# ttp://upload.wikimedia.org/wikipedia/commons/1/15/Lunar_Eclipse.jpgile:Apollo 15 Lunar.jpgttp://upload.wikimedia.org/wikipedia/commons/thumb/3/31/Bradfield.JPG/800px-Bradfield.JPGPlanetary Science for the Middle School Student

Universe

For Middle School Students

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**Summary**

This unit is a collection of interactive lessons directed at increasing student comprehension of difficult solar system concepts. While most activities can be done individually or in small groups by the students, whole group instruction and demonstration can be utilized in classrooms with limited access to computers for student use.

**Minimum technology requirements include:**

|  |  |
| --- | --- |
| x | Video data projector/document camera |
| x | Video data projector/document camera/interactive whiteboard |
| x | Up to 3 visits to computer lab for online activities and assignments |
| x | Use laptops in the classroom on a regular basis (unless you opt for demonstrations, and whole group instruction) |

**General lesson Overview**

Lessons begin with an opening activity, or launch. Videos can be found by clicking the links to google docs.

Student worksheets can be found in the pdf folder. These activities can be done with partners, but it is beneficial for all students to complete a worksheet.

**NOTE:** Lesson 8 is built upon student observations of the moon during the unit. Demonstrate how to observe the moon and handout to students their Observing the Moon (in pdf folder) to complete as daily homework for their moon observations. (another good resource can be found [here](http://www.webfilebrowser.com/webfilebrowserphp/rootFolder/folder%20B/obsmoo.pdf).)

**Lesson Index……………….…….Video Index**

Lesson 1: [Stars](#_Lesson_1:_The)…………………….[A Star is Born](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-OGI5NzRlMTMtMWMwMi00ZDFjLTgwOWQtMGQzNDc4MzA3NjNk&hl=en_US) & [Nebula Birth](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-Yzc4ZjkwNzgtZWFkZC00ZjhhLWEwMDgtNWRkNjE3YWM0MDBm&hl=en_US)

Lesson 2:  [Solar Movement](#_Lesson_2:_Planetary)

Lesson 3: [Shadows](#_Lesson_3:_Shadows)

Lesson 4: [Rotation](#_Lesson_4:_ROTATION)………………..[Earth Rotation](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-NWY0NjJjYmMtNzU0MS00ZGVlLTljN2QtNjhiMGQwZTczZTRk&hl=en_US)

Lesson 5: [Revolution](#_Lesson_5:_REVOLUTION)…………….[Mechanism of the Seasons](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-ODhiYzRiOTEtZjVhNy00YWE2LWJkNzYtMGE1OTg3NjVmMTE1&hl=en_US)

Lesson 6: [Gravity](#_Lesson_6:_Gravity)…………….…...[Laws of Motion Rap](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-YzljYjc1MDYtZTIzMy00M2QxLWIxNDktY2FhZDA0Yjg3MTU3&hl=en_US) & [Hammer](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-MDRiZjYzZGYtMmQzZi00MDkwLWIwYmQtNWY4Y2Q3Y2JlZmYz&hl=en_US)

Lesson 7: [Solar System](#_Lesson_7:_Solar)………..[Solar System Rap](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-YmJlM2JkNGItNmMyYi00ODg2LWExYjgtNzZmOGU3Yzg3MDY2&hl=en_US) & [Pluto](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-NDNhMjI4YWQtNDM3NC00YTk3LTkwNDgtOGQxMzk1Zjc2YzQ2&hl=en_US)

Lesson 8: [Moon](#_Lesson_8)……………….…..[Phases of the Moon Hip-Hop](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-OTJmZjlkOWYtYTI5OC00NGMwLWFkZDAtNmVkNWJjMGMwMTNh&hl=en_US)

Lesson 9: [Final Assessment](#_Lesson_9)

# Lesson 1: THE STARS

*Standard: Recognize that the sun is a medium-sized star, one of billions of stars in the Milky Way galaxy, and the closest star to Earth.*

*Assessment: Students will create a poster using Microsoft Word, PowerPoint, or Comic Life demonstrating their understanding of our sun. Use the following rubric to assess student projects.* (Printable 2-Up rubric in rubric folder)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ­­­Category | 4  | 3  | 2  | 1  |
| Graphics - Relevance  | All graphics are related to the topic and make it easier to understand. All borrowed graphics have a source citation.  | All graphics are related to the topic and most make it easier to understand. All borrowed graphics have a source citation.  | All graphics relate to the topic. Most borrowed graphics have a source citation.  | Graphics do not relate to the topic OR several borrowed graphics do not have a source citation.  |
| Content - Accuracy  | At least 7 accurate facts are displayed on the poster.  | 5-6 accurate facts are displayed on the poster.  | 3-4 accurate facts are displayed on the poster.  | Less than 3 accurate facts are displayed on the poster.  |
| Knowledge Gained  | Student can accurately answer all questions related to facts in the poster and processes used to create the poster.  | Student can accurately answer most questions related to facts in the poster and processes used to create the poster.  | Student can accurately answer about 75% of questions related to facts in the poster and processes used to create the poster.  | Student appears to have insufficient knowledge about the facts or processes used in the poster.  |
| Required Elements  | The poster includes all required elements as well as additional information.  | All required elements are included on the poster.  | All but 1 of the required elements are included on the poster.  | Several required elements were missing.  |

**Lesson 1: Day 1**

Launch lesson with video: [A Star is Born](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-OGI5NzRlMTMtMWMwMi00ZDFjLTgwOWQtMGQzNDc4MzA3NjNk&hl=en_US)… (Another video is also available that is more in depth titled [Nebula and Star Birth](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-Yzc4ZjkwNzgtZWFkZC00ZjhhLWEwMDgtNWRkNjE3YWM0MDBm&hl=en_US)). Students are encouraged to take notes, or generate 3 questions they have about stars after viewing this 3:11 video.

Then students will conduct mini webquest on stars. Students will review an article by NASA explaining how a star is defined. Students will then answer the following questions:

* What does NASA stand for?
* How does NASA describe a star?
* How old is our closest star?
* If you are standing on the earth in the northern hemisphere, which direction do the stars appear to rotate?
* Name two other stars.

Students will also be directed to go to Astronomy for Kids, where they will answer the following set of questions:

* Compare and contrast three of the different types of stars. (At least 3 characteristics for each type)
* What is the factor that changes the classification of a star?
* What kind of star is our sun?
* How many years do they expect our Sun to exist?
* What will happen when our star dies?

*Lesson 1: Day 2-3*

Students will create their posters using the rubric as their guide. The Rubric can be found in the Rubric folder of the Moodle Classroom.

# Lesson 2: PLANETARY MOTION

*Standard: The student will use the predictability of the motions of the Earth, and sun to explain the length of day, length of year, phases of the moon, eclipses, tides and shadows.*

*Pre-Assessment: Students will complete the worksheet Observing the Sun to assess student understanding of the key concepts of Rotation and Revolution, and daylight length.*

**Lesson 2**

Lesson 2 standard will be covered individually in lessons 3 and 4. This lesson is a launch into the concepts of rotation and revolution. Students will complete the pre-Assessment Observing the Sun.

After words, students will us bubbl.us to construct a concept map of the words Rotation and Revolution using any available resources for research.

# Lesson 3: SHADOWS

 *Standard: The student will use the predictability of the motions of the Earth, and sun to explain the length of day, length of year, phases of the moon, eclipses, tides and shadows.*

*Assessment: Students will provide an exit slip demonstrating their understanding of the shadow concept.*

*Lesson 3*

Students will complete two online interactive activities that demonstrate the concept of shadows. To reinforce vocabulary in this lesson, students will make vocabulary cards using the follow format. (My students tape these cards into their notebooks to ensure they do not get lost.

**EXIT SLIP (2-UP printable in documents folder)**

# Lesson 4: ROTATION

Draw the shadow for on opaque object at 10am and 5pm. Explain the differences between the two drawings on the back of this slip.

E X I T S L I P

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hour\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Standard: The student will use the predictability of the motions of the Earth, and sun to explain the length of day, length of year, phases of the moon, eclipses, tides and shadows.*

*Assessment: Students will complete an exit slip demonstrating the concept of length of day. Students should indicate that the length of day is dependant on the latitude of the observer because the earth is a sphere.*

***Lesson 4***

Launch: Students will need to copy down the parts of the globe on their worksheet, and be able to define longitude, latitude, Northern and Southern hemispheres, the Tropic of Cancer and Tropic of Capricorn, North and South Poles.

Students will then watch short video: [Earth Rotation](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-NWY0NjJjYmMtNzU0MS00ZGVlLTljN2QtNjhiMGQwZTczZTRk&hl=en_US).

Students will use an online interactive model to explore the concept of latitude and its relationship to daylight time.

Interactive Activity (answers)

1. Set the latitude for Minneapolis' Latitude. *(44.98)*

3. Explain in your own words that the crescent shaped dark area is. *(The part of the sphere that is not exposed to the sun; the dark side of the earth)*

5. How has the crescent shaped area changed? (the dark side of the earth changes to be in the northern hemisphere instead of the southern.)

6. When thinking of the rotation of Earth, in your own words describe how the length of day is determined. (This is where the idea of sun location in relationship to observer position should begin to develop; the concept of tilt)

8. Describe how the daylight time looks for both summer and winter solstices. Be sure to talk about the position of the sun, and rotation of Earth. *(In Alaska, the observer will not see any sunlight in the daytime during Winter Solstice, and will not have any nighttime during the Summer Solstice etc….)*

**Exit Slip**

Explain in your own words how the length of time you see sunlight changes over the course of a year.

# Lesson 5: REVOLUTION

*Standard: The student will use the predictability of the motions of the Earth, and sun to explain the length of day, length of year, phases of the moon, eclipses, tides and shadows.*

*Assessment: Worksheet with completed Flashlight Activity*

**Lesson 5**

Launch: Watch video called [Mechanism of the Seasons](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-ODhiYzRiOTEtZjVhNy00YWE2LWJkNzYtMGE1OTg3NjVmMTE1&hl=en_US)

Students will complete interactive activity on the seasons from Engineering Interact.

Students will use worksheet to take notes on the season and tilt of the Earth.

Then students will investigate indirect and direct light by doing the Flashlight Activity.

**Flashlight Activity**

*Materials: Notebook, paper, flashlight, protractor, calculator*

Students will shine a flashlight onto paper that is placed on a notebook at 90° angle and trace the outline of the light that hits the surface. Students should note any observations they have about shape, light intensity, etc.. Then students are to tip the notebook/paper noting the angle of inclination, and trace the outline of the light at two other angles of their choice. Students will then calculate the area of the circle, and the areas of the ellipse (ovals), and report back their findings. Students will be able to see that the area of the circle is smaller that the area of the ovals, and therefore get less light per area.

No time for calculations? Then used gridded paper and students can count the gridded areas for comparison.

ELLIPSE
Area = πab

CIRCLE

Area = πr2

# Lesson 6: GRAVITY

*Standard: Recognize that gravitational force exists between any two objects and describe how the masses of the objects and distance between them affect the force.*

*Assessment: Complete the Center of Mass Activity and Worksheet.*

***Lesson6***

Launch Watch Video: [Laws of Motion Rap](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-YzljYjc1MDYtZTIzMy00M2QxLWIxNDktY2FhZDA0Yjg3MTU3&hl=en_US)

Materials: Classroom set of directions of Center of Gravity Activity, a suspended paperclip or pushpin, colored Markers, stiff paper, hole punches, string, scissors, and washers.

Definition and concept of gravity will be introduced when using the Engineering Interact site.

Students will then test their ideas of gravity under different gravitation pulls.

Finally, the finding the center of gravity activity will walk students through the Science Projects for Kids site. Use the Gravity Worksheet for students to reflect upon their learning.

**Assessment**

Students will watch video: [Hammer Balance](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-MDRiZjYzZGYtMmQzZi00MDkwLWIwYmQtNWY4Y2Q3Y2JlZmYz&hl=en_US) and explain the forces at play, identifying the direction of gravity, and the center of mass in the system.

**Center of Gravity:**

**How to Locate the Centroid of a Plane Figure**

1. Using a colored marker, place a mark where you think the center of gravity of your shape is located.
2. Using stiff paper, such as the back of a writing tablet, design and cut out a **polygon (plane figure with many sides).**
3. With a paper hole punch, cut holes on the different sides of the figure.
4. Using a string that can extend across the figure, tie a weight, such as a metal washer, to one end of the string. Tie the opposite end of the string to a push pin.
5. Place the figure against a vertical cork board.
6. Insert the stick pin in one of the hole, and then allow the paper to hang freely. The paper should be free to rotate around the stick pin.
7. **The weighted string should hang vertically across the paper shape.**
8. Use a marker to trace a line next to the hanging string.
9. **Rotate the paper so that another hole is at the top. Repeat steps 4 through 7.**
10. Repeat steps 4 through 8 until you have drawn a line from each of the holes across the paper. Where the lines cross is the centroid of the plane figure (its center of gravity, which is its center of mass).

# Lesson 7: SOLAR SYSTEM

*Standard: Compare and contrast the sizes, locations, and compositions of the planets and moons in our solar system.*

*Assessment: Students will submit several Microsoft Xcel graphs that compare the sizes locations and compositions of the planets in the solar system.*

Why isn’t Pluto a planet anymore? by Dr. Robert Hurt (Use this video when questions about Pluto’s downgrade occur. )

**Lesson 7 (Day 1: Research Planets, Day 2: Learn Xcel, Day 3: Create own graph)**

Launch: [Solar System Rap](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-YmJlM2JkNGItNmMyYi00ODg2LWExYjgtNzZmOGU3Yzg3MDY2&hl=en_US) by Zackzych This is a student project and is a great way to get student engaged in the content!

Students will download planet characteristics table and complete the missing information using resources from Foss and Windows to the Universe. Once completed, direct instruction in Xcel may be needed to show how to sort and rearrange information to compile the graphs needed to make the comparisons.

Scaffolding is suggested in teaching how to use Xcel.

1. Model one comparison (distance).
2. Walk through with another graph (size) for the whole class.
3. Students complete Mass or Temperature (or both) graph on their own.

***Areas in orange are the info students will be filling in.***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Planet | Distance from Sun AU | Period of Revolution (in Earth Days) | Period of Rotation (in Earth Days) | Mass(kg) | Diameter (km) | Temperature (K) | Number of Moons |
| Earth | 1 | 365.26 | 1 | 5.98E+24 | 12,756 | 285 | 1 |
| Jupiter | 5.203 | 11.8 | 9.84 | 1.90E+27 | 142,796 | 120 | 18+ |
| Mars | 1.5 | 686.98 | 1.026 | 6.42E+23 | 6,787 | 240 | 2 |
| Mercury | 0.36 | 87.97 | 58.647 | 3.30E+23 | 4,878 | 452 | 0 |
| Neptune | 30.06 | 164.81 | 19.1 | 1.02E+26 | 49,500 | 48 | 2 |
| Pluto | 39.53 | 247.7 | 6.39 | 1.29E+22 | 2,274 | 37 | 3 |
| Saturn | 9.539 | 29.456 | 10.2 | 5.69E+26 | 120,000 | 88 | 18+ |
| Uranus | 19.19 | 84.07 | 17.9 | 8.68E+25 | 51,118 | 59 | 15 |
| Venus | 0.723 | 224.68 | 243 | 4.86E+24 | 12,104 | 726 | 0 |

# Chart Suggestions….Lesson 8: THE MOON

Standard: Use the predictable motions of the Earth around its own axis and around the sun, and of the moon around the earth, to explain day length, he phases of the moon, and eclipses.

Assessment:

Scientific Statement on the phases of the moon.

Exit Slip

Lesson 8

Launch: Video: [Phases of the Moon Hip-Hop](https://docs.google.com/leaf?id=0Bx8AqYgoYgG-OTJmZjlkOWYtYTI5OC00NGMwLWFkZDAtNmVkNWJjMGMwMTNh&hl=en_US)

In this lesson students will use 2 resources to build understanding of the moon phases. The first is an online movie that shows the moon revolving around Earth and then a series of stops and close-ups of the phases from Earth viewer. The worksheet will ask student questions and walk students through their observations.

Then students will work with an online activity. The questions built on-line have been modified and included on the worksheet, so they will not need to do the online questions. Just read the information and do Activity 1, 2 and 3. Students will complete the moon phase diagram using the interactive tools found in these activities.

The third activity is not necessary unless students are still struggling with the idea of the observer/moon/sun relationship. Another valuable resource can be found at

[MoonConnection.com](http://www.moonconnection.com/moon_phase_activity.phtml).

**Exit Slip**

**Based on your observations of the last few weeks, when do you expect the next (full, New, Waning Gibbous, and/or Waxing Crescent) to occur and why?**

E X I T S L I P

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hour\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Lesson 9: FINAL ASSESSMENT

Students in groups of 3 or 4 will collaborate online using google docs presentation software to create a presentation of planet in the solar system.

(Groups that are more technologically advanced or creative could use other products like imovie or podcast software, create a skit and perform it; include original art, comic life images etc; this will also create more interest during presentation time.) Students research on the premise of creating a comparative presentation between their planet and earth.

Group members should assign themselves each a role. The follow sheets are good guide in directing student projects.

Assessment:

Student sheets on the following pages. The rubric is set up as a collaborate grading, and the printables can be found in the rubric folder in the Moodle classroom.

Planet\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Group Member\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Meteorologist’s Report**

|  |
| --- |
| AtmosphereWindTemperatures (Avg High and Low)Precipitation (Rainfall, snowfall) |

Planet\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Group Member\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Astronomer’s Report**

|  |
| --- |
| Size (Diameter in Km and Miles)Density, Distance from sun, Rotation rate, Revolution rate, Moons, Gravity, Rings, Axis tilt |

Planet\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Group Member\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Geologist’s Report**

|  |  |
| --- | --- |
| Rock PlanetMinerals that make up its surfaceMountains, Volcanoes, Valleys, Water | Gas PlanetGases that make up the planetHow many layersUnique Features  |

Planet\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Group Member\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Historian’s Report**

|  |
| --- |
| When was the planet discovered?Have we sent satellites to it?Have we landed rovers on it?Show at least one picture of the planet. |

Planet Research Project

As suggested in the book *Contact*, by Carl Sagan, if we are alone in the universe, and there really is no one else out there, it certainly is a tremendous waste of space. Now that planets have been confirmed around several neighboring stars, it seems plausible that planet formation is a fairly natural accompaniment to the process of star formation. Our galaxy alone holds billions of stars, with billions of opportunities for planets to form. Who’s to say there aren’t millions of Earth-type planets in our galaxy?

This is a really big idea- a universe filled with the potential for life. Our species should start to think about the implications of contact with other life-forms. Will we be inviting to these new beings? History has showed us we tend to have more confrontational encounters with others. It may be that the universe is populated by life-forms that have not evolved the burden of intelligence, so that they are content to go about their business unperturbed by the affairs of the rest of the universe. They will launch no craft nor transmit any messages. They will simply wallow in their pool or cling to their cliff, doing what they must to ensure their progress. If we are to make contact with such life-forms it will be on our initiative.

The journey toward contact may have magical, unexpected twists and revelations, but more likely the path will be traveled incrementally by hard-gained knowledge and discovery, one step at a time. A journey of a thousand miles starts with one step- so does a journey of a thousand light-years. The next step for humanity is to the planets, and your generation could be the colonists.

The purpose of this project is to compare Earth to another planet for planetary habitability. The project culminates in an oral and visual presentation. All members of the group are expected to participate in the research portion, visual aid production, and oral presentation. You will grade your fellow members after the presentation is complete. The second portion of your grade is to take notes during each presentation, filling out a data table with vital information about each planet.