3-D Planets

Overview:

Students construct three-dimensional models of the nine planets in our solar system to help them visualize each planet's location of the rotation and magnetic axes. Students also locate the position of the aurora (if there is one) on each planet.

Objectives:

The student will:

- construct a three-dimensional model, accurately showing the magnetic axis and/or the rotational axis of a planet in our solar system;
- measure angles with a protractor; and
- conclude the position of the aurora oval on a planet depends on the location of the planet's magnetic axis, but also is affected by the planet's rotation axis.

Materials:

- Cardstock
- Pipe cleaners
- Clear tape
- 10 red markers
- 10 gray floral stem wires
- 10 green floral stem wires
- 10 Styrofoam balls (6" in diameter)
- TEMPLATE: "Protractor"
- VISUAL AID: "Planet Diagram: Earth"
- STUDENT INFORMATION SHEET: "How to Build a Planet Model"
- STUDENT INFORMATION SHEET: "Planet Diagram" (9: one for each planet)
- STUDENT WORKSHEET: "3-D Planets"

Preparation:

Make 10 photocopies of the circular protractor template on cardstock. Cut out the protractors along the lines indicated. Each protractor should be a ring that will fit around a 6-inch styrofoam ball.

3-D Planets

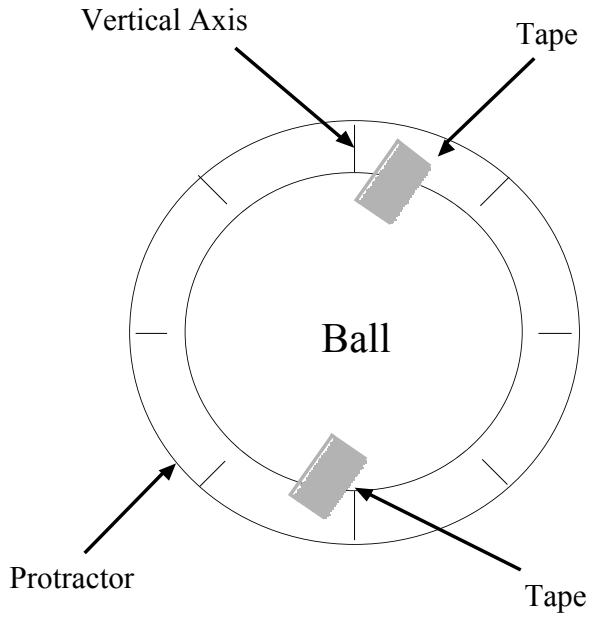
Activity Procedure:

1. Explain the position of the aurora on a planet depends on the location of the planet's magnetic axis, but also is affected by the planet's rotational axis. If the two axes are close together, the aurora forms crowns of light similar to those on Earth. If the two axes are far apart, a weird aurora is formed along the sides of the planet.
2. Divide students into 9 groups (one group for each planet). Give each group a different "Planet Diagram," a 6-inch (in diameter) Styrofoam ball, floral stem wires (one green, one gray), a circular protractor and a red marker.
3. Use the VISUAL AID: "Planet Diagram: Earth" and the STUDENT INFORMATION SHEET: "How to Build a Planet Model" to demonstrate how to build a planet model that shows the rotation and magnetic axes, and the direction in which it rotates. Ask groups to build their own models.
4. Once completed, students can remove the circular protractors and designate a representative. Call group representatives for the **Earth**, **Jupiter** and **Saturn** models to the front of the classroom.
5. Ask the representatives to choose a location for the sun and stand in the order in which the planets occur in the solar system. Ask each to spin the model planet in the proper direction on its rotation axis, and to point out the location of the magnetic axis. Give each representative two pipe cleaners and ask them to shape the pipe cleaners into rings about two inches in diameter. Place them around the magnetic poles of the model planet to represent the aurora. Explain the auroras on these planets closely resemble each other in terms of shape and location.
6. Call the group representatives for **Uranus** and **Neptune** forward and fall into line. Ask each to spin the model planet on its rotation axis and point out the location of the magnetic axis. Explain the magnetic and rotation axes of these planets are far apart. Only dim rings of aurora form over the magnetic poles of these planets. Most aurora on these planets occur on their sides. Give each four pipe cleaners. Two pipe cleaners need to be modeled into two inch rings to put over the magnetic poles, and two need to stay open so they can be held along the sides of each planet.
7. Ask the group representative for the **Venus** model to come forward, to fall into line, and spin Venus at the proper tilt. Explain Venus has no magnetic field to pull particles from the solar wind to its poles so it does not have an aurora oval. However, Venus has a very thick atmosphere of gas particles into which solar particles crash and create a temporary glow that looks like an aurora. The glow occurs in different spots around the planet. **Do not give this person a pipe cleaner.**
8. Call the remaining group representatives to come forward, fall into line, and spin their planets (**Mercury**, **Mars** and **Pluto)** in the correct manner. Ask why these planets do not have aurora.
9. Distribute the STUDENT WORKSHEET: "3-D Planets" and ask students to complete them.

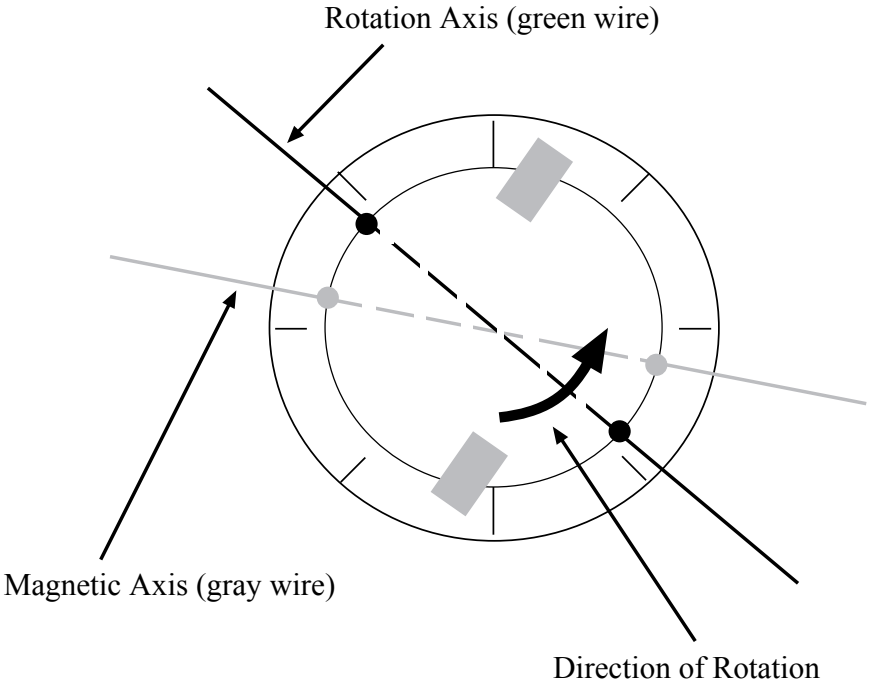
Answers to Student Worksheet:

(1) Earth, Jupiter, Saturn, Uranus, Neptune
(2) Jupiter, Saturn
(3) Uranus, Neptune
(4) Venus
(5) Uranus (Pluto also acceptable)
(6) Venus

How to Build a Planet Model

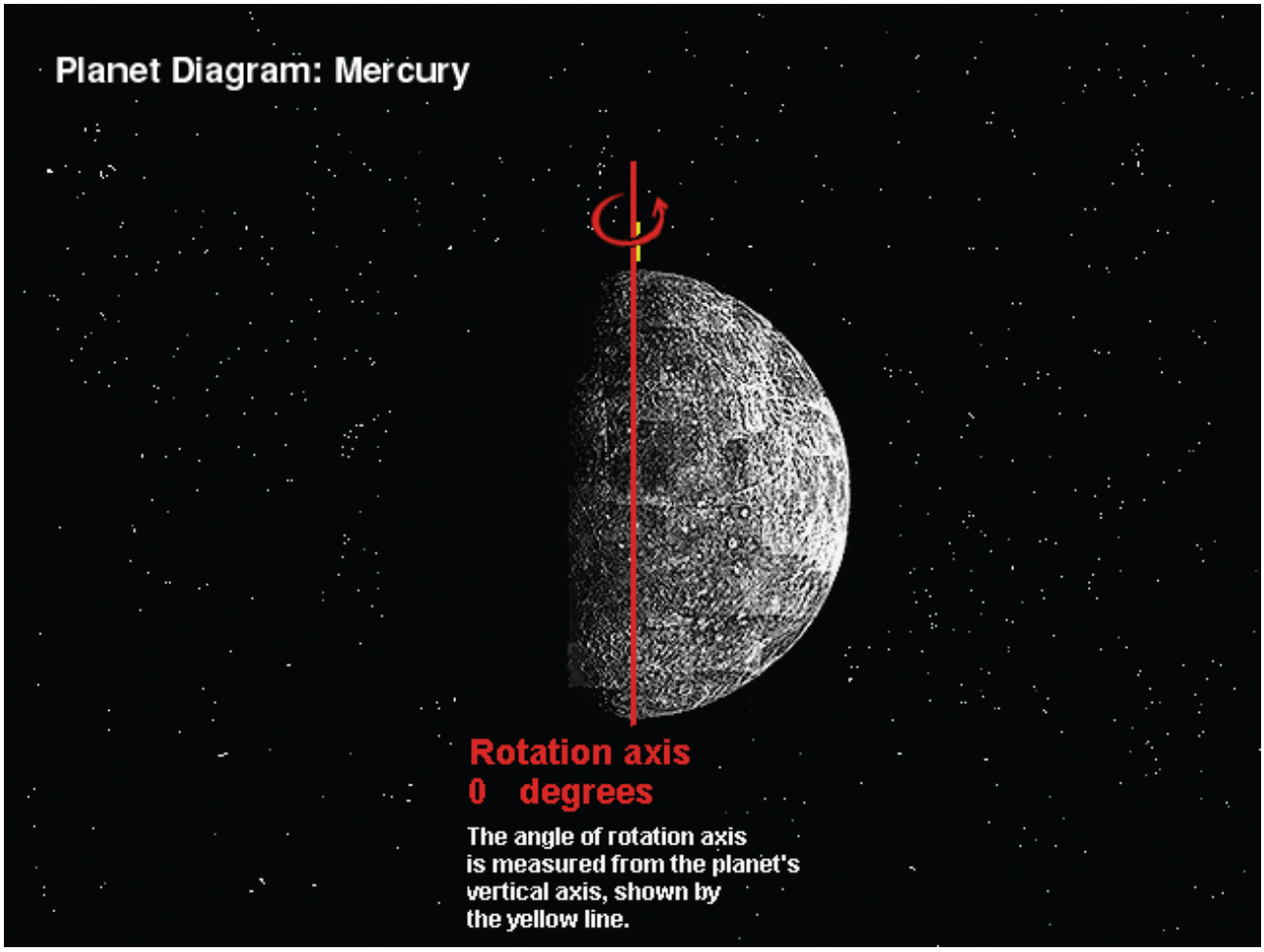


1. Place the circular protractor around the ball, as shown, and tape it in place. Use a marker to make a small X on the ball under the line on the protractor labeled "vertical axis."
2. On the "Planet Diagram," the angle of the rotation axis (shown in red) is measured from the vertical axis (shown as a small yellow line). Use dots to mark the angle of the rotation axis on both ends of the ball.
3. Using the green wire to represent the planet's rotation axis, push it through the ball, so that it enters at one dot and exits at the other.
4. On the "Planet Diagram," the arrow circling the planet's rotation axis indicates the direction the planet rotates. With a marker, draw an arrow on the ball to indicate the direction of rotation.
5. If the planet has a magnetic axis, it will be shown in gray on the "Planet Diagram." Continue with steps 6 and 7. If the planet does **NOT** have a magnetic axis, the model is complete.

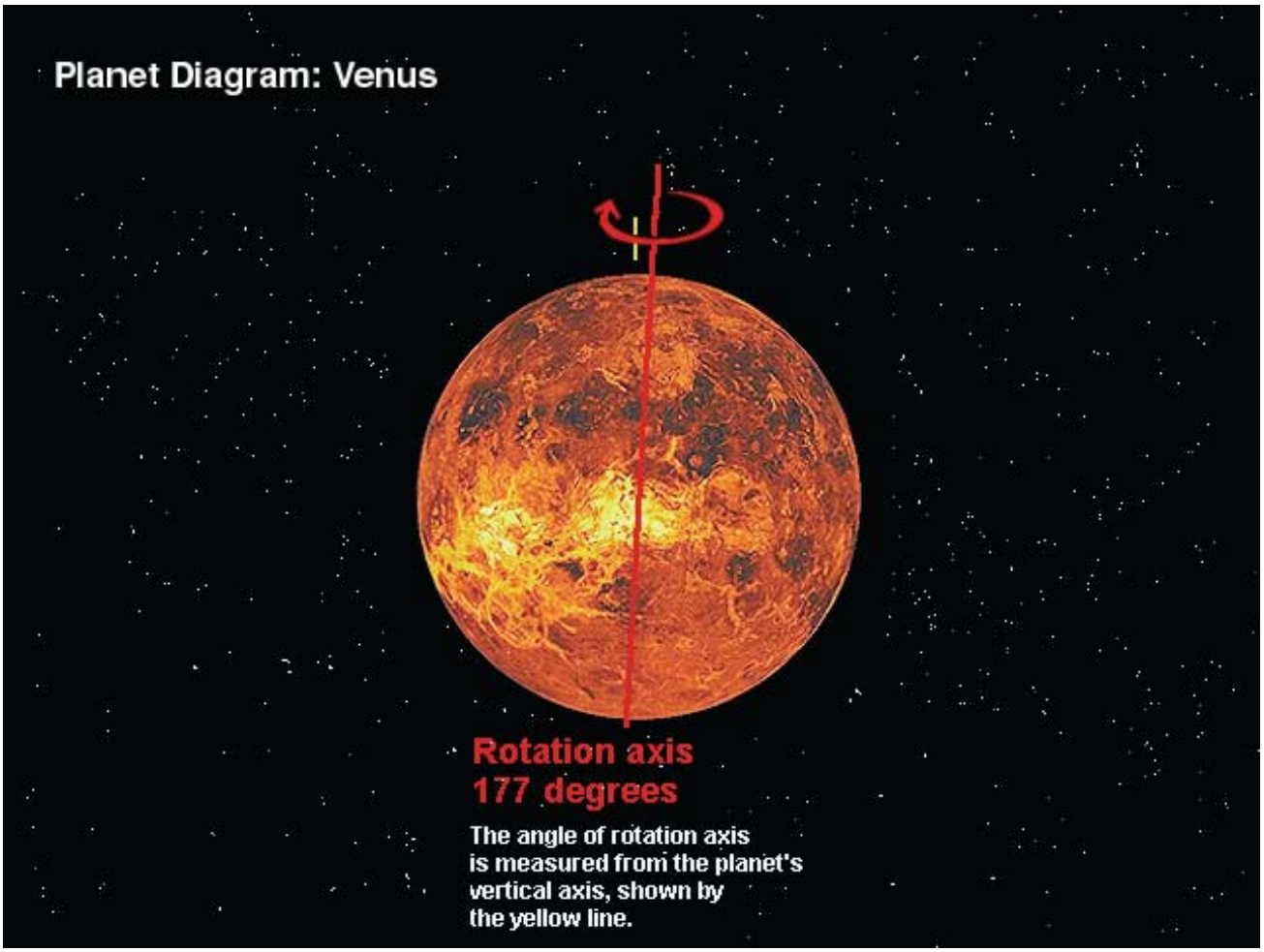


6. On the Planet Diagram, the angle of the magnetic axis (shown in gray) is measured from the rotation axis. The "Planet Diagram" shows if this measurement should be made clockwise or counter-clockwise from the rotation axis. Make two more dots to mark the angle of the magnetic axis on both ends of the ball.
7. Using the gray wire to represent the planet's magnetic axis, push it through the ball, so that it enters at one of the new dots, and exits at the other.

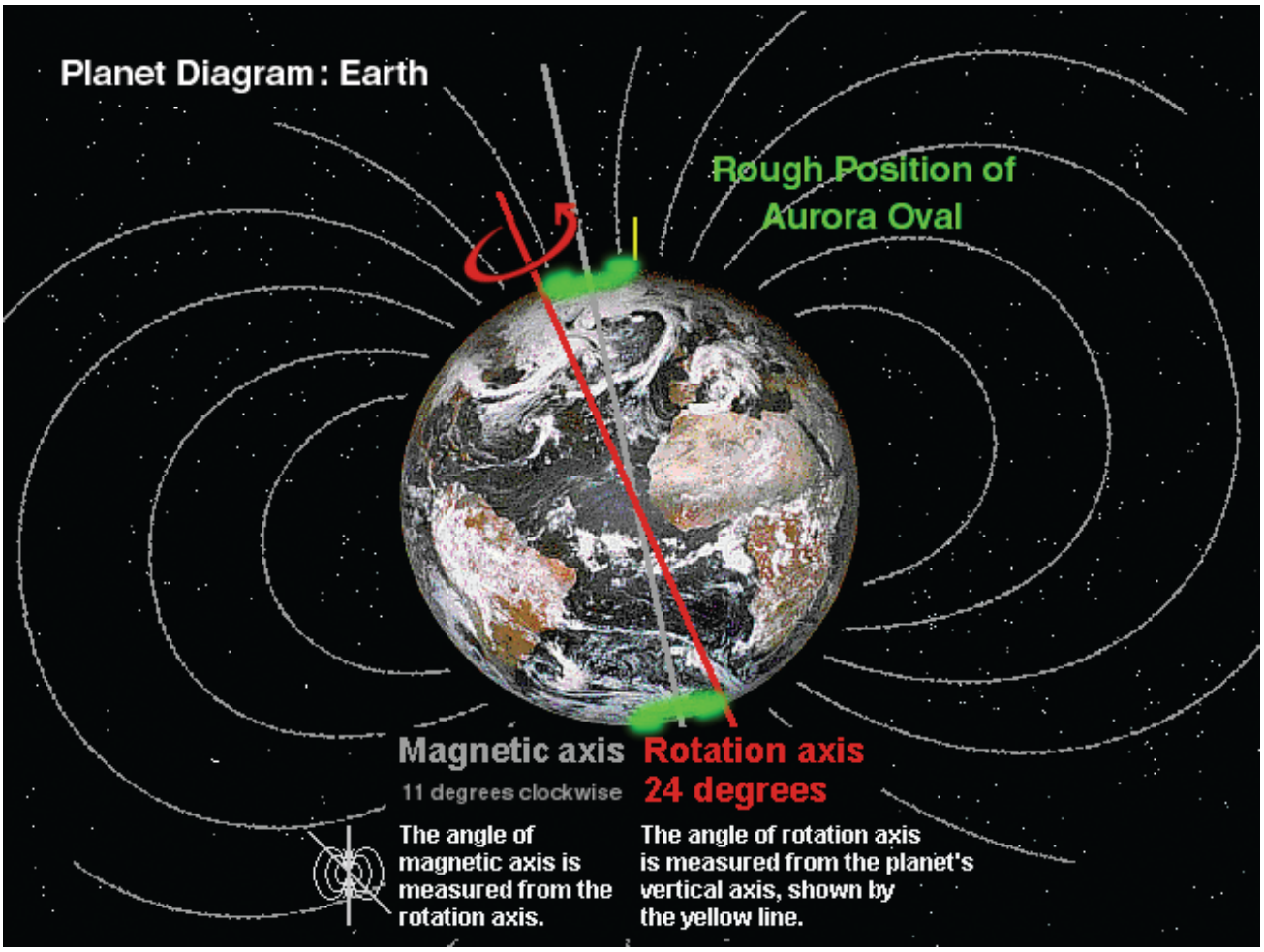
Planet Diagram: Mercury



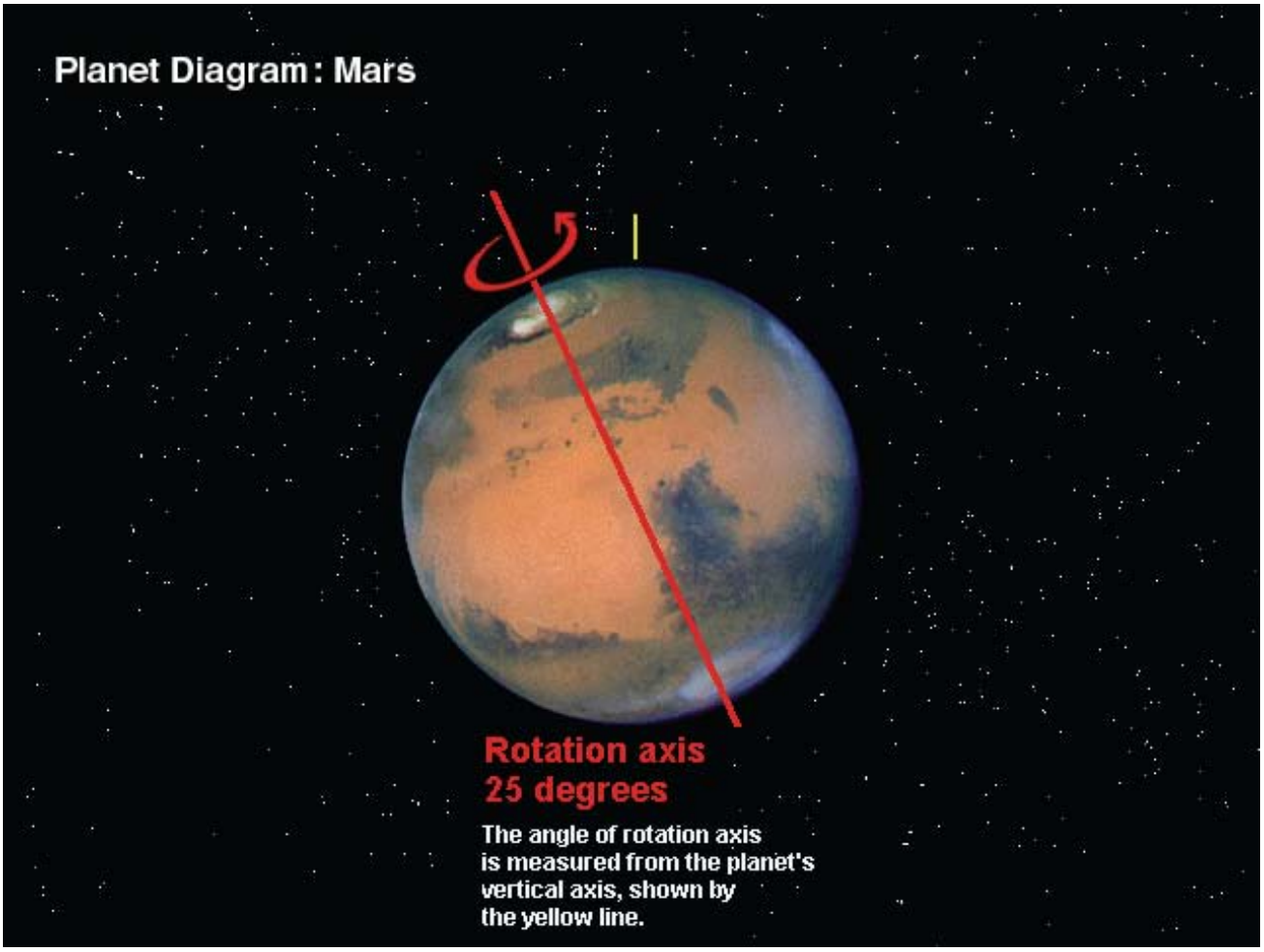
Planet Diagram: Venus



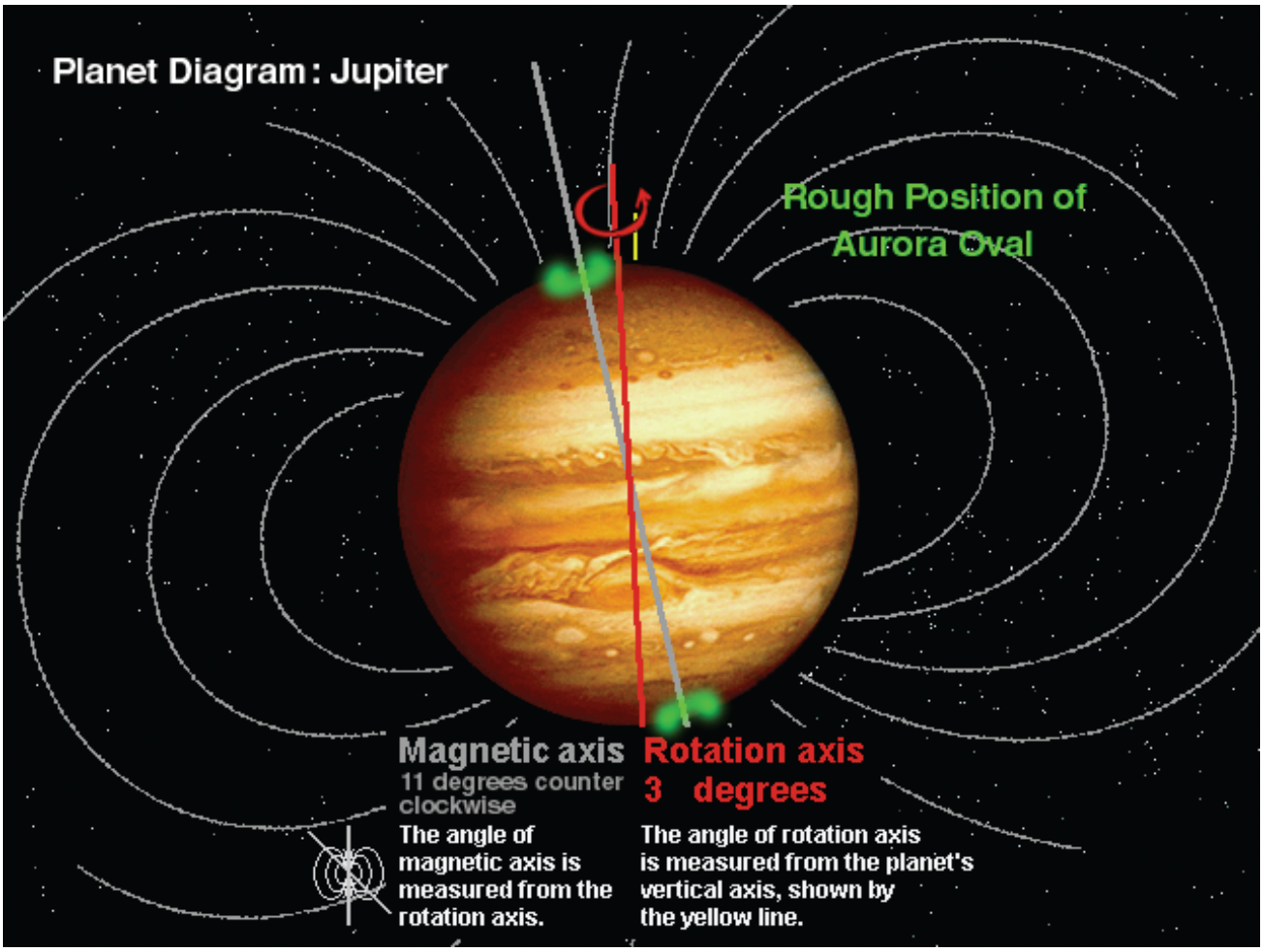
Planet Diagram: Earth



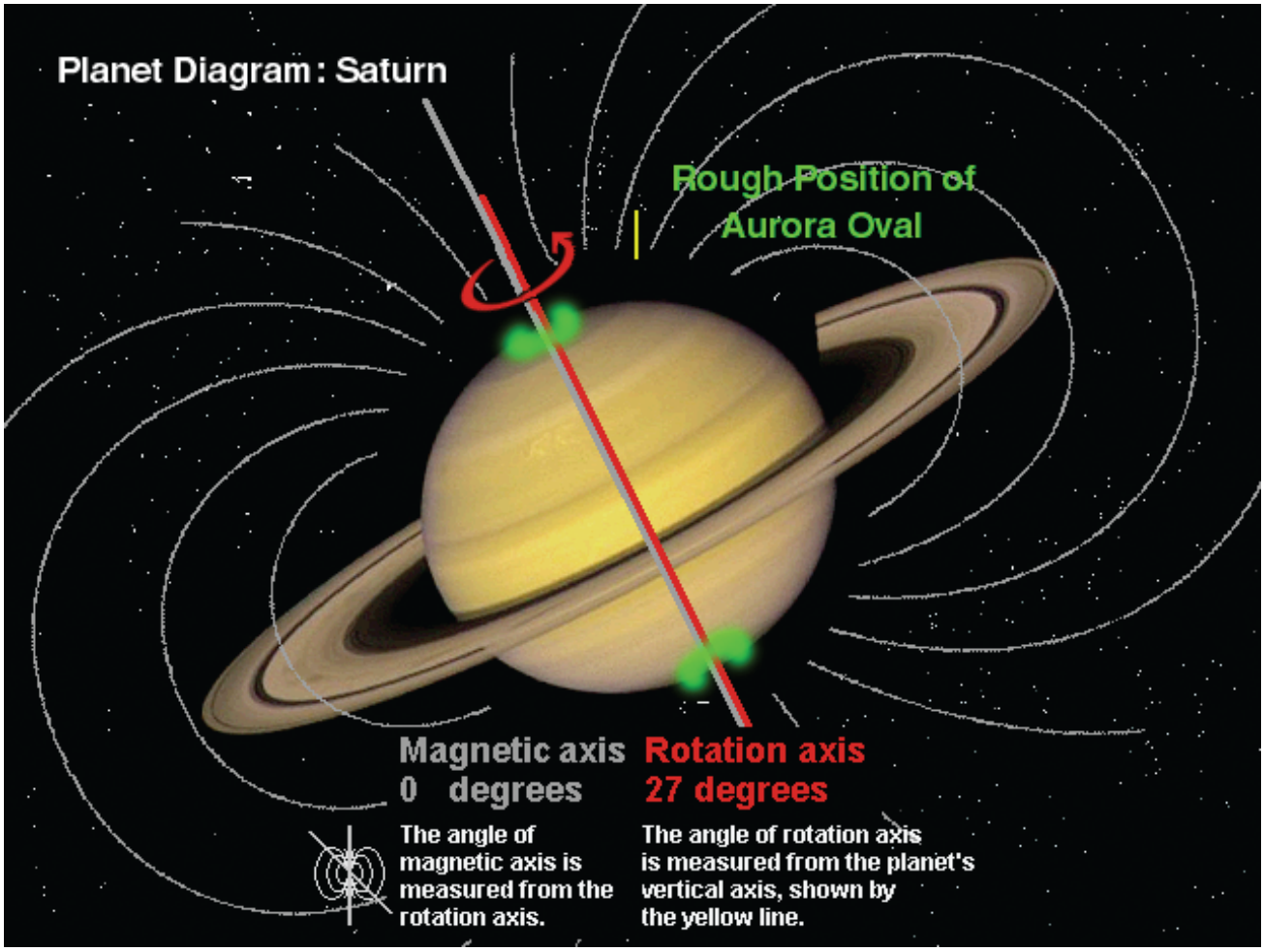
Planet Diagram: Mars



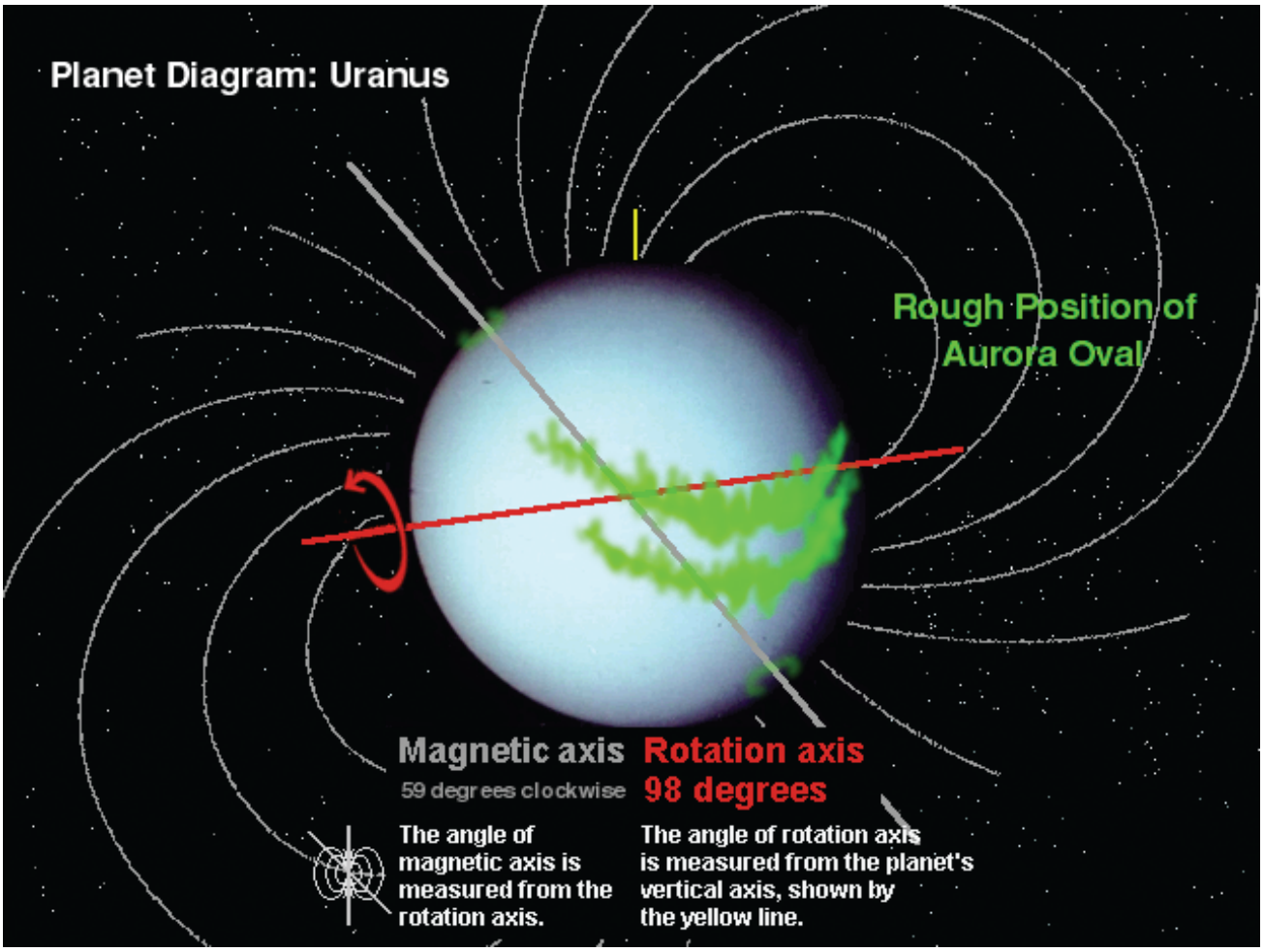
Planet Diagram: Jupiter



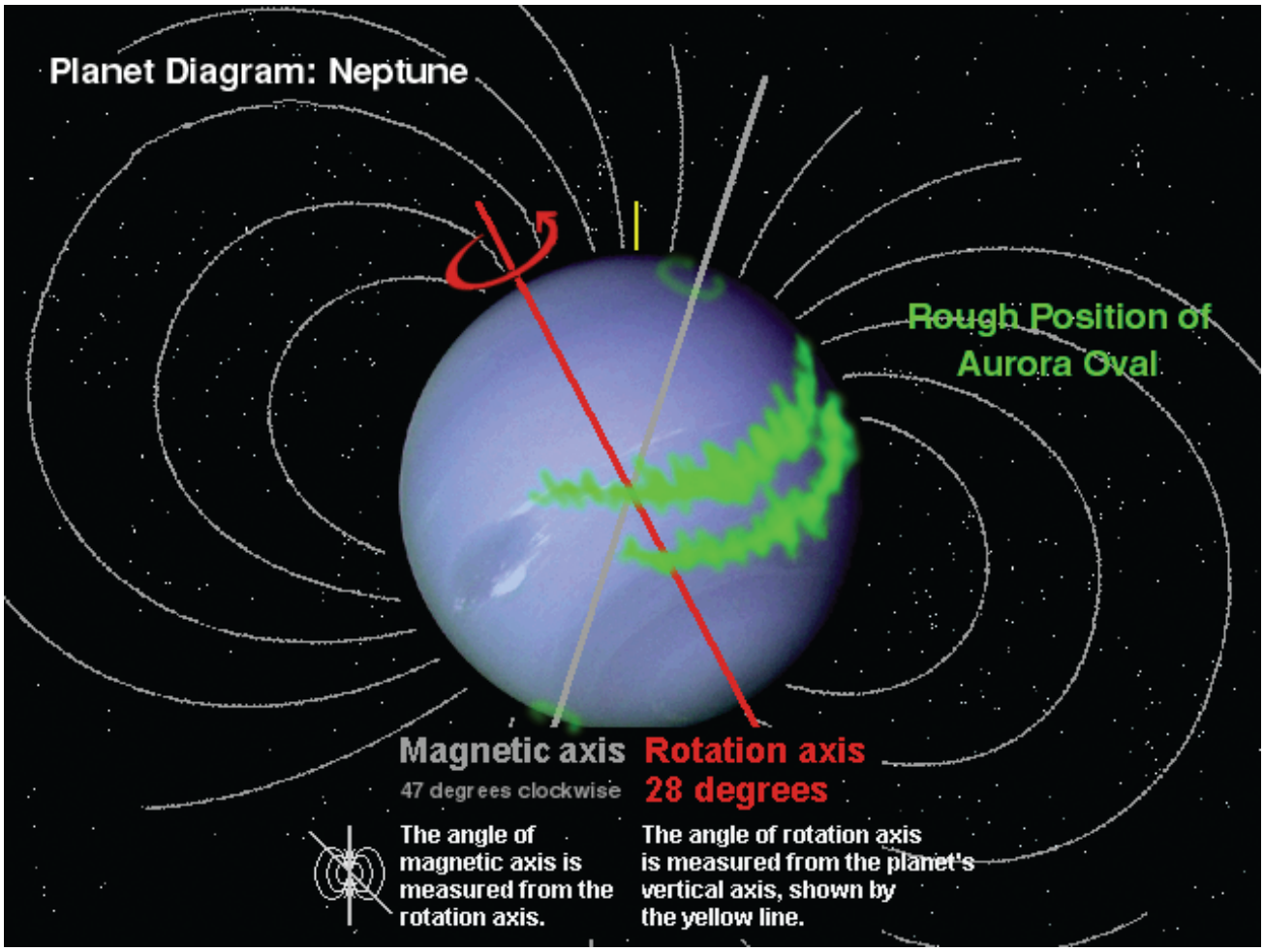
Planet Diagram: Saturn



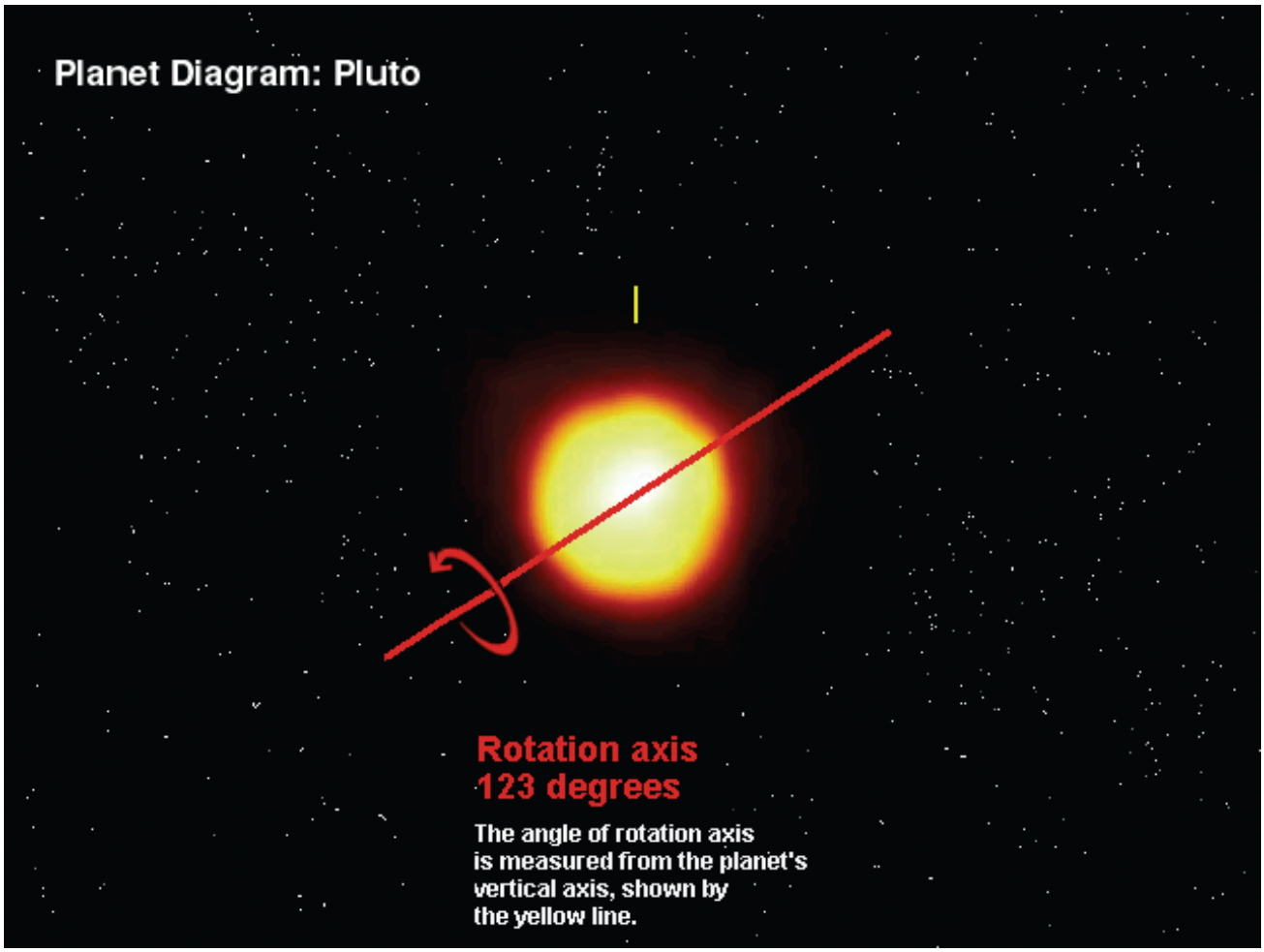
Planet Diagram: Uranus



Planet Diagram: Neptune



Planet Diagram: Pluto



Name:_____ **Student Worksheet**

3-D Planets

1. In the list below, circle the five planets that have aurora ovals.

Mercury	Venus	Earth
Mars	Jupiter	Saturn
Uranus	Neptune	Pluto

2. In the list below, circle the two planets that have aurora ovals that look most like Earth's aurora ovals.

Mercury	Venus	Earth
Mars	Jupiter	Saturn
Uranus	Neptune	Pluto

3. In the list below, circle the two planets on which most of the aurora is seen along their sides.

Mercury	Venus	Earth
Mars	Jupiter	Saturn
Uranus	Neptune	Pluto

4. In the list below, circle the planet that sometimes has a glow that looks like an aurora, but does not have an aurora oval. This planet has no magnetic axis.

Mercury	Venus	Earth
Mars	Jupiter	Saturn
Uranus	Neptune	Pluto

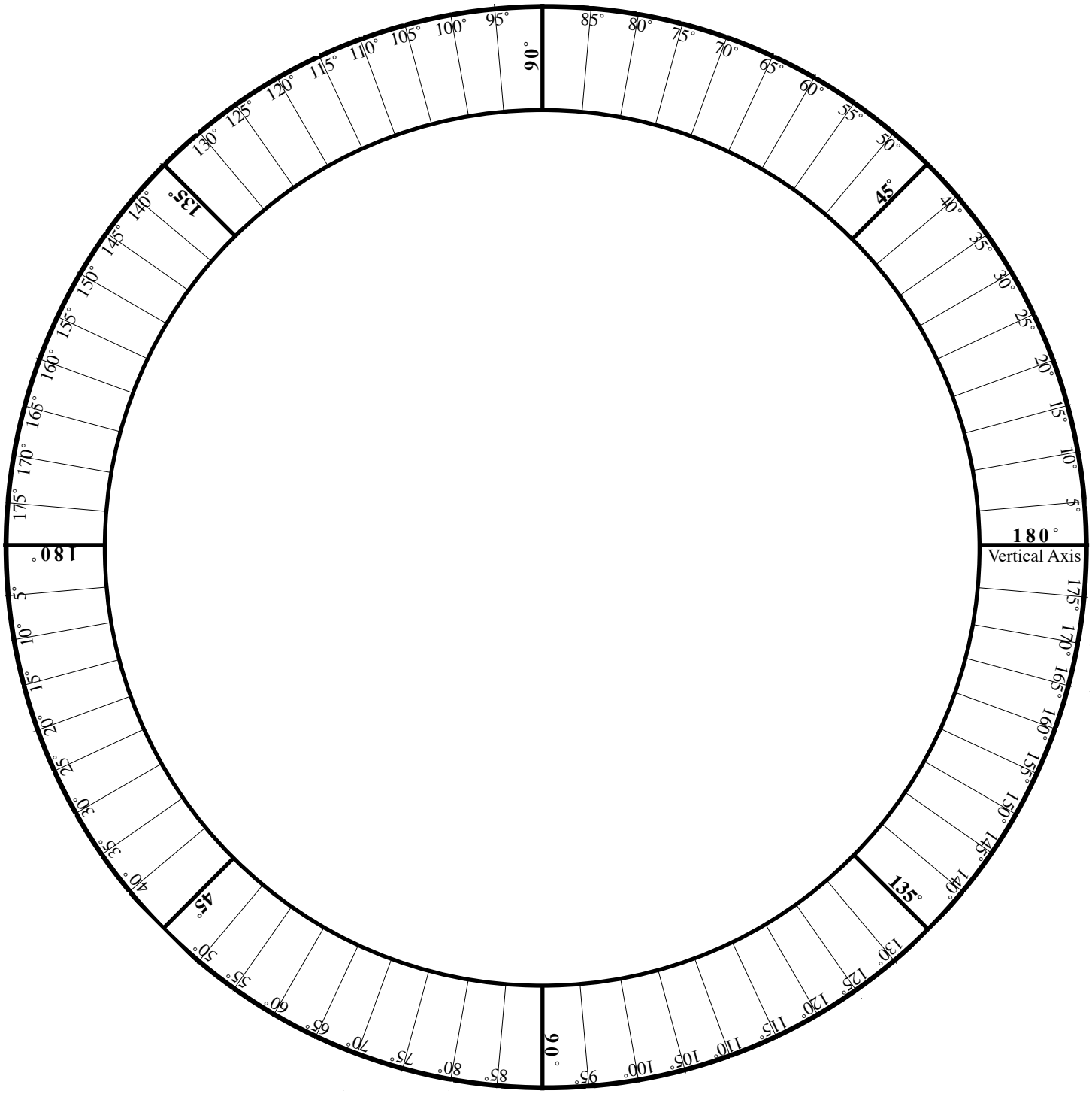
5. In the list below, circle one planet that rotates nearly on its side.

Mercury	Venus	Earth
Mars	Jupiter	Saturn
Uranus	Neptune	Pluto

6. In the list below, circle the planet that rotates in a direction nearly opposite all the other planets.

Mercury	Venus	Earth
Mars	Jupiter	Saturn
Uranus	Neptune	Pluto

Protractor


90°
85° 80° 75° 70° 65° 60° 55° 50°
45°
40° 35° 30° 25° 20° 15° 10° 5°
180°
Vertical Axis
175° 170° 165° 160° 155° 150° 145° 140°
135°
130° 125° 120° 115° 110° 105° 100° 95°
90°
85° 80° 75° 70° 65° 60° 55° 50°
45°
40° 35° 30° 25° 20° 15° 10° 5°
180°
175° 170° 165° 160° 155° 150° 145° 140°
135°
130° 125° 120° 115° 110° 105° 100° 95°