ASTRONOMY
GRADE 8

ASSESSMENT PACKET

This section teaches the big ideas behind Newton and Einstein's ground-breaking work. Students will discover how to design and build reflector and refractor telescopes, investigate how gravity curves spacetime, identify meteorites, detect black holes, play with the electromagnetic spectrum, and uncover the mysterious forces that shape the incredible universe we call home.

Created by Aurora Lipper, Supercharged Science

www.SuperchargedScience.com

This curriculum is aligned with the National State Standards and STEM for Science.

Educational Goals

Professional astronomers come in two varieties: observational and theoretical. Professional observational astronomers mostly use expensive scientific instruments to look through their massive telescopes for them. They spend a lot of time measuring things, taking data, and crunching the numbers. They are very good at designing and performing experiments that answer the big questions to which no one knows the answers.

Professional theoretical astronomers think up new ideas and new models for fitting the data so that it makes sense in the field of physics. They are great at asking the big questions in the first place. Albert Einstein was a theoretical astronomer, as he hated to do experiments of any kind. Instead, he preferred to sit back and think about what might happen in the laboratory of his mind.

Here are the scientific concepts:

- The number of stars that can be seen through telescopes is dramatically greater than can be seen by the unaided eye.
- The structure and composition of the universe can be learned from the study of stars and galaxies.
- How to use astronomical units and light years as measures of distance between the sun, stars, and Earth.
- Stars are the source of light for all bright objects in outer space. The moon and planets shine by reflected sunlight, not by their own light.
- The appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.
- Current detection methods of extrasolar planets.
- Galaxies are clusters of billions of stars, and may have different shapes. The Sun is one of many stars in our own Milky Way galaxy. Stars may differ in size, temperature, and color.
- Black holes are objects where the escape velocity is greater than the speed of light. They are the leftovers of a BIG star explosion. There is nothing to keep it from collapsing, so it continues to collapse forever. It becomes so small and dense that the gravitational pull is so great that light itself can't escape.
- Gravitational lensing occurs when black holes and other massive objects bend light.
- Mass causes spacetime to curve. The amount of curvature depends on how massive the object is and your distance from the massive object.
- Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.
- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.
- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.

- This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.

By the end of the labs in this unit, students will be able to:

- Design an experiment that shown the Earth-sun-moon system and its cyclic patterns of eclipses, lunar phases, and seasons.
- Illustrate how gravity works in the motions within galaxies and the solar system.
- Analyze and interpret data to determine properties of objects in the solar system.
- Design and build a telescope using optical equipment such as mirrors and lenses.
- Know the celestial objects in the solar system and how they relate and interact with each other.
- Understand how to determine the structure and composition of celestial objects.
- Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- Measure and estimate the length and volume of objects.
- Formulate and justify predictions based on cause-and-effect relationships.
- Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
- Construct and interpret graphs from measurements.
- Follow a set of written instructions for a scientific investigation.

Astronomy Evaluation

Teacher Section

Overview: Kids will demonstrate how well they understand important key concepts from this section.

Suggested Time: 45-60 minutes

Objectives: Students will be tested on the key concepts:

- Understand how objects in our solar system, including the sun, the planets, their moons, asteroids, and comets fit together in our solar system.
- Demonstrate how the laws of physics are used to predict motion of objects.
- Be able to perform real experiments using scientific instruments, like telescopes to take observational data.

Students will also demonstrate these principles:

1. Collecting and interpreting data from an experiment
2. Making valid observations based on their actions in lab

Materials (one set for entire class)

- string
- flashlight
- index card
- pencil
- tennis ball
- marble
- 3 peppercorns
- beach ball
- 2 marbles
- 2 pins (with pinheads)
- 2 shooter size marbles
- scissors

Lab Preparation

1. Print out copies of the student worksheets, lab practical, and quiz.
2. Have a tub of the materials in front of you at your desk. Kids will come up when called and demonstrate their knowledge using these materials.

Lesson

The students are taking two tests today: the quiz and the lab practical. The quiz takes about 20 minutes, and you'll find the answer key to make it easy to grade.

Astronomy Grade 8 Evaluation

Student Worksheet

Overview: Today you're going to take two different tests: the quiz and the lab practical. You're going to take the written quiz first, and the lab practical at the end of this lab. The lab practical isn't a paper test – it's where you get to show your teacher that you know how to do something.

Lab Test & Homework

1. Your teacher will call you up so you can share how much you understand astronomy. Since science is so much more than just reading a book or circling the right answer, this is an important part of the test to find out what you really understand.
2. While you are waiting for your turn to show your teacher how much of this stuff you already know, you get to get started on your homework assignment. The assignment is due next week, and half the credit is for creativity and the other half is for content, so really let your imagination fly as you work through it. Choose one:
    a. Design a new solar system with a two stars (binary) in the center orbiting each other. Write a short story or skit about the planets, moons, asteroids, and comets in your new solar system from the perspective of one of the stars in a binary star system.
    b. Make a poster that teaches the main concepts of our solar system, including the sun, planets, moons, asteroids, comets, and Kuiper Belt objects. When you're finished, you'll use it to teach to a class in the younger grades and demonstrate each of the principles that you've learned.
    c. Write and perform a poem or song about the sun. This will be performed for your class.

Astronomy Grade 8 Quiz

Teacher's Answer Key

1. _____ are clusters of billions of stars. (galaxies)
2. Astronomers use _____ to view the moon, comets, asteroids, and planets of our solar system. (telescopes)
3. We live in the _____ galaxy. (Milky Way)
4. _____ are objects were the _____ velocity is greater than the speed of light. (black holes, escape)
5. One astronomical unit (AU) is the distance from the _____ to the _____. (sun, earth)
6. The solar system consists of the sun and a collection of objects, including planets, their _____, _____ and comets. (moons, asteroids)
7. The _____ are caused by the tilt in the Earth's rotational axis away or _____ the sun as it travels in its path around the sun. (seasons, toward)
8. We can see _____ stars in the night sky through a telescope than we can with our unaided eye. (more)
9. The moon and planets shine by _____ light, whereas the sun is the _____ of light. (reflected, source)
10. Stars differ in size, temperature and _____. Our sun is a _____ dwarf star. (color, yellow)
11. Gravitational lensing occurs when massive objects _____ light. (bend)
12. Retrograde motion is the apparent motion of a planet in a direction _____ to the rest of the bodies in the system. (opposite)
13. The phases of the moon are caused by the position of the _____, _____and moon as related to each other. (sun, earth)
14. A _____ eclipse occurs when the moon enters the Earth's shadow. (lunar)
15. The sun is a large ball of _____ .(hot gas)
16. The visible surface of the sun is called the _____ and is made up mostly of _____. (photosphere, plasma)
17. A _____ eclipse occurs when the moon's shadow falls on the Earth. (solar)
18. Sunspots are _____ areas on the surface of the sun where the hot gases have cooled down. (dark)
19. The sun's _____ rotates faster than it's _____. (equator, poles)
20. Solar _____ are massive eruptions and explosions on the surface of the sun related to the sun's magnetic field. (flares)

BONUS QUESTION:
Five things to look for when identifying if a rock is a real meteorite are: _____, _____, _____, _____ and _____. (heavy for its size/dense, magnetic, non-porous, looks like splashed metal, and leaves no streak on an unglazed tile)

Astronomy Grade 8 Quiz

Student Quiz Sheet

Name_____

Fill in the blank:

1. _____ are clusters of billions of stars.
2. Astronomers use _____ to view the moon, comets, asteroids, and planets of our solar system.
3. We live in the _____ galaxy.
4. _____ are objects were the _____ velocity is greater than the speed of light.
5. One astronomical unit (AU) is the distance from the _____ to the _____.
6. The solar system consists of the sun and a collection of objects, including planets, their _____, _____ and comets.
7. The _____ are caused by the tilt in the Earth's rotational axis away or _____ the sun as it travels in its path around the sun.
8. We can see _____ stars in the night sky through a telescope than we can with our unaided eye.
9. The moon and planets shine by _____ light, whereas the sun is the _____ of light.
10. Stars differ in size, temperature and _____. Our sun is a _____ dwarf star.
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13. The phases of the moon are caused by the position of the _____, _____and moon as related to each other.

14. A _____ eclipse occurs when the moon enters the Earth's shadow.

15. The sun is a large ball of _____ .

16. The visible surface of the sun is called the _____ and is made up mostly of _____. (photosphere, plasma)

17. A _____ eclipse occurs when the moon's shadow falls on the Earth.

18. Sunspots are _____ areas on the surface of the sun where the hot gases have cooled down.

19. The sun's _____ rotates faster than it's _____.

20. Solar _____ are massive eruptions and explosions on the surface of the sun related to the sun's magnetic field.

BONUS QUESTION!

5 things to look for when identifying a real meteorite:

_____

_____

_____

_____

_____

Astronomy Grade 8 Lab Practical

Teacher's Answer Key

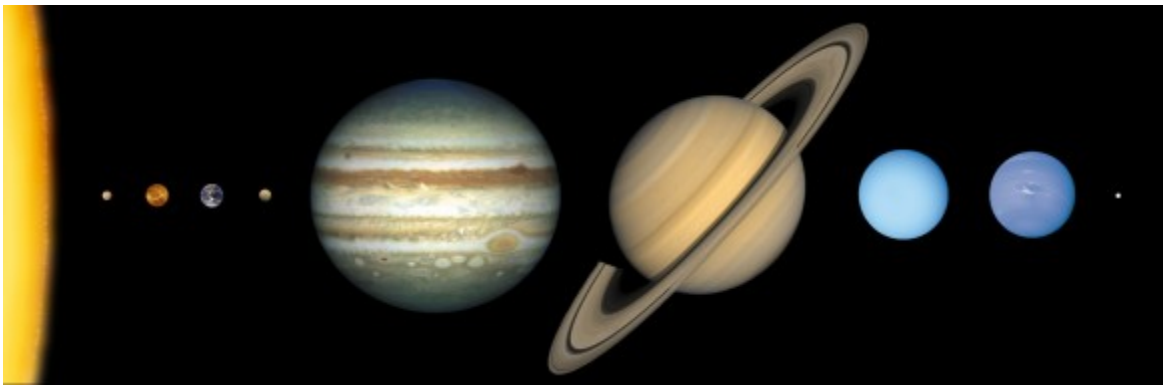
This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- string
- flashlight
- index card
- pencil
- tennis ball
- marble
- 3 peppercorns
- beach ball
- 2 marbles
- 2 pins (with pinheads)
- 2 shooter size marbles
- scissors

Lab Practical: Ask the student *Note: Answers given in italics!*

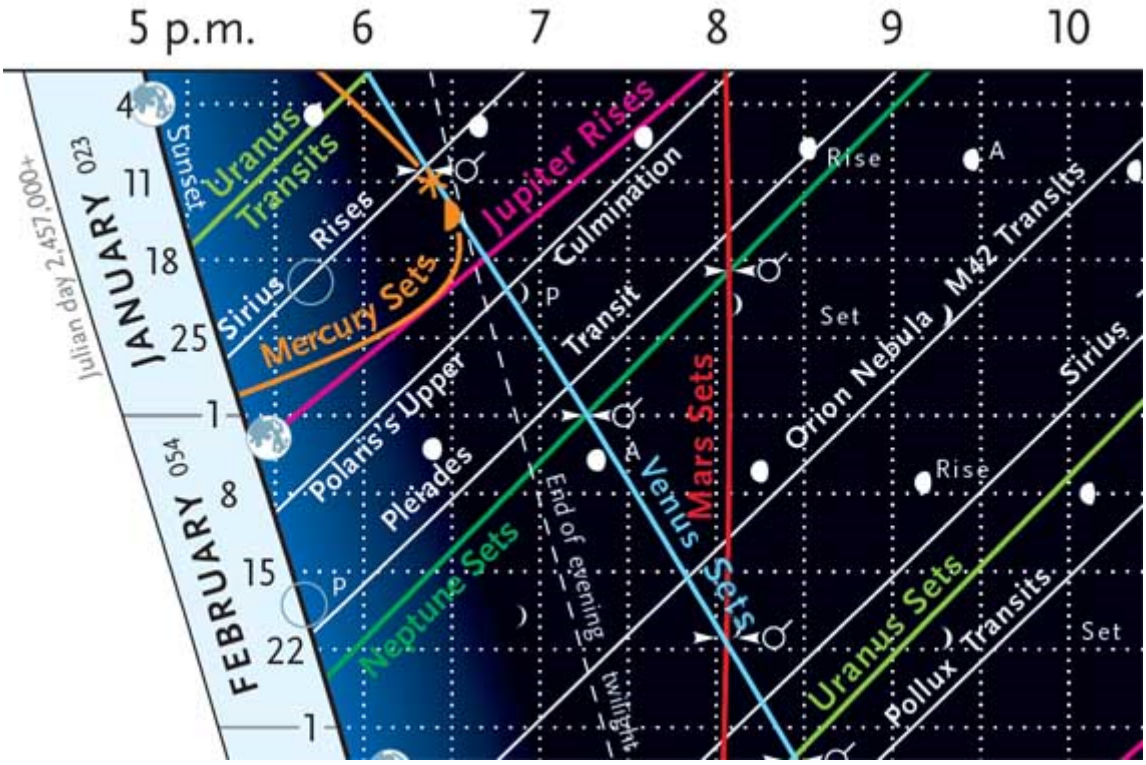
1. Design an experiment that shows why we do not have eclipses every month.
    a. *Students can use a pencil and paper and draw the Earth, sun and moon in their orbits. Students then show how the moon goes around the Earth, and the Earth-moon system goes around the sun. However, the moon's position isn't drawn accurately, because sometimes it's a little above the piece of paper and sometimes it's a little below. When the moon's position is on the paper just as the moon lines up with the earth and sun with an eclipse happen.*
2. Using the materials provided, show the relative size of each of the planets.
    a. *Refer to image and sizes below.*



- Jupiter (69,911 km / 43,441 miles) – 1,120% the size of Earth; shooter size marble
- Saturn (58,232 km / 36,184 miles) – 945% the size of Earth; shooter size
- Uranus (25,362 km / 15,759 miles) – 400% the size of Earth; marble
- Neptune (24,622 km / 15,299 miles) – 388% the size of Earth; marble
- Earth (6,371 km / 3,959 miles); peppercorn
- Venus (6,052 km / 3,761 miles) – 95% the size of Earth; peppercorn
- Mars (3,390 km / 2,460 miles) – 53% the size of Earth; head of a pin

- Mercury (2,440 km / 1,516 miles) – 38% the size of Earth; head of a pin
- Sun (432,687 miles) – 1,300,000% the size of the Earth; beach ball

3. Demonstrate Kepler's 3 Laws of Planetary Orbits.
    a. *Refer to "Kepler's Swinging System" experiment.*
    b. *Kepler's first law states that the orbits of the planets are not circles but rather ellipses where the sun lies at one of the foci of the ellipse.*
    c. *Kepler's second law states that the further out a planet is from the sun, the slower it goes.*
    d. *Kepler's third law is an equation that relates the time it takes to orbit the sun with the average speed of the planet. If we double the mass of the sun, the Earth would orbit faster.*
4. Using the chart below, what can you expect to see in the night sky on January 19 at 7:30pm?
    a. *Using the chart on the next page, at 7:30pm, we would see Jupiter has just risen in the east, Neptune getting ready to set in the west, the Pleiades nearly overhead, Uranus on the ecliptic path setting in a few hours, and no Mercury or Venus. Bright stars include Sirius and Pollux, and a nice telescope target object would be the Orion Nebula M42.*



Astronomy Grade 8 Lab Practical

Student Exam

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- string
- flashlight
- index card
- pencil
- tennis ball
- marble
- 3 peppercorns
- beach ball
- 2 marbles
- 2 pins (with pinheads)
- 2 shooter size marbles
- scissors

Lab Practical: You will demonstrate the following:

1. Design an experiment that shows why we do not have eclipses every month.
2. Using the materials provided, show the relative size of each of the planets.
3. Demonstrate Kepler's 3 Laws of Planetary Orbits.
4. Using the chart below, what can you expect to see in the night sky on January 19 at 7:30pm?