Astraviator

SPACE WORKBOOK

UNIT 3 OF 8

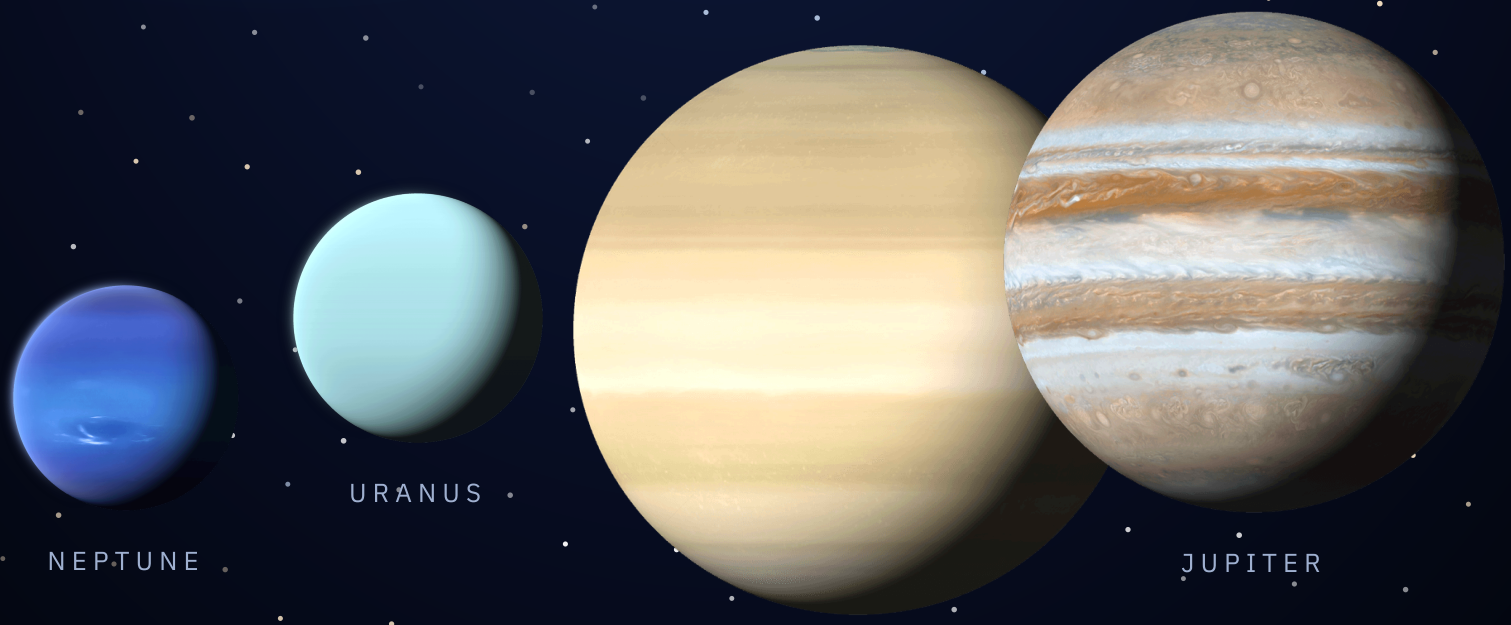
Giant Planets

Jupiter · Saturn · Uranus · Neptune

Puzzles · Math labs · Coloring · Experiments · Games

Ages 9–14 · three levels · answer key included

★ Explorer · ★★ Navigator · ★★★ Commander



astraviator.com | Solar System Explorer Simulator

Print at 100% · black & white pages, color cover · Imagery rendered from NASA / USGS data and Solar System Scope textures (CC BY 4.0)

FREE SIMULATOR

Scan to fly to the Moon

SOLAR SYSTEM EXPLORER

astraviator.com/explore

Assemble the rocket, launch, cross to the Moon and explore real space data. Play the free simulator in your browser, on a phone, tablet or computer: no install, no account.

SAFETY FIRST Children should do the experiments with an adult, using ordinary household materials and eye protection when asked. Never look directly at the Sun, never cap a bottle that fizzes, and do not point anything at people or pets. Adults are responsible for supervision and for deciding whether an activity is suitable for the child.

Point your phone’s camera at the code and tap the link.

Mission Briefing: Meet the Giants ★ EXPLORER

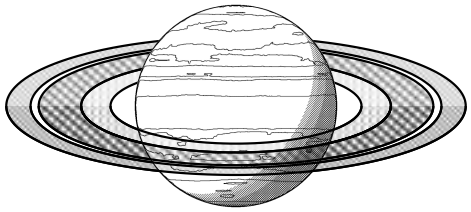
Beyond the asteroid belt live four enormous worlds. **Jupiter** and **Saturn** are **gas giants**, made mostly of hydrogen and helium. **Uranus** and **Neptune** are **ice giants**, with more water, ammonia and methane.

None of them has a solid surface to land on: you would sink through thicker and thicker clouds. All four have **rings** and dozens of moons.

Jupiter is so big that all the other planets would fit inside it. Its **Great Red Spot** is a storm as wide as Earth.

Saturn has the most spectacular rings, made of billions of pieces of ice. It is so light for its size that it would float in a giant bathtub!

Uranus spins on its side. **Neptune**, the farthest planet, has winds of up to 1,200 miles per hour, the fastest in the solar system.



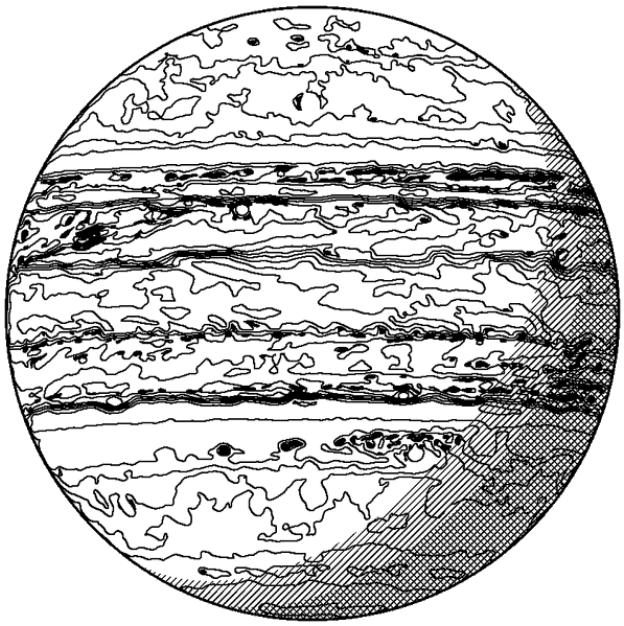
Saturn and its rings

	Jupiter	Saturn	Uranus	Neptune
Width (mi)	86,881	72,367	31,518	30,599
Distance from the Sun	484 million mi	886 million mi	1.78 billion mi	2.79 billion mi
One day	9 h 56 min	10 h 33 min	17 h 14 min	16 h 6 min
One year (Earth years)	12	29	84	165

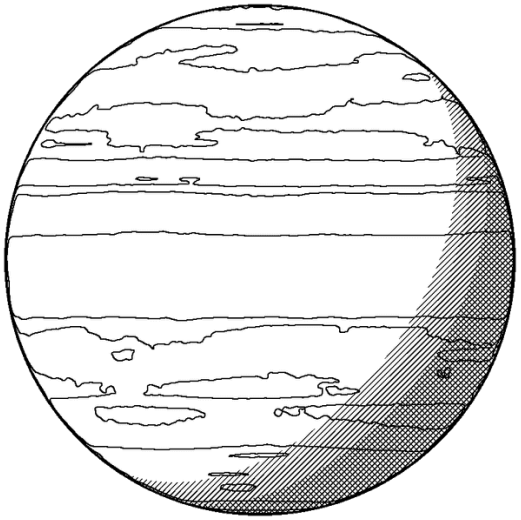
Vocabulary to spot: gas giant · ice giant · atmosphere · ring · storm · hydrogen · helium · methane · moon · probe

Draw the Giants to Scale ★ EXPLORER ★★ NAVIGATOR

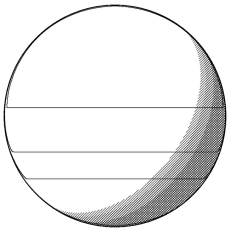
In this model **1 inch = 25,000 miles** (print at 100%). Color each planet and write its name. Earth is the tiny dot!



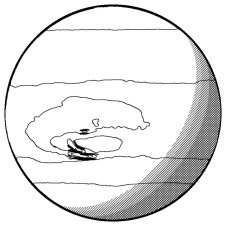
_____



_____



_____



_____



Earth

1. How many inches wide is Jupiter in this model? (86,881 ÷ 25,000 = _____) Saturn? _____

2. Measure with a ruler: how many Earth dots would fit across Jupiter? _____ (Use the table: 86,881 ÷ 7,918.)

3. Which two giants are almost the same size? _____ and _____

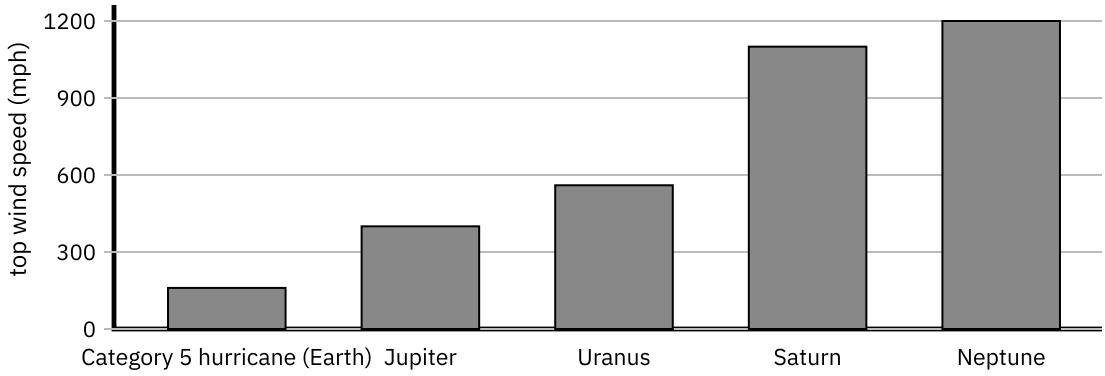
Math Lab 1 · Giant Numbers ★★ NAVIGATOR ★★★ COMMANDER

Use a calculator. Round to one decimal place, or to the nearest minute for times.

Planet	Width (mi)	Earths wide (÷ 7,918)	Distance from Sun (mi)	Sunlight takes… (min) (÷ 186,282 ÷ 60)
Jupiter	86,881	_____	484,000,000	_____
Saturn	72,367	_____	886,000,000	_____
Uranus	31,518	_____	1,784,000,000	_____
Neptune	30,599	_____	2,793,000,000	_____

1 Sunlight reaches Earth in about 8 minutes. How many times longer does it take to reach Neptune? _____ (Neptune's minutes ÷ 8)

Wind speed record



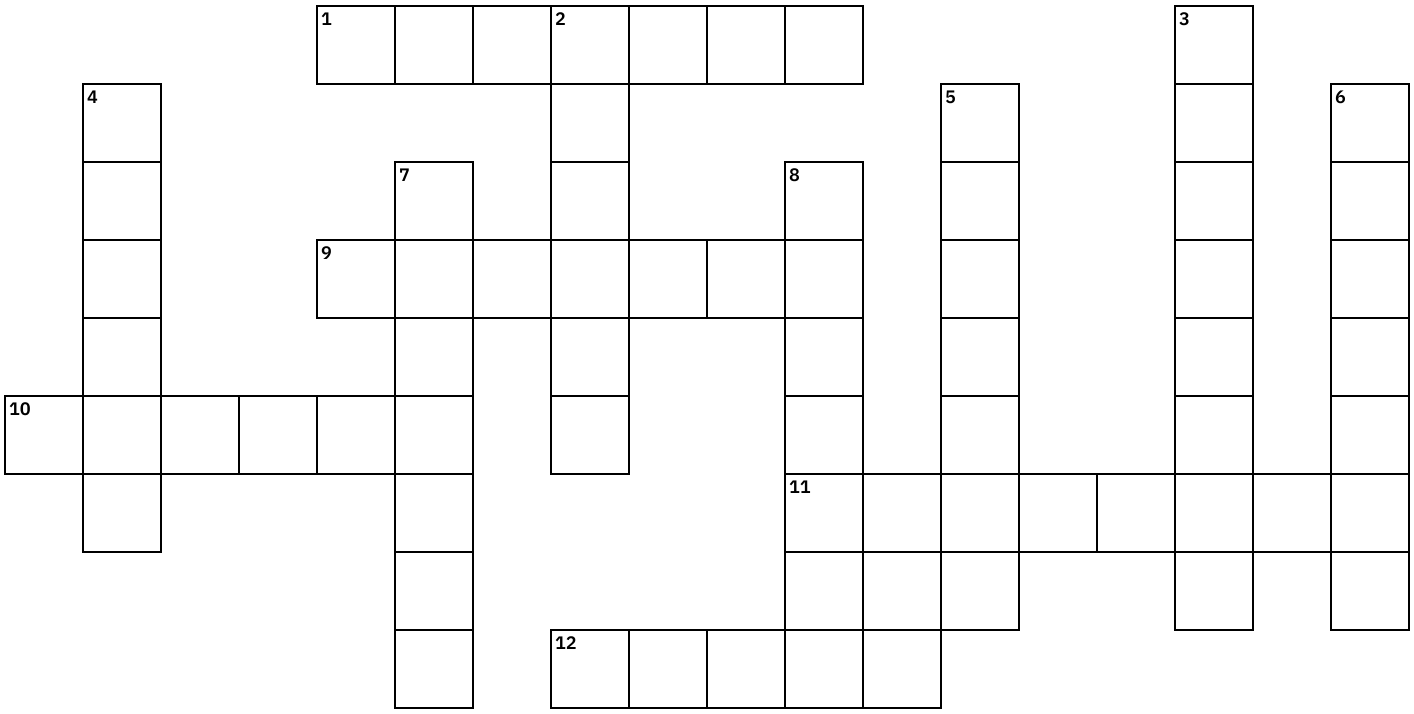
2 Which planet has the fastest wind? _____ How much faster than a Category 5 hurricane? (1,200 ÷ 160 = _____ times)

3 Saturn's wind is 1,100 mph. How many miles does it blow in 3 hours? _____ miles

★★★ Jupiter has about 318 times the mass of Earth. If Earth were a 1-pound ball, Jupiter would weigh _____ pounds. And Saturn (95 Earths) would weigh _____ pounds.

Giant Planets Crossword ★★ NAVIGATOR

Every answer is a word from this unit.



ACROSS →

1. A gas that makes Uranus and Neptune look blue

9. He discovered four moons around Jupiter in 1610

10. The giant planet that rolls around the Sun tilted on its side

11. Jupiter's moon, the largest moon in the solar system

12. The Great Red Spot is a giant _____ on Jupiter

DOWN ↓

2. The second most common gas in Jupiter and Saturn

3. The lightest gas, and the main ingredient of the gas giants

4. The planet famous for its bright rings

5. The windiest planet, farthest from the Sun

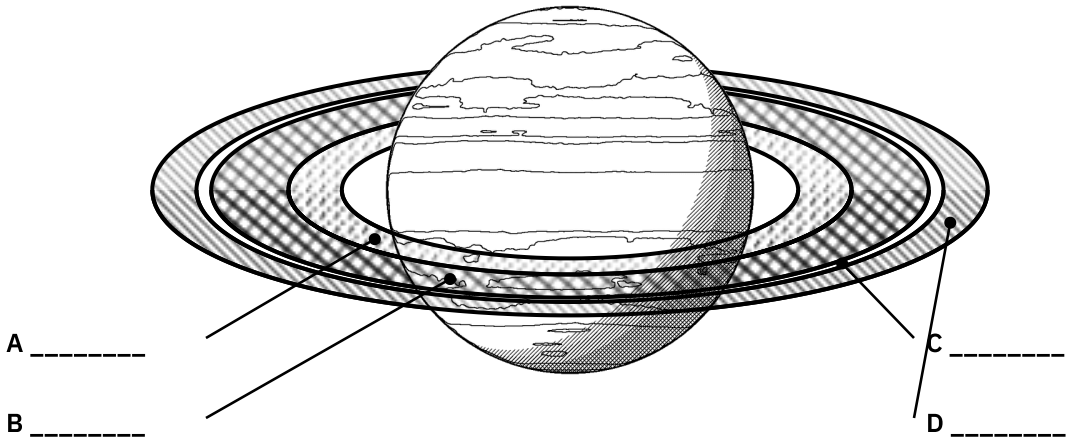
6. The largest planet in the solar system

7. Spacecraft that studied Saturn for 13 years

8. Name of two probes launched in 1977 that toured the giants

Saturn's Rings: Color & Calculate

★ EXPLORER ★★★ COMMANDER



Saturn's main rings are named with letters in the order they were discovered. Label the diagram with the words below, then color the rings. Use different colors for each ring and leave the **Cassini Division** gap white.

C ring · B ring (brightest and widest) · Cassini Division (gap) · A ring

The rings are made of ice, from dust-sized grains to house-sized boulders. They span about **175,000 miles** but are often only about **30 feet** thick.

1 Change 175,000 miles into feet (1 mile = 5,280 feet): _____ feet

★★★ The rings are _____ times wider than they are thick (feet wide ÷ 30). If a sheet of paper is 0.004 inch thick, a paper-thin ring of the same proportion would be about _____ inches wide (answer ÷ 12 = feet).

Logic Grid: Who Studies Which Giant? ★★ NAVIGATOR ★★★ COMMANDER

Four students each study a different giant planet. Use the clues to find out who studies which. Put an **X** for "no" and an **O** for "yes". Each row and column gets exactly one O.

	Jupiter	Saturn	Uranus	Neptune
Ana				
Ben				
Cara				
Dev				

Clues

1. Ana does not study Saturn or Uranus.
2. Ben studies either the planet with the Great Red Spot or the planet with the fastest winds.
3. The planet that is tilted on its side is not studied by Cara.
4. Ben does not study Jupiter.
5. Dev does not study Jupiter either.

Ana: _____ Ben: _____ Cara: _____ Dev: _____

> Facts to use: Jupiter has the Great Red Spot · Saturn is famous for its rings · Uranus is tilted on its side · Neptune has the fastest winds.

Riddles ★

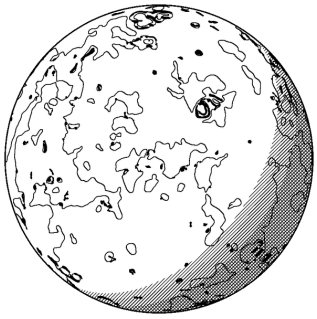
1. I am the biggest planet and I have a red storm. I am _____.
2. My rings are famous and I could float in water. I am _____.
3. I am farthest from the Sun and I have supersonic winds. I am _____.

Moons of Jupiter: Trading Cards

★ EXPLORER cut-out & color

Galileo discovered these four moons in 1610 with his telescope. Cut out the cards and play: pick a number and compare. Bigger wins… except for orbit time, where the smaller number wins!

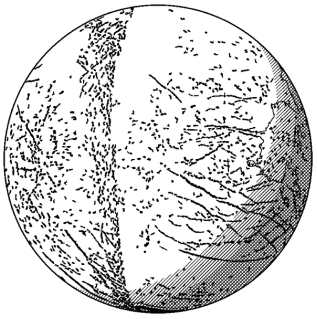
IO



Width	**2,263 mi**
Orbit time	**1.8 days**
Distance from Jupiter	**262,000 mi**

★ Most volcanic world in the solar system

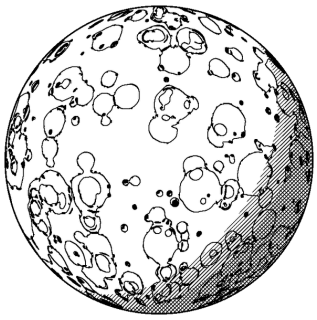
EUROPA



Width	**1,940 mi**
Orbit time	**3.6 days**
Distance from Jupiter	**417,000 mi**

★ A salty ocean hides under its ice

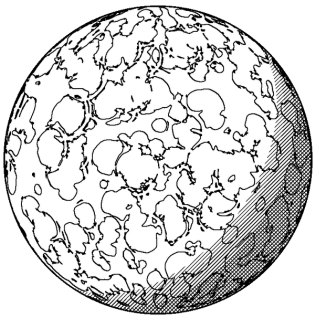
GANYMEDE



Width	**3,273 mi**
Orbit time	**7.2 days**
Distance from Jupiter	**665,000 mi**

★ Largest moon: bigger than Mercury

CALLISTO

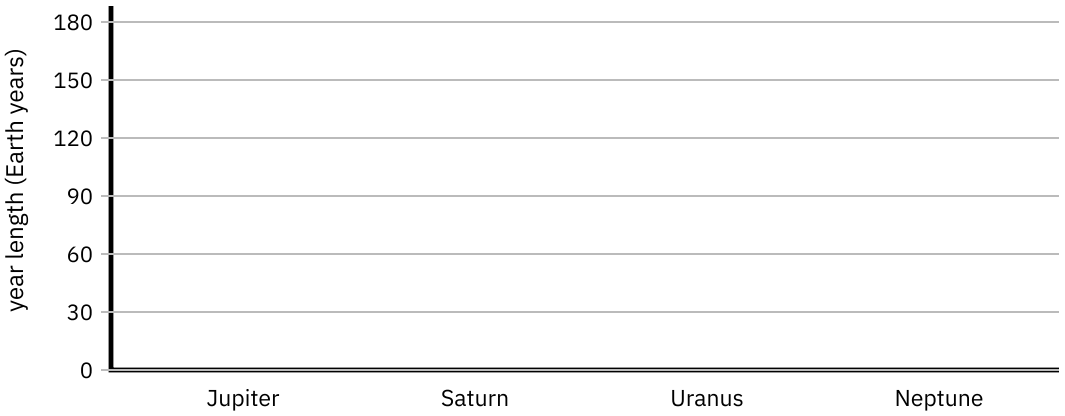


Width	**2,995 mi**
Orbit time	**16.7 days**
Distance from Jupiter	**1,170,000 mi**

★ One of the most cratered surfaces known

Math Lab 2 · Giant Years & Ages ★★ NAVIGATOR

The farther a planet is from the Sun, the longer its year. Draw a bar for each planet's year length (in Earth years).



Year lengths: Jupiter 12 · Saturn 29 · Uranus 84 · Neptune 165 Earth years.

1. How many Earth years does it take Neptune to circle the Sun once? _____ Neptune was discovered in 1846. In what year did it complete its **first full orbit** since being discovered? (1846 + 165 = _____)

2. **Your age on the giants.** Age = your Earth age ÷ the planet's year. For a 12-year-old: Jupiter _____ Saturn _____ Uranus _____ Neptune _____ (round to 2 decimals)

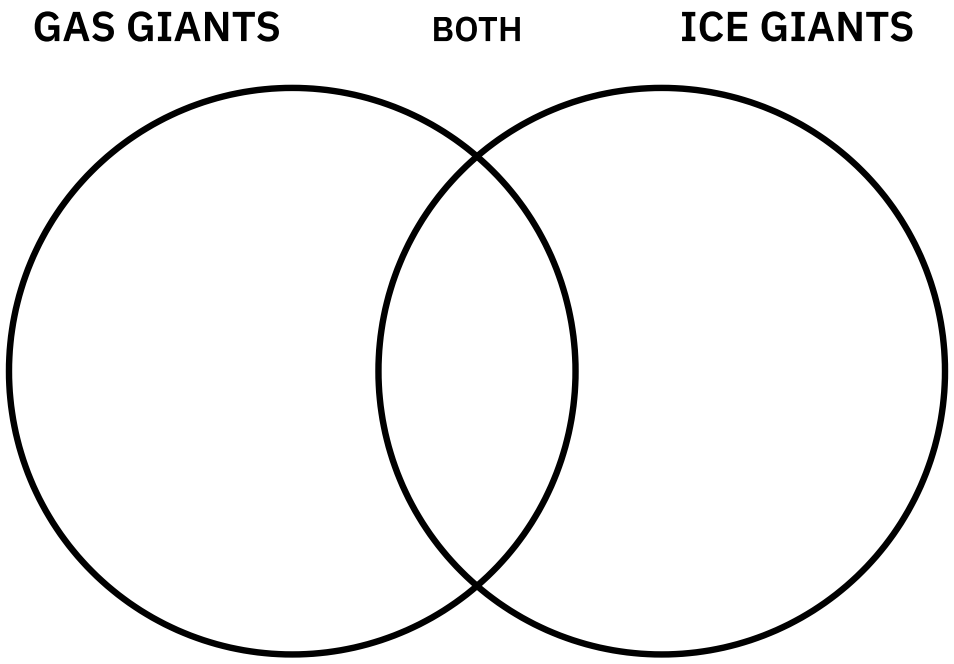
3. A day on Jupiter lasts about 10 hours. How many Jupiter days pass in one Earth day (24 hours)? _____

4. Jupiter spins so fast that it bulges at its equator. Why might fast spinning make a planet flatten? Try the spinning-paper experiment on page 11 to find out.

_____

Gas Giants vs Ice Giants ★★ NAVIGATOR

Sort the fact strips: **gas giants** (Jupiter and Saturn), **ice giants** (Uranus and Neptune) or **both**. Write each letter in the right place, or cut and paste.



(A) Includes the two biggest planets	(B) Much bigger than Earth	(C) Has rings
(D) Has no solid surface	(E) Has many moons	(F) Made mostly of hydrogen and helium
(G) Includes Uranus and Neptune	(H) Methane gives it a blue-green color	(I) Spins in less than 20 hours
(J) Contains lots of water, ammonia and methane		

Why do you think Uranus and Neptune are called “ice” giants even though they are not frozen? (They contain water, ammonia and methane that were ices when the planets formed.)

Giant Planet Labs ★★ NAVIGATOR

SAFETY Do this with an adult. Do not taste or drink any of the liquids, use a plastic or sturdy glass, and wipe up spills right away so nobody slips.

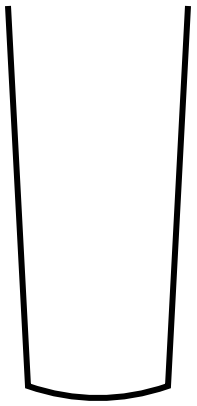
A · Density tower: layers in a giant

Heavier liquids sink, lighter ones float, just like the materials inside a giant planet.

- A tall clear glass
- Corn syrup or honey
- Dish soap
- Water with food coloring
- Vegetable oil

1. Pour a little of each liquid slowly down the side of the glass, in this order: syrup, soap, water, oil.
2. Do not stir. Watch the layers form.

Draw and color your layers



1 Predict the order from bottom to top: _____

2 In a gas giant, heavy materials sink to the center. What do you think is at the center of Jupiter?

_____

B · Spin it flat!

- A strip of paper about 1 × 11 inches
- A pencil and tape

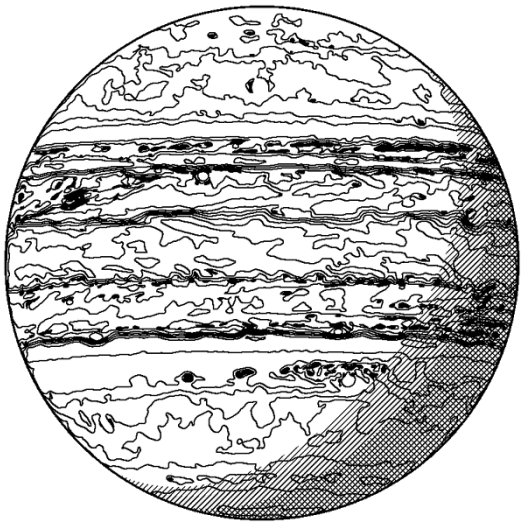
1. Tape the ends of the strip together to make a loose ring.
2. Hold the ring on the pencil with a loop of tape and spin the pencil quickly between your palms.
3. Watch the ring: where does it bulge?

Saturn spins in about 10.5 hours, so it bulges: its width across the equator is about 74,900 miles but only about 67,600 from pole to pole. How much flatter is it? (74,900 − 67,600 = _____ miles)

Jupiter: Read, Color & Decide ★ EXPLORER ★★ NAVIGATOR

The Great Red Spot

The Great Red Spot is a storm on Jupiter that astronomers have watched for well over a century. It is an enormous whirlwind, an **anticyclone**, wide enough to swallow about one Earth, though it has been shrinking. Its winds blow faster than any hurricane on our planet. Jupiter has no ground, so there is nothing to slow a storm down: it can last for hundreds of years.



Color the bands: pale cream **zones**, brown-orange **belts**, and a red-orange spot.

True or false?

1. The Great Red Spot is a storm. T / F _____
2. Jupiter has a solid surface where the storm hits the ground. T / F _____
3. The spot is about as wide as Earth. T / F _____
4. Storms on Jupiter die quickly. T / F _____

1 **Why does the storm last so long?** Use evidence from the text.

_____

_____

2 **Decide.** A probe can visit Jupiter's storm or Saturn's rings, but not both. Which would you choose? Give two reasons.

_____

_____

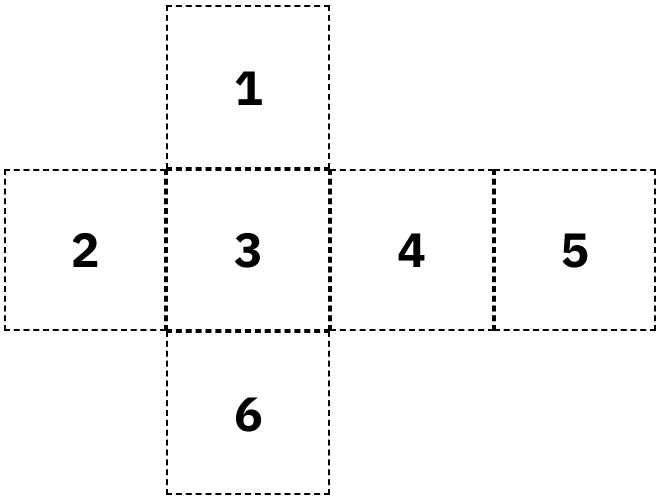
_____

Board Game: Gas Giant Grand Tour

★ EXPLORER cut-out

2–4 players. Use a coin or small paper pieces as tokens. Roll the die (cut and fold the net below) and race from Jupiter to the finish. Follow the instructions in the shaded squares!

START	**2**	**3**	**4** Great Red Spot storm! Go back 2.	**5**	**6**
12	**11**	**10** Jupiter gravity assist (like Voyager)! Move ahead 3.	**9**	**8**	**7** Io volcano show! Move ahead 2.
13 Question: what are the rings of Saturn made of? (Ice) Right = move ahead 2.	**14**	**15**	**16** Saturn is less dense than water: it would float! Slide to 18.	**17**	**18**
24 Voyager 2 flies past Uranus (1986). Move ahead 2.	**23**	**22**	**21** Uranus rolls on its side. Miss a turn.	**20**	**19** Cassini Division gap: slip through to 22.
25	**26** Neptune winds at 1,200 mph push you ahead 3!	**27**	**28** Cold and dark out here: go back 2.	**29**	**FINISH**



Cut and fold the cross along the dashed lines. Fold the edges to make a cube and glue the flaps. Or use any 6-sided die.

Create · Front Page News ★ EXPLORER

You are a reporter on a space probe near Jupiter. Write a front-page story about something you see: the Great Red Spot, the moon Io erupting, or Saturn's rings.

The Giant Planet Gazette

Edition: Outer Solar System · Price: 1 credit Date: _____

_____

Draw the photo

_____

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Unit Review · Mission Check

★ EXPLORER ★★ NAVIGATOR ★★★ COMMANDER

1. **Sort** the planets: Jupiter · Saturn · Uranus · Neptune. Gas giants: _____ Ice giants: _____

2. **Match** each planet to its fact (write the letter): Jupiter ___ Saturn ___ Uranus ___ Neptune ___
   A. fastest winds · B. spins on its side · C. spectacular rings · D. Great Red Spot

3. **Calculate.** Neptune is 2,793,000,000 miles from the Sun. Sunlight travels 186,282 miles per second. How many minutes does it take? _____

4. **Complete.** The four largest moons of Jupiter were discovered by _____ in the year _____.

5. **True or false?** a) Saturn would sink in water. T / F b) Neptune's year is longer than Uranus's. T / F c) Jupiter has a solid surface. T / F

6. **Explain.** Why are Uranus and Neptune blue?

7. **Draw.** Sketch Saturn with its rings in the box and label two parts.

8. **Decide.** Could a spaceship land on Jupiter? Explain.

Mission Log ★ EXPLORER

Check the boxes when you can do each one. Color a star for each section you enjoyed.

☐ I can name the four giant planets and say which are gas and which are ice.

☐ I can explain why the giants have no solid surface.

☐ I can compare sizes of the giants with Earth.

☐ I can work out light travel times with a calculator.

☐ I can describe Saturn's rings and what they are made of.

☐ I can use a density tower to explain layers in a planet.

☐ I can solve a logic grid using clues.

☐ I can name the four Galilean moons.

My favorite activity was

Something new I learned

A question I still have about space

UNIT 3
GIANT PLANETS
★ ★ ★
MISSION COMPLETE

Signed: _____

Date: _____

The Space Workbook series

You have **Mission 3**. There are **8 missions** in all: each one is a complete set of puzzles, math labs, games and experiments, and each works on its own.

1	**Earth, Moon & Sun** Phases, time zones, seasons, eclipses, tides	☐
2	**Rocky Planets** Mercury, Venus, Earth and Mars	☐
3	**Giant Planets** Jupiter, Saturn, Uranus and Neptune	**★ YOU ARE HERE**
4	**Moons, Dwarf Planets & Small Bodies** Pluto, Ceres, comets, asteroids and icy moons	☐
5	**Rockets, Orbits & Missions** SLS, orbits, Morse code, spacecraft	☐
6	**Stars, Constellations & Galaxies** Light-years, star maps, galaxies, black holes	☐
7	**Life Beyond Earth** Habitable zones, extremophiles, exoplanets	☐
8	**Astronaut Life** Training, spacewalks, food, living in orbit	☐
+	**Field Guide** The 29 destinations of the Solar System Explorer	in the Complete Workbook

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