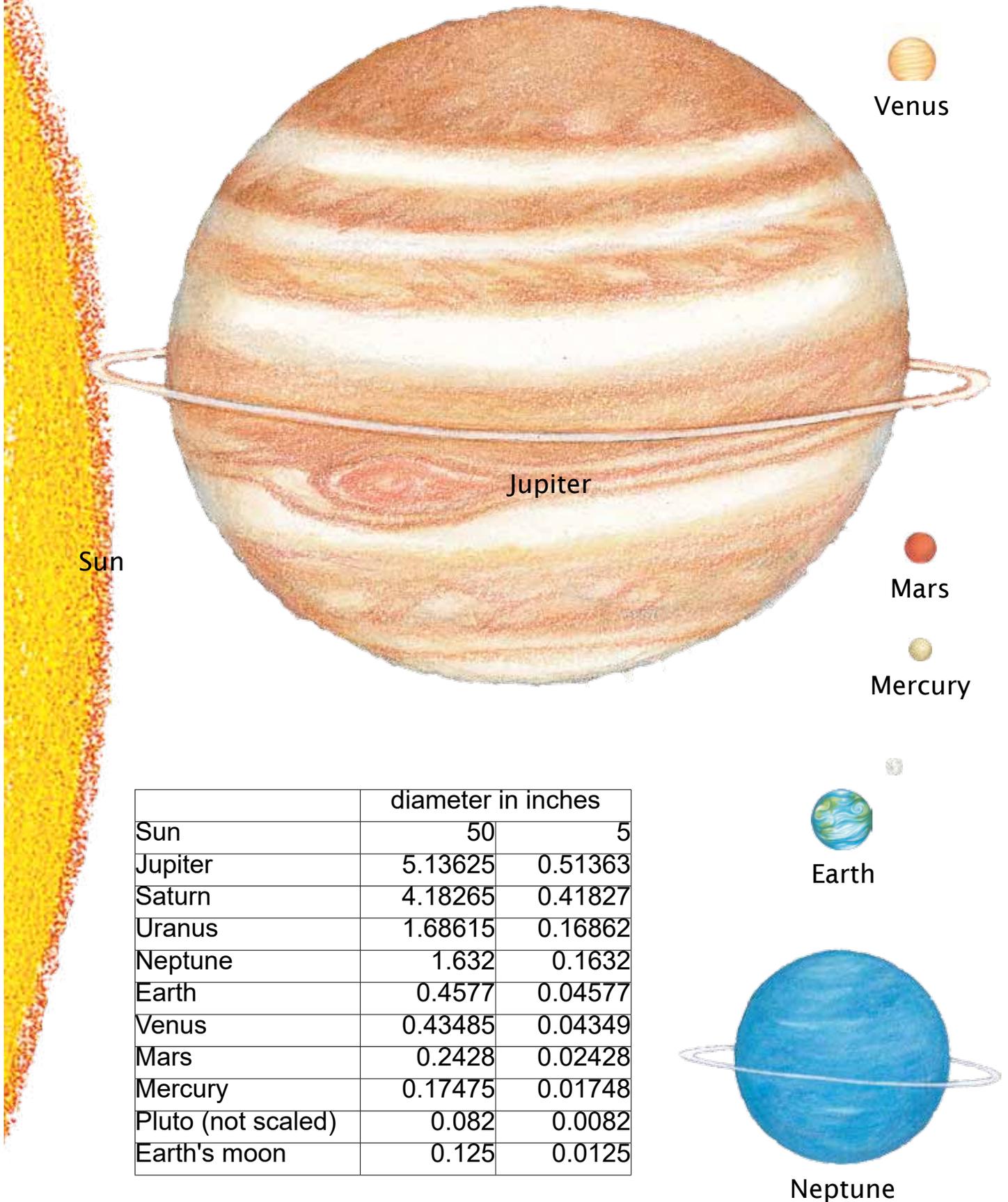
In order to scale the planets as seen in the book, we used the converter at Nine Planets and set the diameter of the Sun at 50 inches, as shown on the next two pages and on the scaled sorting cards. However, with that scale, you would not be able to equate to the distance scale...unless it spreads for a few miles. To find a distance scale that would work, we re-scaled the planets down to ten percent.

If desired, find objects that are approximately the same size as the 10%-scaled planets to use for the distance scaling. Or use both copies of the scaled planets to “mark” the distances: the larger planets are more visible but the understanding of the size comparison is necessary to help understand the distance scale.

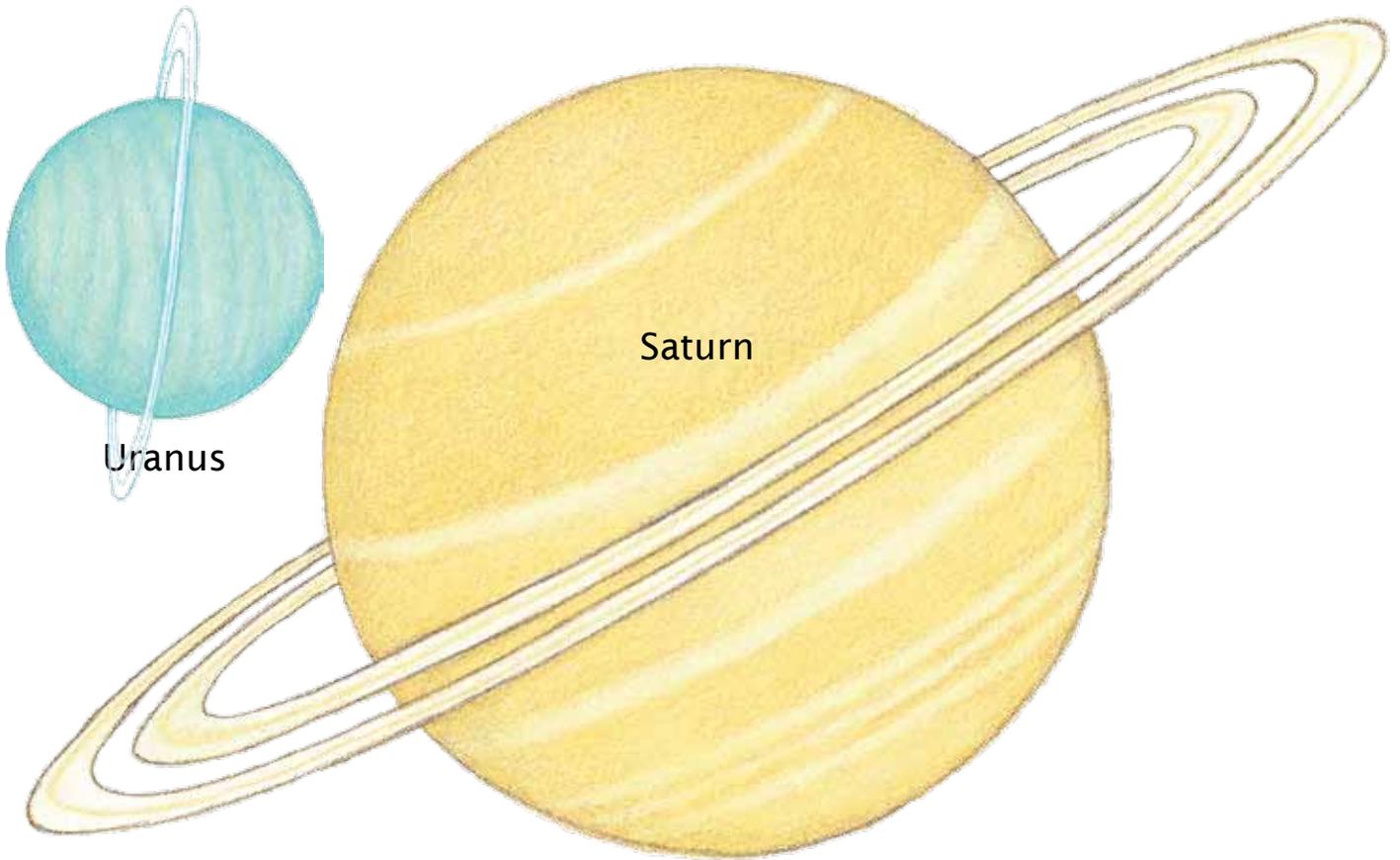
Using the chart below, you might want to round the measurements. Start with the sun and place it as your “start point.” Use a measuring tape or yardstick to measure out the rounded measurement for Mercury and place or mark your “Mercury” that distance away. Instead of measuring each planet from the sun, you can subtract the distance of the planet before it and just measure the difference.

<b>Orbit Radius or distance from the Sun</b>			
	<b>kilometers</b>	<b>meters</b>	<b>feet and inches</b>
Mercury	57,950,000	5.287	17 ft & 4.16 in
Venus	108,110,000	9.864	32 ft & 4.35 in
Earth	149,570,000	13.647	44 ft & 9.28 in
Mars	227,840,000	20.788	68 ft & 2.44 in
Jupiter	778,140,000	70.999	232 ft & 11.24 in
Saturn	142,700,000	130.202	427 ft & 2.08 in
Uranus	287,030,000	261.892	1347 ft & 0.59 in
Neptune	449,990,000	410.48	1770 ft & 0.75 in
	<b>Round to:</b>		<b>Distance between</b>
	<b>feet</b>	<b>yards &amp; feet</b>	<b>planets</b>
Mercury			
Venus			
Earth			
Mars			
Jupiter			
Saturn			
Uranus			
Neptune			

Sun and planets scaled as seen in the book (diameter of sun = 50 inches):



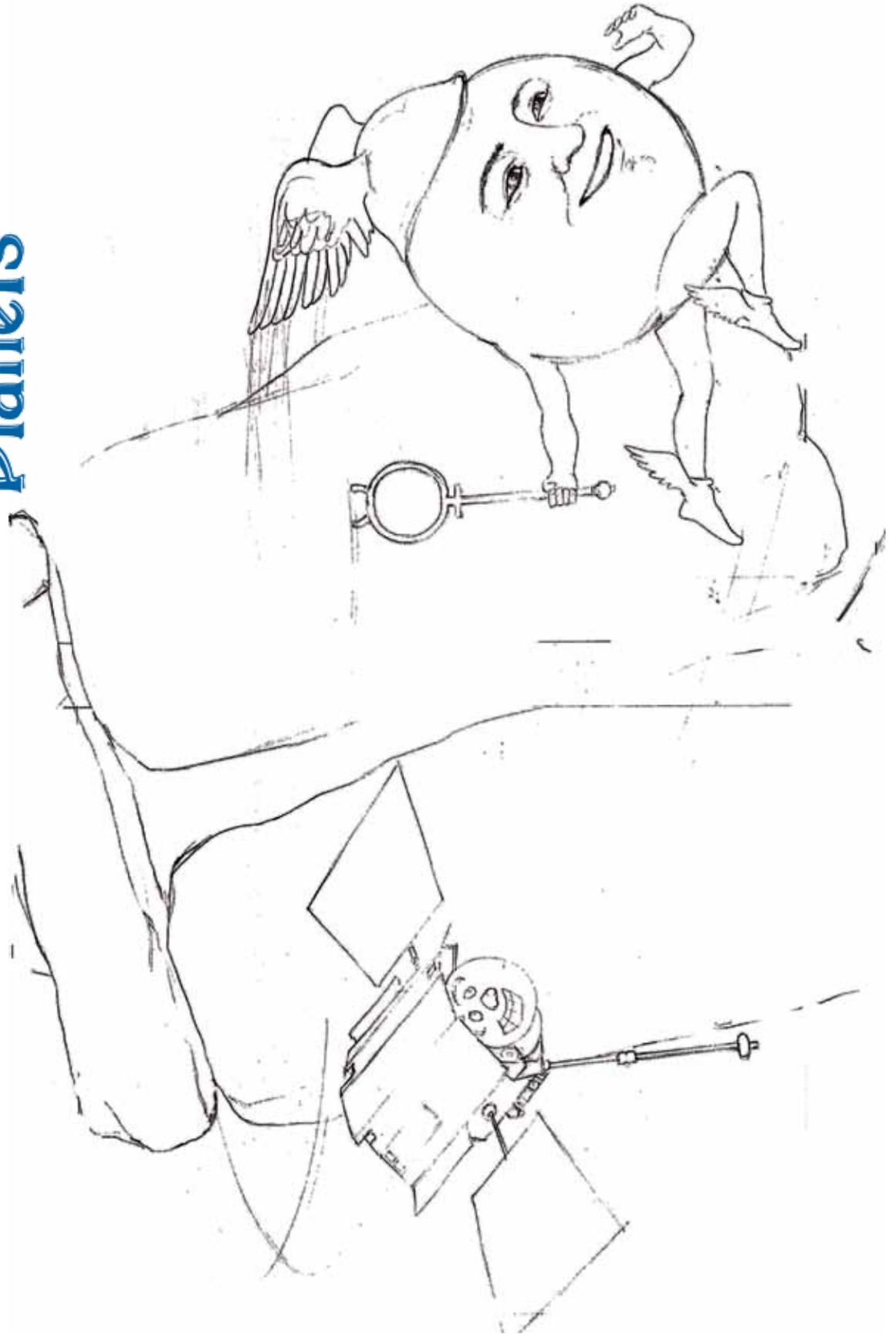
	diameter in inches	
Sun	50	5
Jupiter	5.13625	0.51363
Saturn	4.18265	0.41827
Uranus	1.68615	0.16862
Neptune	1.632	0.1632
Earth	0.4577	0.04577
Venus	0.43485	0.04349
Mars	0.2428	0.02428
Mercury	0.17475	0.01748
Pluto (not scaled)	0.082	0.0082
Earth's moon	0.125	0.0125



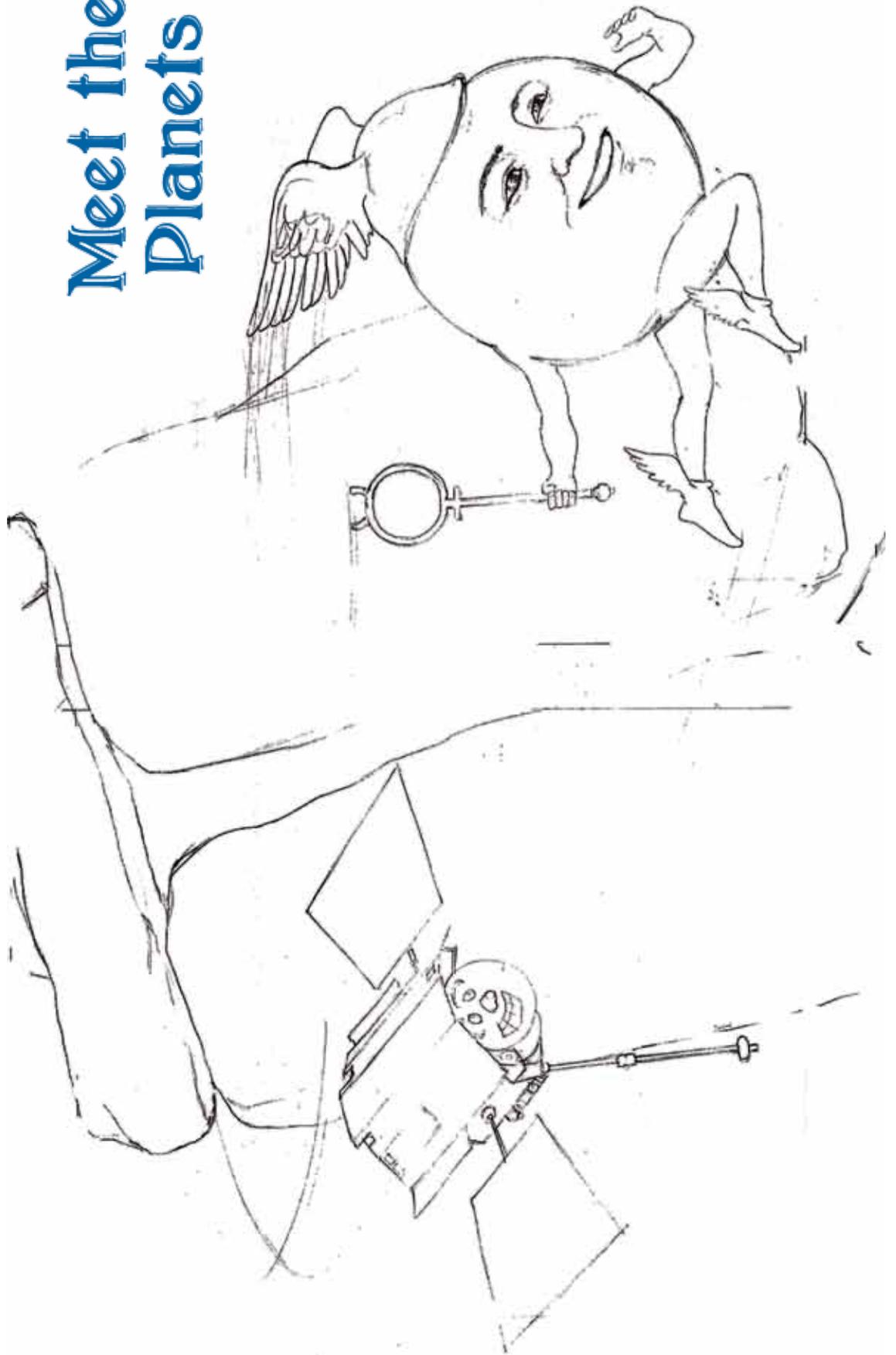
Sun and planets scaled for distance measurements on next page:



## Meet the Planets



# Meet the Planets



# Meet the Planets



# Glossary

Word	Definition	Part of Speech	Spanish
asteroid	a small rocky body orbiting the Sun, too small to be a planet	noun	asteroide
asteroid belt	a region of the solar system between the orbits of Mars and Jupiter in which most asteroids are located.	noun	cinturón de asteroides
astronomer	a scientist that studies the stars and moons found in outerspace	noun	astrónomo
bright	strong, shiny light	adjective	brillante
Cassini Space Probe	a spacecraft studying the planet Saturn	noun	Sonda Espacial de Cassini
Cassiopeia	a constellation (pattern of stars) the looks like the shape of a queen	noun	Casiopea
constellation	a star pattern, usually named after mythological gods, people, animals and objects	noun	constelación
Copernicus	an astoronomer that discovered that the planets spun around the sun	noun	Copérnico
crater	a large round hole on the surface of a planet caused by a volcanic explosion or meteorite hit	noun	cráter
dazzling	shiny, bright	adjective	deslumbrante
Draco	a constellation that looks like a dragon	noun	Draco
dwarf planet	a celestial body that orbits our sun that is larger than a satellite (moon) but smaller than a planet	noun	planeta enano
Earth	the planet on which we live, third planet from the sun	noun	Tierra

<b>Word</b>	<b>Definition</b>	<b>Part of Speech</b>	<b>Spanish</b>
first quarter	about a week (1/4) into lunar month, right-hand side of moon is visible	noun	Cuarto Creciente
full moon	the phase of the moon when it is completely lit up by the sun and able to be seen as a whole	noun	plenilunio, la luna llena
galaxy	a system of millions or billions of stars, together with gas and dust, held together by gravitational attraction	noun	galaxia
Galileo	an Italian astronomer who was the first to use a telescope to look at outerspace	noun	Galileo
gas	a state of matter that has no definite shape or volume	noun	gas
Herschels	brother & sister (late 1700s/ early 1800s) who discovered Uranus and many comets with homemade telescopes	noun	Herschels
Hypatia	a (female) Greek philosopher (370-415 AD) who invented the astrolabe	noun	Hypatia
inner	inside, close to	adjective	interior
inner planets	"the four rocky planets (Mercury, Venus, Earth, and Mars) whose orbits are closest to the sun." "	noun	planetas interiores
Jupiter	the fifth planet from the sun, largest planet in our solar system, named for the king of ancient Roman gods.	noun	Júpiter
last quarter	the last of the 4 phases of the moons rotation	noun	Cuarto Menguante
Leo the Lion	a familiar constellation seen in the spring in the northern hemisphere	noun	Leo el León
lunar	relating to the Earth's moon.	adjective	lunar

<b>Word</b>	<b>Definition</b>	<b>Part of Speech</b>	<b>Spanish</b>
lunar month	the average time between successive new or full moons, equal to 29 days 12 hours 44 minutes	noun	mes lunar
Mariner	NASA space probes that explored Mars, Venus, and Mercury	noun	Mariner
Mars	Fourth planet from the sun. Named for the Roman god of war. Other than Earth, Mars is the most explored planet in our solar system.	noun	Marte
Mars Rover	remote controlled vehicles sent to Mars to do research	noun	Los gemelos Rover de Marte
Mercury	the closest planet to the sun	noun	Mercurio
meteor	shooting star: a bright streak of light in the sky from a meteoroid or a small icy particle entering the Earth's atmosphere	noun	meteoro, bólido
Milky Way Galaxy	the spiral galaxy containing our sun and solar system	noun	Vía Láctea
moon	the natural satellite of the earth, orbiting it every 28 days and shining by reflected light from the sun; any natural body that revolves around a planet	noun	luna
NASA	National Aeronautics and Space Administration	noun	NASA
Neptune	the eighth planet from the sun, named for the ancient Roman god of the sea	noun	Neptuno
new moon	a crescent shaped moon because its passing between the sun and the earth	noun	luna nueva
orbit	an object's path as it goes around another object	noun	órbita

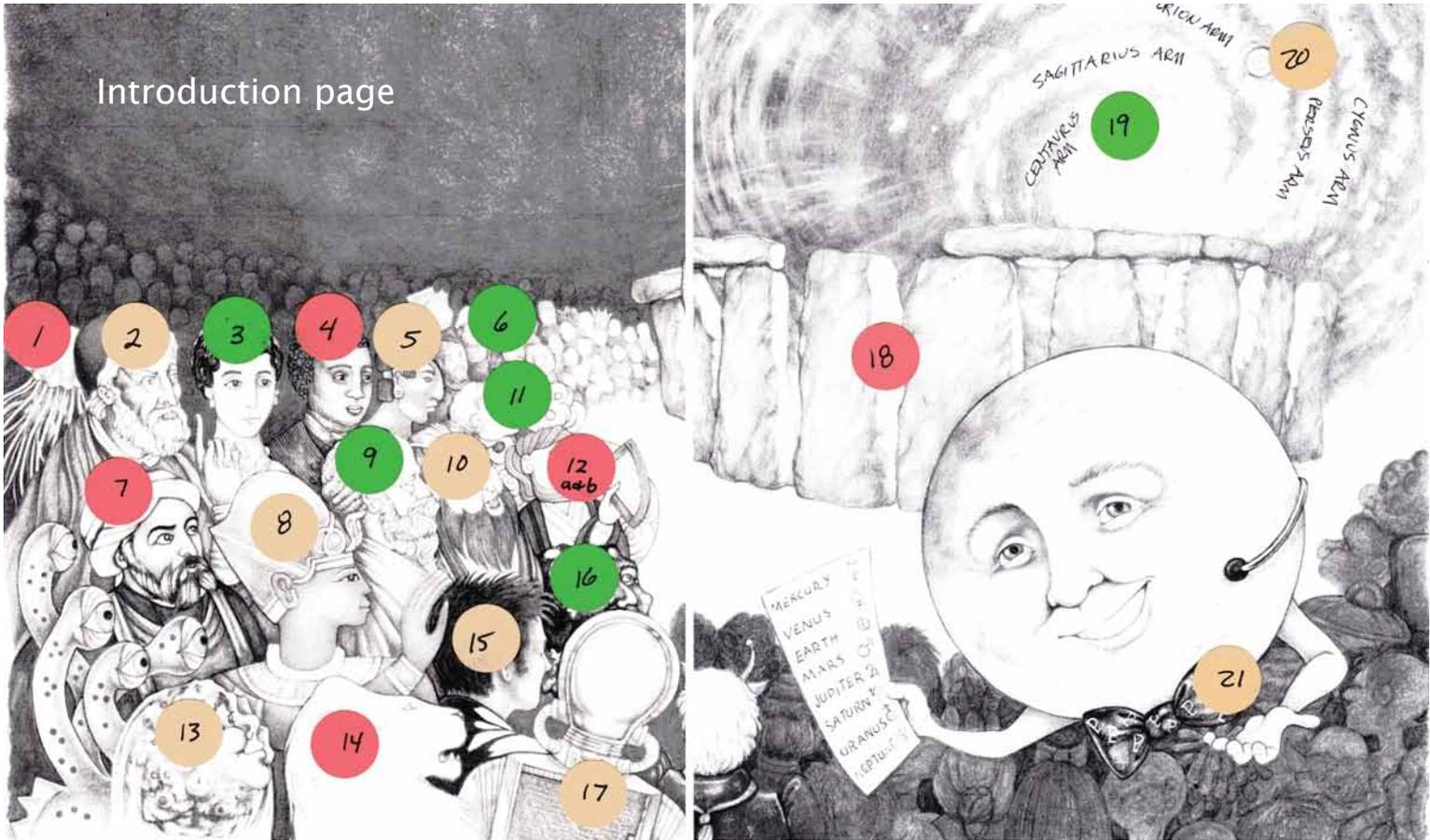
<b>Word</b>	<b>Definition</b>	<b>Part of Speech</b>	<b>Spanish</b>
outer	on or around the outside of something, far from the center of something	adjective	externo
outer planets	Jupiter, Saturn, Uranus, Neptune, and Pluto (all gaseous with rings)	noun	planetas exteriores
oxygen	a colorless and odorless gas that is needed by people and animals to live	noun	oxígeno
planet	a large ball of rock and/or gas that orbits a star (in our case, the Sun)	noun	planeta
Pluto	named for the Roman god of the underworld, used to be considered a planet but now considered a dwarf planet	noun	Plutón
poles	either ends of the earth , North and South Poles	noun	polos
predict	to make an educated guess, based on evidence or a pattern	verb	predecir
predict	to make an educated guess about an outcome	verb	predecir
Ptolemy	an ancient Greek (90-168 AD) astronomer who came up with the first theories of the the solar system.	noun	Ptolomeo
revolution	the motion of the planets in their orbit around the Sun	noun	revolución
revolve	to move in a curved path around a center or axis	verb	girar en órbita
ring (planetary)	circle of ice around an outer planet (Saturn, Jupiter, Uranus, Neptune)	noun	anillo planetario
rocky	having lots of or made of rocks	adjective	de roca
rotate	to turn about an axis or a center	verb	rotación
satellite	any object, man-made or natural, that orbits another body.	noun	satélite

<b>Word</b>	<b>Definition</b>	<b>Part of Speech</b>	<b>Spanish</b>
Saturn	sixth planet from the sun, second largest planet in our Solar System, know for its rings	noun	Saturno
slanted	at an angle	adjective	inclinado
solar system	a system of planets and other bodies orbiting a star	noun	sistema solar
solid	a state of matter that has a definite shape and volume	adjective	sólido
spacecraft	a vehicle made to travel in space	noun	nave espacial
speed	the measure of how fast an object is moving	noun	rapidez
star	a huge ball of hot gases that gives off energy including light and heat	noun	estrella
Stonehenge	stone monument in England believed to have been built around 2500 BC that some believe was used as an early astronomical calendar	noun	Stonehenge
stormy	windy, rainy weather	adjective	tempestuoso
sun	the star closest to Earth, the center of our solar system; a ball of hot, glowing gases giving Earth heat and light.	noun	sol
swirl	to move quickly in a circle	verb	arremolinarse
tally mark	a mark used to keep track of data being counted.	noun	marca de conteo
telescope	a scientific instrument that magnifies distant images	noun	telescopio
temperature	the warmth or coldness of something; measured with a thermometer	noun	temperatura
Triton	Neptune's largest moon	noun	Tritón
Uranus	the seventh planet from the sun, third largest planet in our solar system	noun	Urano

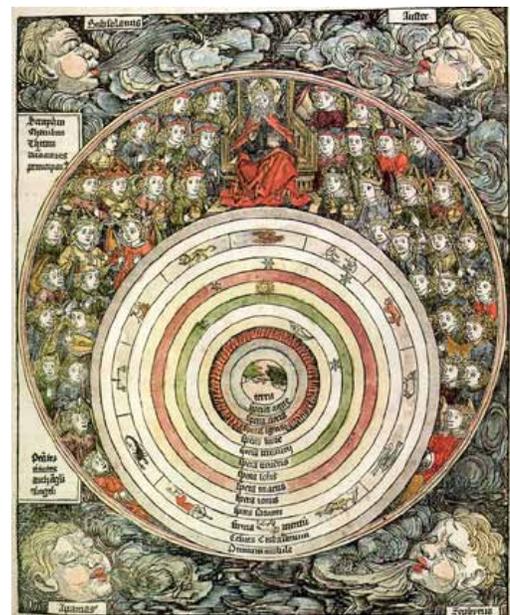
<b>Word</b>	<b>Definition</b>	<b>Part of Speech</b>	<b>Spanish</b>
Venus	the second planet from the sun, named for the Roman goddess of love and beauty.	noun	Venus
waning	shrinking	adjective	menguante
waning crescent	shrinking moon between third quarter and new moon	noun	creciente menguante
waning gibbous	shrinking moon between full moon and third quarter	noun	gibosa menguante
waxing	growing	adjective	creciente
waxing crescent	growing moon between new moon and quarter moon	noun	luna creciente
waxing gibbous	growing moon between quarter moon and full moon	noun	gibosa creciente

# Answers

## In the art



- 1 JELLYFISH are the first primitive animals to appear on Earth 600 million years ago.
- 2 PTOLEMY (100-178) was an Alexandrian Greek philosopher & astronomer who thought the Earth was the center of the universe.
- 3 HYPATIA (415) was an Alexandria female astronomer, astrologer, and mathematician.
- 4 BENJAMIN BANNEKER (1731-1806) was the first African American astronomer, mathematician and scientist. He calculated the astronomical tables and predicted an eclipse, which was difficult to do at the time.
5. MAYANS (1000) built an observatory.
- 6 Crowd inspired by 1490 engraving of the PTOLEMAIC UNIVERSE (on right)
- 7 ABD AL-RAHMAN AL-SUFI (964) was a Persian astronomer who compiled "The Book of Fixed Stars." According to some historians, Persian astronomers invented the astrolabe in 400.



8 RAMESES THE GREAT(1,200 BC) created the earliest known almanac during reign of an Egyptian pharaoh

9 THALES (585 BC) was a Greek astronomer who predicted solar eclipses.

10 CHINESE ASTRONOMERS (2,300 BC) built observatories which led to the earliest known observation of a comet in 2,296 BC.

11 WIND CHERUB is a popular way of depicting wind in Western art.

12a NEOLITHIC GRAVESTONE (Ireland 3,200 BC) this was aligned so that on the day of the Winter Solstice sunlight illuminated the rear wall of a chamber, probably the first solar observatory.

12b TALIESON was an ancient Celtic poet (in style of the Medieval “Book of Kells”) who represents Celtic planetary mythology. He also referenced in a poem about the cosmos and “music of the spheres.”

13 COMET Sixty Five million years ago a comet or asteroid struck the northern tip of the Yucatan Peninsula which caused the end of dinosaurs, and allowed mammals to flourish.

14 LEO is a constellation and Solar/Sun sign.

15 NERDY, SCIENCE GEEK is a person obsessively enthusiastic about science.

16 METEORITE FRAGMENT Meteorites that are recovered after being observed as they transited the atmosphere or impacted the Earth are called falls. All other meteorites are known as finds

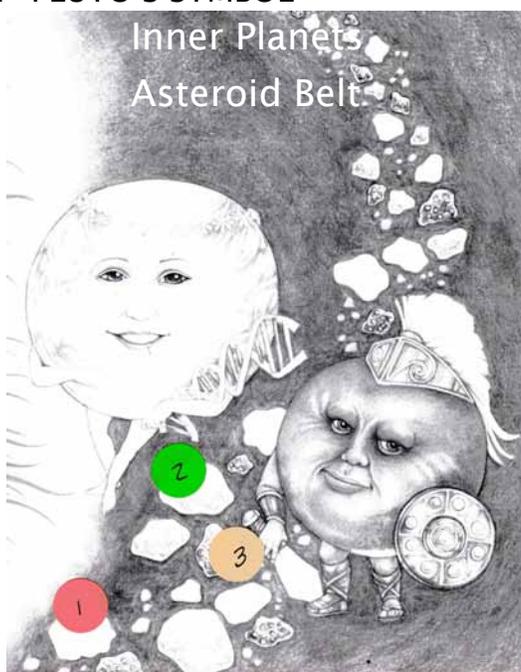
17 PRINTED CIRCUIT BOARD

18 STONEHENGE (2,900-1,600 BC) is an ancient megalithic monument. It’s placement suggests astronomical connections possibly used to predict solar & lunar eclipses (making it the world’s 1st astronomical calculator).

19 OUR SPIRAL GALAXY/MILKY WAY

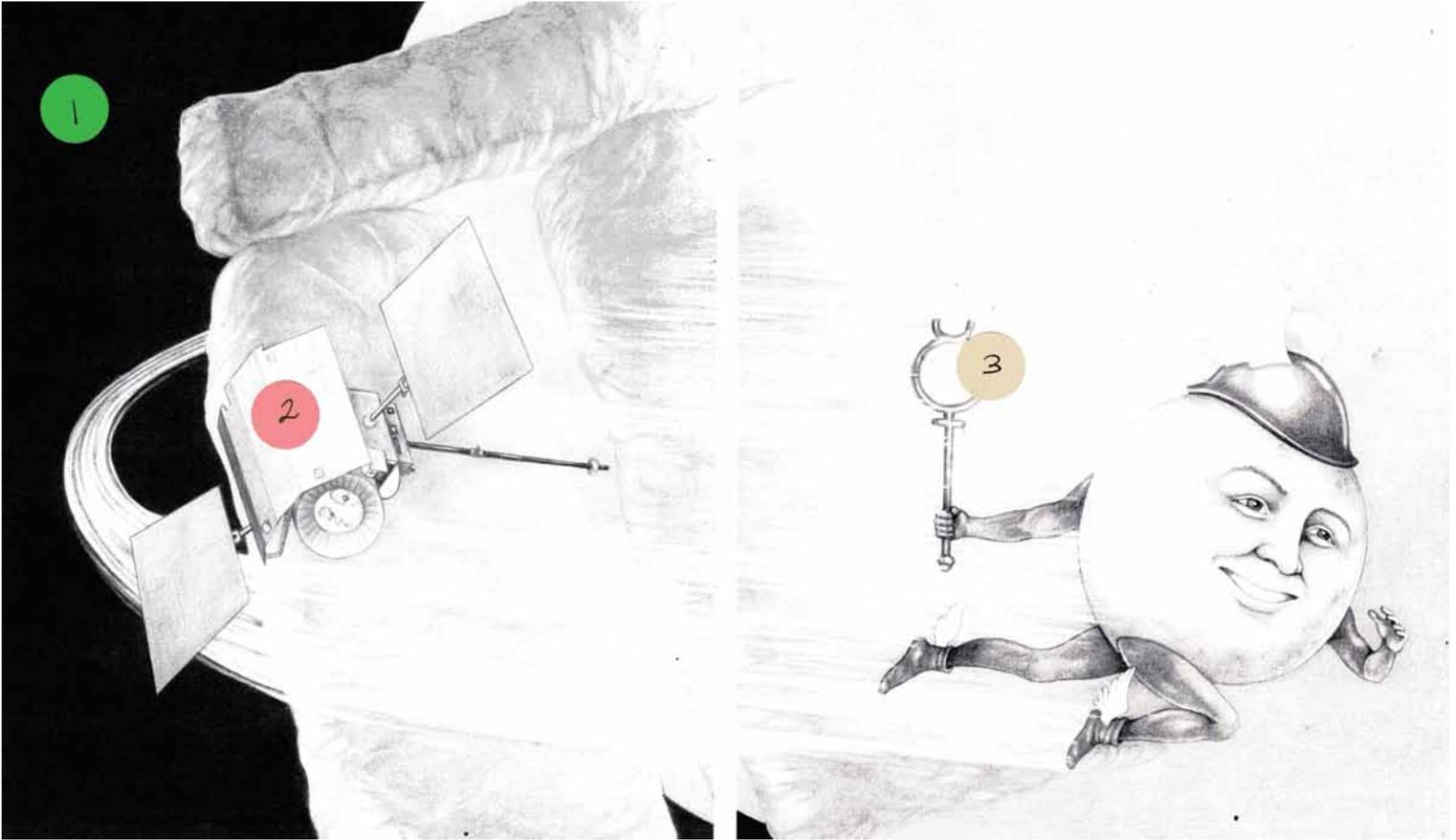
20 OUR SUN is Located in the Orion Arm (the circle with a dot in the center is the symbol for the Sun)

21 PLUTO’S SYMBOL



The Asteroid Belt-3 types of asteroids:

- 1 M-TYPE: Silvery grey, made up of nickel and iron
- 2 S-TYPE: Reddish brown, made up of rocky material
- 3 C-TYPE: Black, made up of carbon. They are the most common type forming 75% of known asteroids.



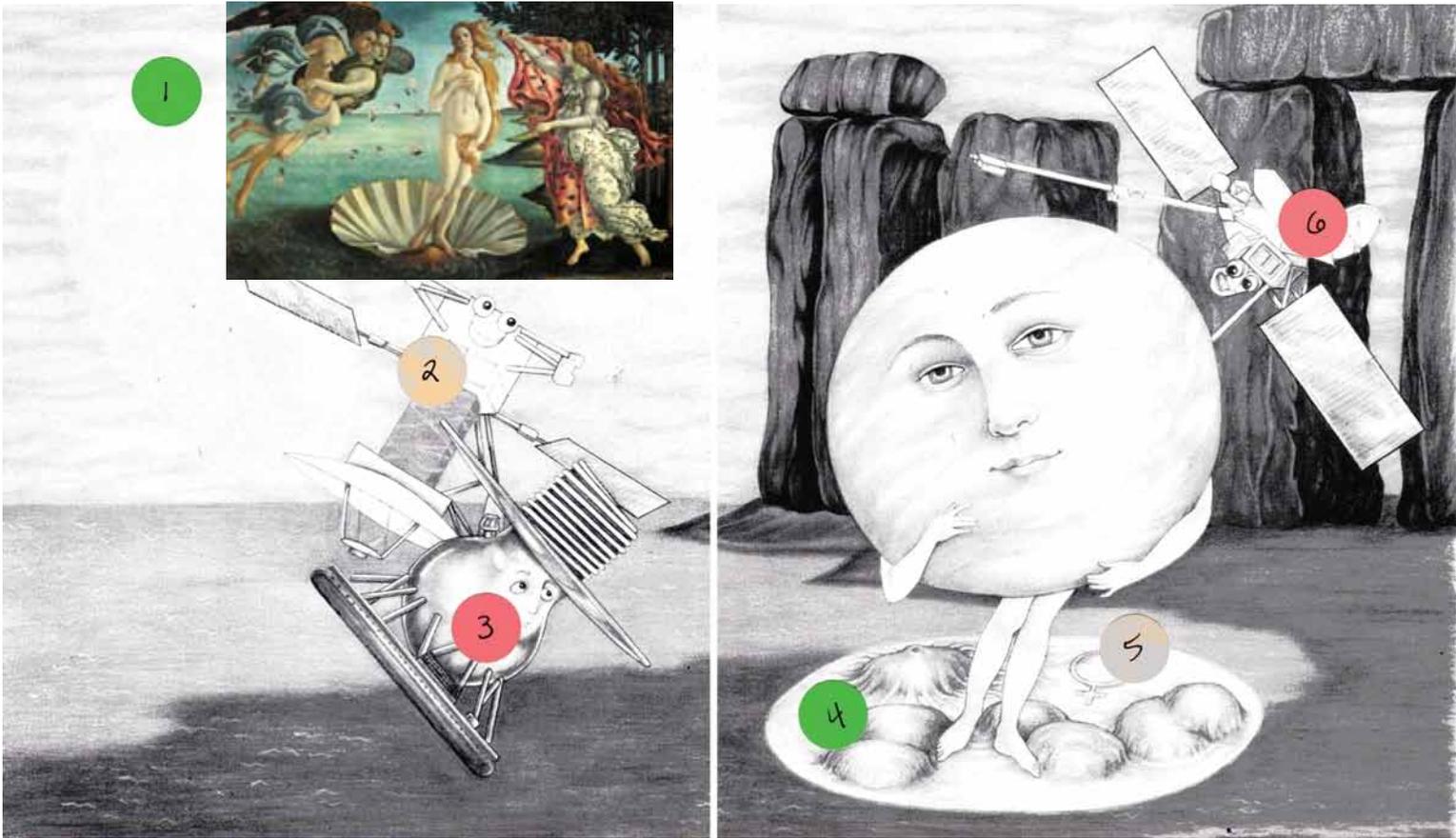
### Mercury (Winged god)

The Sun looks 3 times bigger than it does on Earth]

1 The atmosphere of Mercury is too thin to scatter light waves, so the sky always looks black, even in the daytime.

2 MESSENGER the spacecraft is supposed to go into orbit around Mercury in 2011 (the 1st mission since Mariner 10 in 1974-75)

3 Symbol for Mercury



### Venus (goddess of love)

The layout, and general look, of the Venus page illustration is based on Botticelli's "Birth of Venus"

1 Atmosphere is so thick it always looks like a cloudy day. The sky is orange. Thick atmosphere causes sunlight to bend so the Sun looks like a flat oval shape in the sky.

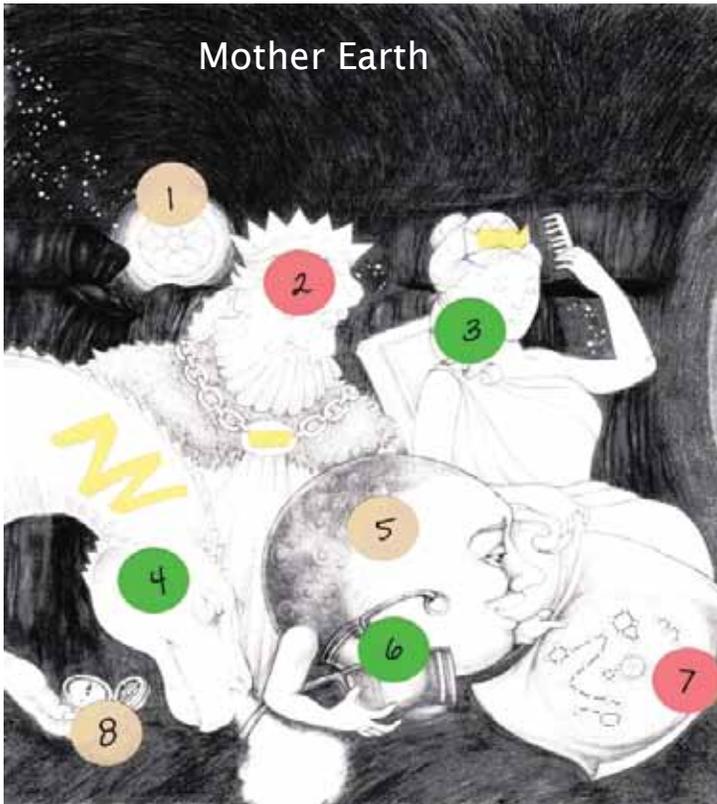
2 MAGELLAN: 1990 US planetary probe

3 VENERA 14: 1982 Russian spacecraft, landed on Venus and sent back photos & data for only 57 minutes before melting.

4 Images of some of Venus' volcanoes: one group has flattened round domes that look like pancakes, another looks like a giant spider.

5 VENUS' SYMBOL

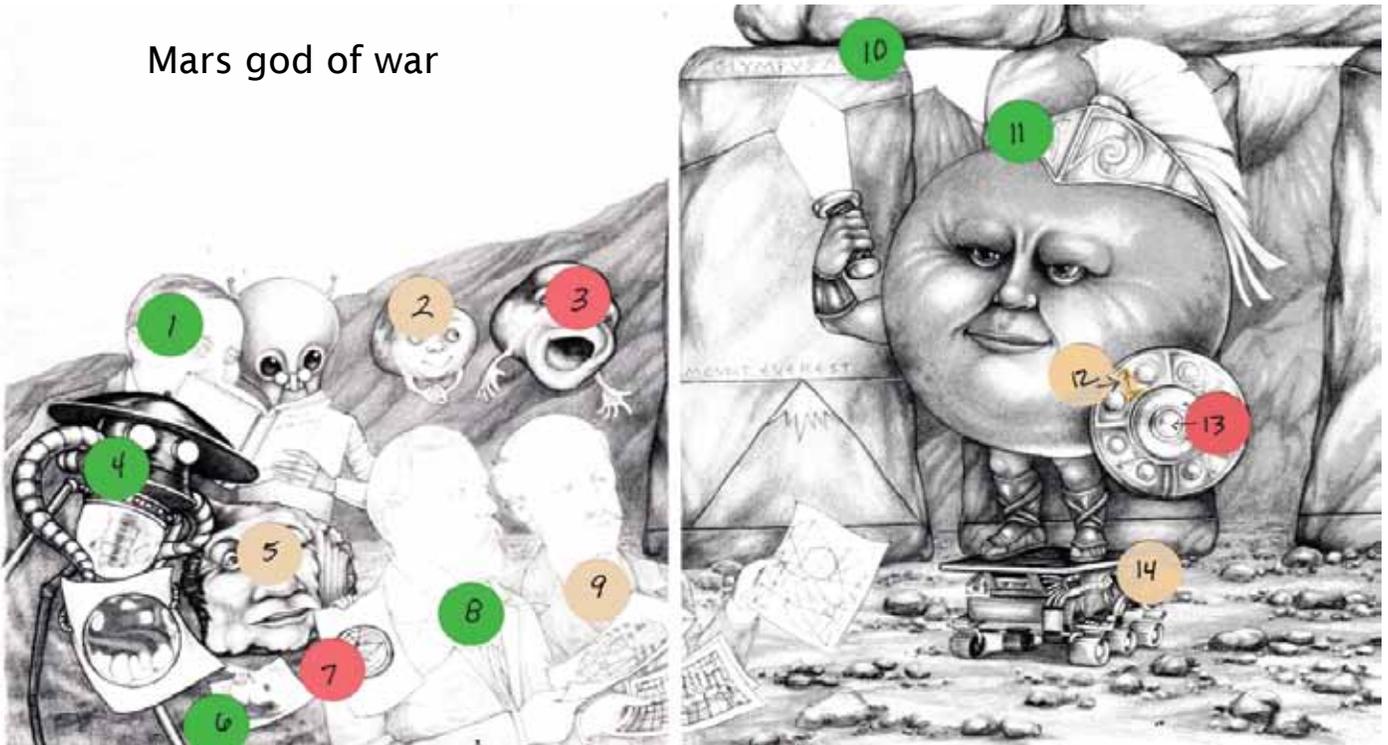
6 MARINER: 1962 NASA spacecraft, 1st to visit another planet



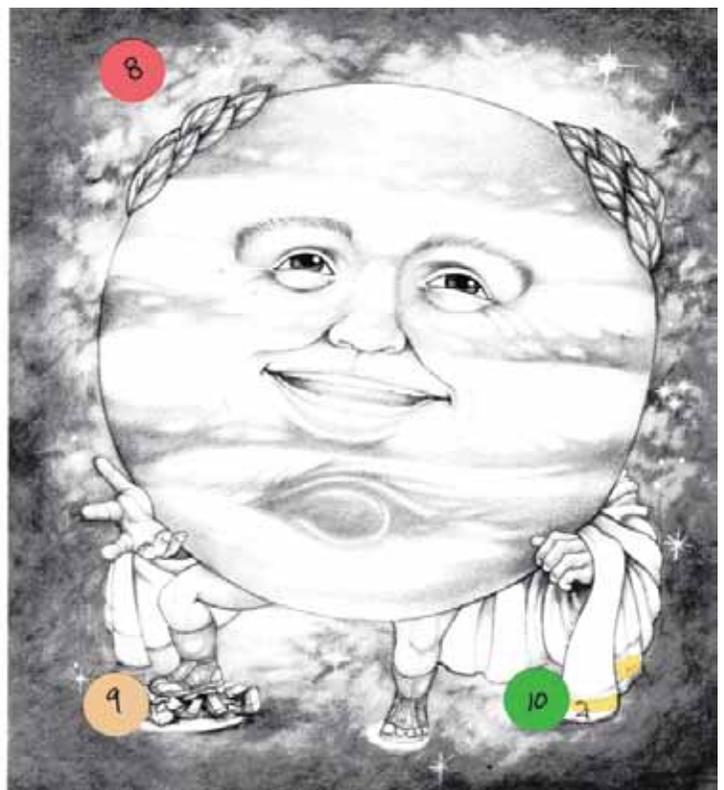
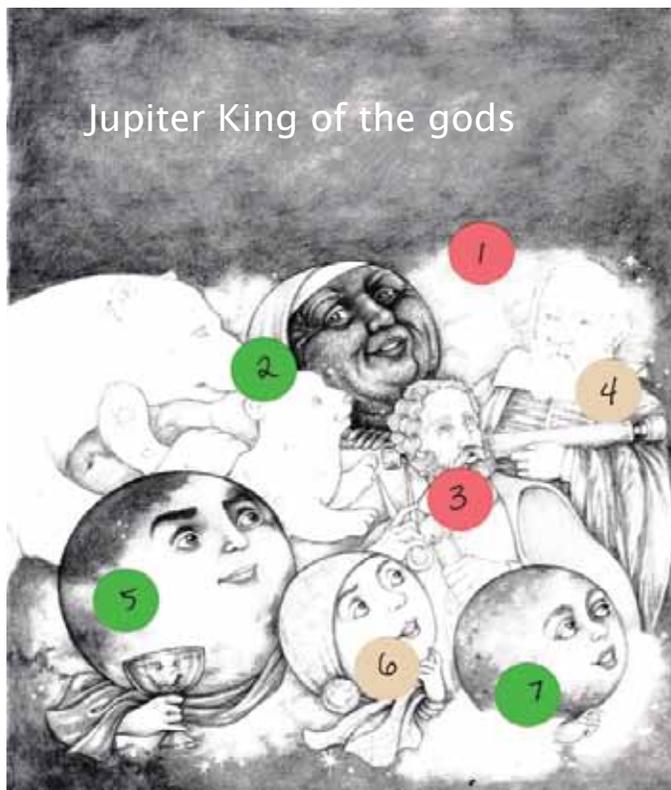
## Mother Earth

- 1 THE POLE STAR (aka: the North Star): look inspired by the Babylonian depiction of the “Morning Star.”
- 2 CEPHEUS THE KING: one of the Circumpolar Constellations seen in the night sky (Northern Hemisphere) NOTE: The constellation is pictured on his chain
- 3 CASSIOPIA THE QUEEN: another Circumpolar Constellation. She is usually depicted sitting in a chair, holding either a feather, a mirror, or a comb. NOTE: Her constellation is pictured on her crown.
- 4 DRACO THE DRAGON: another Circumpolar Constellation (illustrator purposely made him look like a dinosaur since that was mentioned in the copy and dinosaur fossils probably gave rise to the idea of “dragons”). His constellation is hidden in the pattern on his neck.
- 5 MOON: a Gibbous Moon (falls between 1st Quarter and Full).
- 6 BIG & LITTLE DIPPERS: more Circumpolar Constellations NOTE: The Moon holds the dippers to illustrate the “trick” of finding the North Star: Look for the Big Dipper and follow the lip to the end of the handle of the Little Dipper)
- 7 CIRCUMPOLAR MAP
- 8 COMPASS (pointing North) & EARTH’S SYMBOL
- 8 LAYERS OF EARTH’S ATMOSPHERE: A. Troposphere, B. Stratosphere, C. Mesosphere, D. Ionosphere, E. Thermosphere, F. Exosphere/Space
- 9 (a & b) AURORAS at Earth’s poles
- 10 DOUBLE HELIX: building blocks of Life

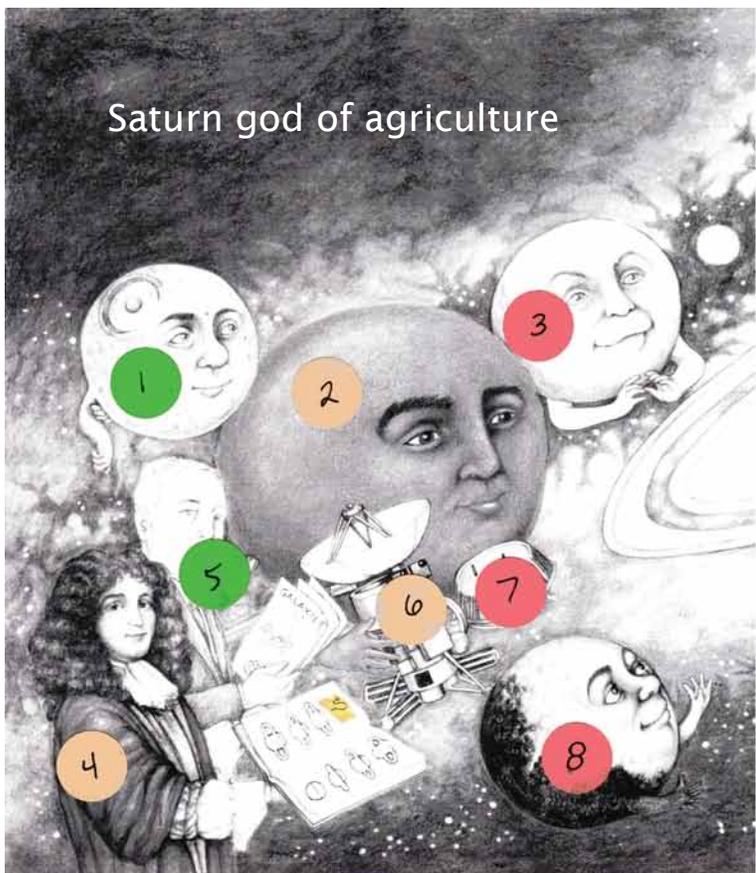
## Mars god of war



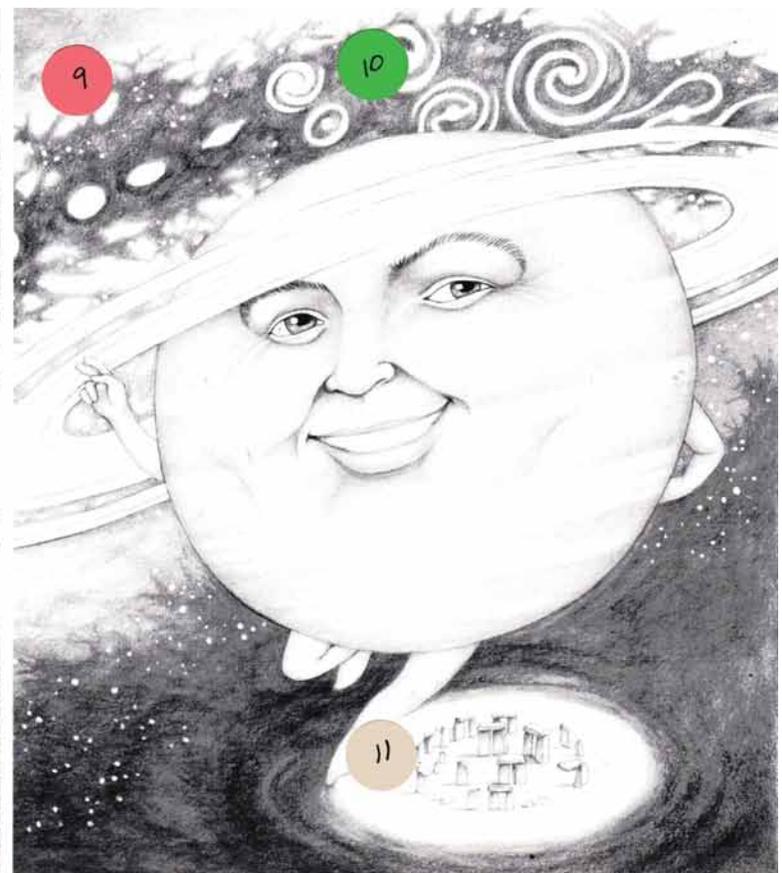
- 1 H. G. WELLS English writer, reading a 1st edition copy (1897) copy of his novel, “War of the Worlds”, with a Martian
- 2 DEIMOS moon of Mars
- 3 PHOBOS moon of Mars (has a big round crater, that’s why his mouth is like that)
- 4 WAR OF THE WORLDS MARTIAN variation, as described in H.G. Wells’ book
- 5 ALH84001,0: knocked off Mars by an asteroid impact and landed on Earth 13,000 years ago and discovered in Antarctica in 1984.
- 6 PHOTO OF “THE FACE” taken by Viking 1 in 1976. Thought, by some, to be a stone monument it just turned out to be a natural rock formation that cast unusual shadows.
- 7 MAP OF MARTIAN SOUTHERN POLE: an inside joke since ALH84001.0 was found at Earth’s South Pole.
- 8 GIOVANNI SCHIAPARELLI: (1835-1910) Italian astronomer. Made a close study of Mars’ surface, noticed a series of dark lines that looked to form some sort of “network.” He called them “canali” canals.
- 9 PERCIVAL LOWELL: (1855-1916) American astronomer. Made a beautiful series of drawings of the Martian canals described by Schiaparelli (NOTE: Several characters are holding Lowell and Schiaparelli’s drawings).
- 10 OLYMPUS MONS: largest volcano in the solar system (shown on Stonehenge in relation to Earth’s Mount Everest)
- 11 ARIES THE RAM: In Astrology, Mars is considered the Ruling Planet of Aries (symbolized by the ram horns)
- 12 SYMBOL FOR IRON: the iron-rich soil of Mars
- 13 SYMBOL FOR MARS: the shield and sword
- 14 SOJOURNER: (1977) rover that collected samples from Martian surface.



- 1 SMALL MAGELLANIC CLOUD: the smaller of 2 irregular dwarf galaxies visible in the Southern Hemisphere, named for Magellan, the 1st European to see them.
- 2 CALLISTO: one of the 4 largest of Jupiter's moons. Discovered by Galileo so they are called the "Galilean Moons." In mythology, Jupiter/Zeus placed Callisto and her son in the heavens as Ursa Major & Ursa Minor (the Big and Little Bears). NOTE:
- 3 MAGELLAN: (1480-1521) Portuguese navigator who commanded the first expedition to voyage around the world (although he did not complete the trip). One of the 1st Europeans to see the Magellanic Clouds.
- 4 GALILEO: (1564-1624) Italian astronomer who revolutionized astronomy and proved Copernicus' theory that the Earth revolves around the Sun (among a whole slew of other discoveries). Discovered the 4 largest moons of Jupiter.
- 5 GANYMEDE: largest Galilean Moon. In mythology, Jupiter/Zeus carried Ganymede up to Mount Olympus, in the form of a giant eagle, to serve as his cup bearer (that is why the moon is holding a cup with an eagle on it).
- 6 EUROPA: smallest Galilean Moon with relatively smooth icy surface with network of grooves (shown on her scarf) where the ice crust has cracked. In mythology, Europa was a Phoenician noblewoman who met Jupiter/Zeus when he disguised himself as a white bull (seen on her earring).
- 7 IO (Eye Oh): Sulfur covered moon with many erupting volcanoes. In mythology, Io was a nymph who met Jupiter/Zeus when he disguised himself as a cloud. Her smokey stole represents both her volcanic surface and Jupiter's disguise.
- 8 LARGE MAGELLANIC CLOUD: largest of the irregular dwarf galaxies visible in the Southern Hemisphere. Discovered by Al-Sufi and mentioned in his "Book of Fixed Stars."
- 9 HEAVIEST PLANET: Jupiter crushes Stonehenge
- 10 JUPITER'S SYMBOL

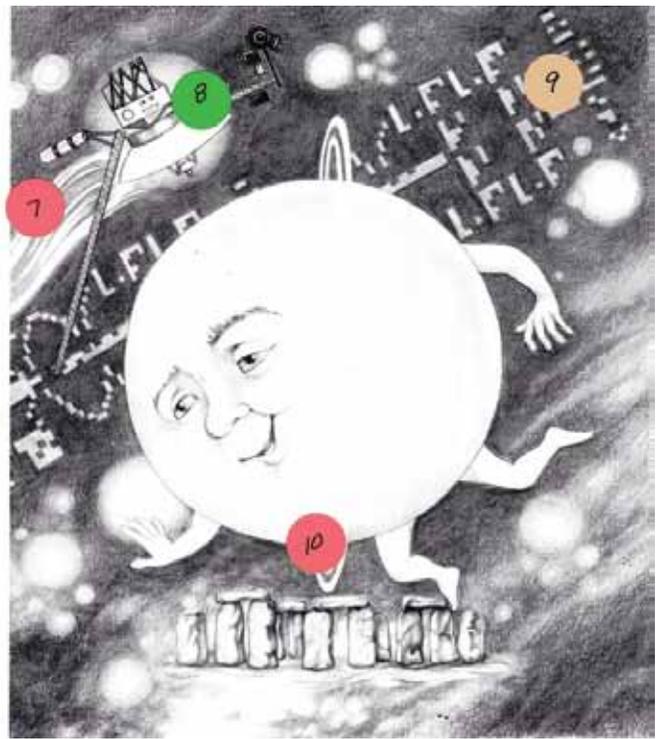
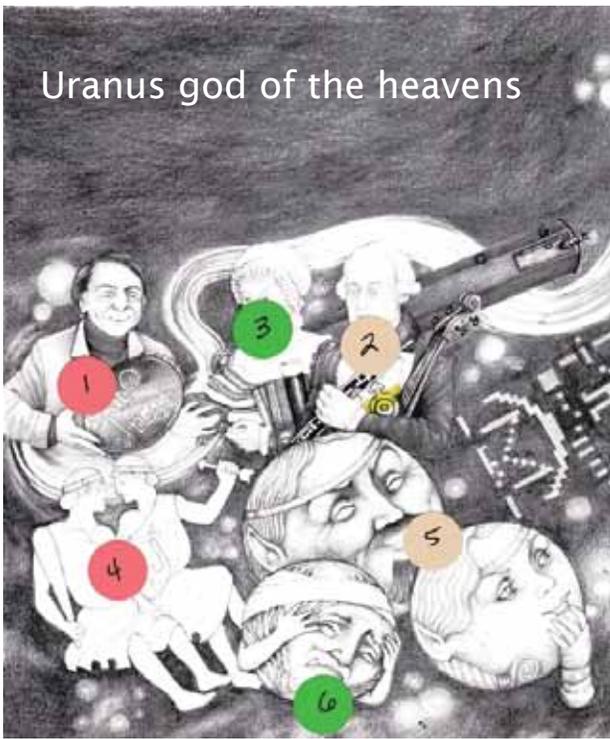


Saturn god of agriculture



- 1 MIMSA: one of Saturn's moons. The enormous crater is named, Herschel.
- 2 TITAN: the largest of Saturn's moons, covered by thick nitrogen-and hydrogen-rich atmosphere that hides the surface.
- 3 ENCELADUS: an icy moon with parallel fissures nicknamed "tiger stripes."
- 4 CHRISTIAAN HUYGENS: (1629-1695) Dutch scientist & astronomer who identified and described Saturn's rings. NOTE: Saturn's symbol is at the top of the page in Huygen's book
- 5 EDWIN HUBBLE: (1889 - 1953) American astronomer, 1st to study distant star systems, devised a classification of galaxies according to shape. Hubble Telescope is named after him.
- 6 CASSINI SPACE PROBE: (2004) US spacecraft reaches Saturn
- 7 HUYGENS PROBE: (2004) dropped from Cassini spacecraft to land on Titan and transmit data.
- 8 IAPETUSL two-toned moon
- 9 THE MILKY WAY
- 10 HUBBLE GALAXIES: the different shaped galaxies Hubble discovered/described.
- 11 LIGHTEST PLANET: Saturn floats above Stonehenge.

## Uranus god of the heavens



- 1 CARL SAGAN: (1934-1996) American astronomer & astrophysicist. Sagan helped develop and assemble the gold record, containing sounds and images of Earth, that was sent on the Voyager space probes.
- 2 WILLIAM HERSCHEL: (1738-1822) English musician and astronomer who discovered Uranus. NOTE: He played the oboe, cello, and harpsichord, which is why illustrator shows him holding all the instruments in his arms. He also holds Uranus' symbol and his telescope is behind him.
- 3 CAROLINE HERSCHEL: (1750-1848) English astronomer, sister of William Herschel. She was the 1st woman to find a new comet and eventually discovered 8. She served as assistant and housekeeper for her brother, feeding him soup and sandwiches while he ground lenses and other work (which is why she holds a plate of sandwiches).
- 4 CONSTELLATION GEMINI: where Herschel found Uranus
5. OBERON & TITANIA two largest moons, discovered by Herschel, named for the fairy King and Queen in Shakespeare's "A Midsummer Night's Dream."
- 6 MIRANDA: another moon (also named after a Shakespearean character). Seemingly composed of a jumble of huge rocks scientists suggest a huge impact blew Miranda apart and the pieces drifted back together through gravitational attraction.
- 7 RED SHIFT: When an object travels away from the observer, the light waves are lengthened and the object appears to move into the red end of the electromagnetic spectrum.
- 8 VOYAGER 2: (1979) one of two unmanned American space probes sent to explore the outer planets. Voyager 2 passed Uranus, and sent back data, in January 1986.
- 9 DIGITAL MESSAGE: a set of 1,670 on-off pulses was transmitted into space sending a message to any intelligent life form that might be out there somewhere. This number is the result of multiplying two prime numbers, 23 and 73, and the message becomes clear when laid out in 73 rows of 23 columns. With black squares for 1s and white squares for 0s, a pattern or pictogram is produced.
- 10 TILTED PLANET: Uranus is tilted on its side as it orbits around the Sun, probably the result of a catastrophic collision. (That's why illustrator shows Uranus tripping over Stonehenge.)

## Neptune god of the sea



- 1 **NEWTON'S LAW OF UNIVERSAL GRAVITATION:** or at least a small portion of it. Part of the mathematical formula by which Neptune was discovered. NOTE: Neptune's symbol is in the top right corner of the blackboard.
- 2 **JOHN COUCH ADAMS:** (1819-1892) A British mathematician who discovered Neptune mathematically.
- 3 **URBAIN LEVERRIER:** (1811-1877) A French mathematician who also discovered Neptune mathematically.
- 4 **GALILEO'S BOOK:** a nod to Galileo who saw Neptune in 1612, but thought it was a star.
- 5 **NAUTICAL ALMANAC:** first published in 1766, it provided a series of tables showing the distances between certain key stars and the Moon at three-hour intervals (just one of many tools used to help in the search for answers, proofs, and discoveries).
- 6 **JOHANN GALLE:** (1812-1910) A German astronomer who used Leverrier and Adams' mathematical predictions and is the 1st credited person to see Neptune.
- 7 **TRITON moon:** Coldest object in the solar system NOTE: the snowflake logo is part of the Extreme Cold Warning symbol. It is tilted relative to Neptune's equator and moves in the opposite direction in which Neptune rotates.
- 8 **QUASAR:** a distant star-like object with an enormous energy output that is brighter than an ordinary galaxy (possibly fueled by a super massive Black Hole).
- 9 **VOYAGER 2:** 1989 - after traveling through space for 12 years Voyager 2 passed Neptune
- 10 **CAT'S EYE NEBULA:** a "Planetary Nebula," named due to its shape. It is/was a sun-like star that died and shed its outer layer of hydrogen gas.
- 11 **HORSE HEAD NEBULA:** a dense cloud of gas and dust called a "Dark Nebula" because it blocks light from the Emission Nebula behind it.
- 12 **CRAB NEBULA:** remnant of a supernova that Chinese astronomers first observed in 1054.
- 13 **KUIPER BELT:** region of the solar system beyond Neptune believed to contain millions of small primitive bodies in orbit around the Sun. Pluto is found in this region.

## Conclusion



- 1 JOHANNES KEPLER: (1571-1630) A German mathematician who formulated three laws of planetary motion. 1st states that all planets orbit the Sun in elliptical paths.
- 2 BLUE STAR: tens of times bigger than the Sun and tens of thousands of times brighter.
- 3 ALBERT EINSTEIN: (1879-1955) A German physicist whose theories transformed the way we look at time and space.
- 4 MARIA MITCHELL: (1818 - 1889) An American astronomer, the 1st woman since Caroline Herschel to discover a comet, 1st woman member of the American Academy of Arts and Sciences, and the 1st person (male or female) appointed to the faculty of Vassar College, where she became professor of astronomy and director of the Vassar College Observatory.
- 5 "STICKMAN": a nickname given to the image on the map of 1,000 nearby galaxies by astronomer Margaret Geller, who along with her colleagues, made the map in 1986.
- 6 LAIKA: 1957, Soviet Union dog that was 1st living creature from our world sent into space aboard Sputnik 2.
- 7 SIRIUS/CANIS MAJOR aka the Dog Star: The brightest star in the night sky, called the Dog Star because it anchors the constellation Canis Major (Big Dog). NOTE: On ancient star maps the dog is usually depicted as a greyhound or a mastiff
- 8 ASTEROID GASPARA: (11 miles across) one of the 1st asteroids photographed by the Galileo spacecraft
- 9 EDMOND HALLEY: (1656-1742) An English astronomer who was the 1st to discover that some comets are regular visitors
- 10 WHITE DWARF: a tiny hot star only about the size of Earth
- 11 HENRIETTA LEAVITT: (1868-1921) An American astronomer whose discovery of the period luminosity relation of "Cepheid Variables" (a class of pulsating variable stars that helps determine distance between many stars and galaxies) changed the theory of modern astronomy. NOTE: She received almost no recognition for this in her life time.

12 SUBRAHMANYAN CHANDRASEKHAR: (1910-1995) An Indian astrophysicist (later became an American citizen) who was awarded the Nobel Prize in Physics in 1983 for his studies on the physical processes important to the structure and evolution of stars. His most notable work was the “Astrophysical Chandrasekhar Limit” which described the maximum (or minimum) mass a White Dwarf Star will ultimately collapse into a Neutron Star or Black Hole - following a supernova.

13 GUSTAV HOLST: (1874-1934) An English composer known for his orchestral suite, “The Planets.”

14 RED GIANT: luminous stars, but cool because of their size, usually 30 times the size of the Sun.

15 ASTEROID IDA: (35 miles across) another asteroid photographed by the Galileo spacecraft.

16 ZERO its use/discovery is attributed to India where calculations were being carried out by the 9th century, it was also an integral part of the Mayan number system.

17 DOLPHIN DISC: in the Hindu collection of stories called “Bhagavata Purana,” all the visible stars and planets moving through space are likened to a dolphin swimming through the water. The heavens are called the Dolphin Disc.

18 NICOLAUS COPERNICUS: (1473-1543) A Polish astronomer who suggested that the Sun was at the center of the planetary system, not the Earth.

19 HALLEY’S COMET: as portrayed in the Bayeux Tapestry (an 11th or 12th century tapestry). One of many artistic depictions of the comet from a variety of different cultures and time periods.



Bayeux Tapestry

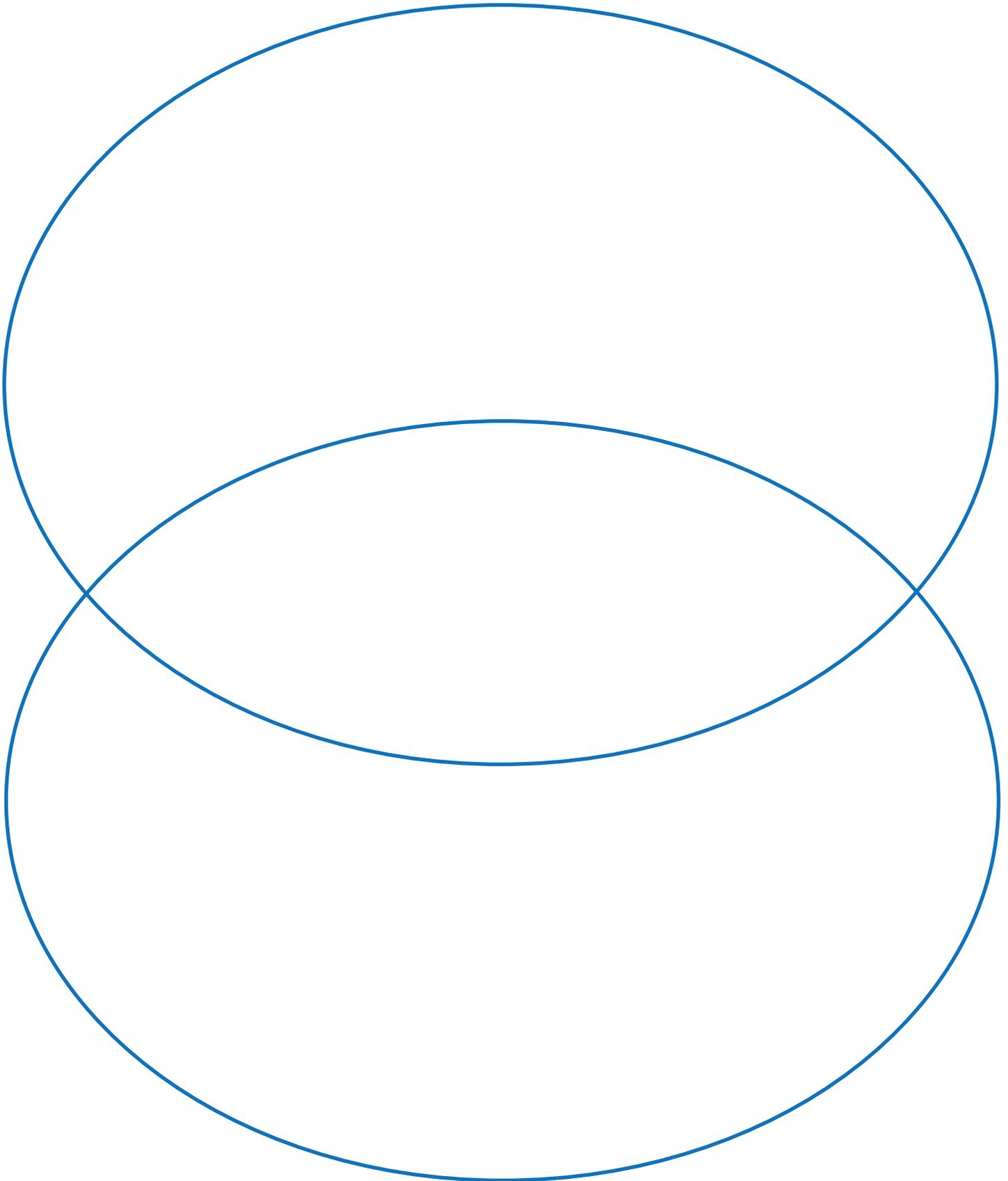
# Appendix A—“What Children Know” Cards

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<p>Question:</p>          <p>My answer:</p>          <p>This information is correct! This information is not correct; can you find the correct information?</p>	<p>Question:</p>          <p>My answer:</p>          <p>This information is correct! This information is not correct; can you find the correct information?</p>
<p>Question:</p>          <p>My answer:</p>          <p>This information is correct! This information is not correct; can you find the correct information?</p>	<p>Question:</p>          <p>My answer:</p>          <p>This information is correct! This information is not correct; can you find the correct information?</p>

# Appendix B—Venn Diagram

Compare and contrast any two planets.



## Appendix C—Vocabulary Cards

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**astonomer**

**bright**

**crater**

**dazzling**

**Earth**

**gas**

**inner**

**Jupiter**

**Mars**

**Mercury**

**moon**

**Neptune**

**outer**

**planet**

**predict**

**ring**

**rocky**

**Saturn**

**star**

**sun**

**telescope**

**universe**

**Uranus**

**Venus**