**University of Arkansas**

**College of Education**

**Lesson Plan Format**

**COE Course**

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| **Unit Title: Astronomy** | **Lesson Title: Measuring Distances in Outer Space** |
| **Subject Area: Science** | **Grade Level:    6th Grade** |

1. **Pre-assessment and Planning**

Students have received instruction on the relative positioning of the Earth, moon, and Sun. They have little experience measuring the distances between celestial bodies, and this will be assessed through a bell problem.

Compare a light year and an astronomical unit.

*A light year is the distance light travels in a year and an astronomical unit is the distance between the sun and Earth.*

During this two day lesson, students will model the scale of the solar system, determine how scientists measure distances in outer space, and calculate the time it would take for interstellar space travel. Students will need the following vocabulary in order to successfully understand these concepts:

**astronomical unit**
Definition: A unit of length used in astronomy equal to the mean distance of Earth from the sun, or about 93 million miles (150 million kilometers).
Context :In expressing planetary distances, multiples of the astronomical unit —the average distance from Earth to the sun—are often used.

**light-year**
Definition: A unit of length in astronomy equal to the distance that light travels in one year in a vacuum, or about 5.88 trillion miles (9.46 trillion kilometers).
Context: Many astronomers prefer to use light-years to measure stellar distances because they are easier to work with than other units.

**scaling factor**
Definition: The proportion between two sets of dimensions.
Context: The map indicated a scaling factor of 1 inch to every 10 miles.
Light travel time units: One can define a unit of length or distance by the time it takes light to travel across it. For example, the distance traveled by light in one minute is called a light-minute. Since it takes light 8 minutes to travel from the Sun to the Earth, the distance between them is 8 light-minutes. A unit we will use more often in this course is the light-year: it is the distance traveled by light in one year.

1 light-year = 9.5 x 1012 km

The Astronomical Unit: This is the distance between the Sun and the Earth. It is denoted by the symbol AU and it is useful when referring to the distances of planets from the Sun.

1 AU = 1.5 x 108 km = 8 light-minutes

The Parsec: The symbol for this unit is pc. It is equal to 3.26 light-years. It is the most used unit of distance in astronomy.

1 pc = 3.26 light-years = 3.1 x 1013 km

1. **Objective(s)**

ESS.10.6.2 Compare the distance of the following: from the sun to Earth (light minutes), from the next nearest star to Earth (light years)

ESS.10.6.3  Describe how astronomers measure distance to stars.

ESS.10.6.4 Calculate the rate at which we would have to travel to other stars and planets in our solar system using current technology.

\*I will compare the distance of the sun to Earth.

\*I will compare the distance of the next nearest star to Earth.\*I will describe how astronomers measure distance to stars.

\*I will calculate the rate at which we would have to travel to other stars and planets in our solar system using current technology.

1. **Assessment**

Students will complete the following worksheet at the end of the 2 day lesson to assess their understanding of solar and interstellar distances/speed.

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1 light-year = 9.5 x 1012 km 1 AU = 1.5 x 108 km = 8 light-minutes

1 light-year = 9,500,000,000,000 km 1 AU= 150,000,000 km

1 light second = 300,000 km speed of light = 300,000km/sec

Speed of Voyager Probe= 62,000km/h Distance to Alpha Centauri= 4.2 light years

1. How many minutes does it take for light to reach Earth from the surface of the Sun? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How many light-minutes does it take to reach Pluto? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. How many times farther is Saturn from the Sun than Earth? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Is the Earth closer to Venus or Mars?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Calculate the distance from Earth to Neptune.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. How many years will it take for the Sun’s light to reach Alpha Centauri? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. How many hours will it take for a space probe to reach Jupiter?
8. Calculate the speed of light in km/hour.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. Calculate the speed of the a space probe in km/s.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. If the space probe can travel 510,000,000km in one year, how many years will it take to reach Alpha Centauri? [Hint: Find the total number of kilometers from the Sun to Alpha Centuari and divide by the speed of the probe]. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Observe groups demonstrating the activity to make sure the concepts are understood.

 Journal Activity:

Have students write a short comparing a the speed of light to the speed of a Voyager Probe.

What is the difference between light minutes and light years?

How do scientists measure the distances between celestial bodies?

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| **Name:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |

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| --- | --- | --- | --- |
|   | **5** | **3** | **1** |
| Science Content | Accurate; Connected to big ideas in science | Mostly accurate; Connections to big ideas are not clear | Inaccurate; Not connected to big ideas in science |
| Organization & Presentation | Main ideas are clearly presented; Ideas are presented in an appropriate order; Ideas are supported by information and logic; Appropriate conclusions are based upon evidence presented; Effective use of models, diagrams, charts, and graphs | Main ideas are presented to some extent; Ideas are not presented in an order that adds clarity; Some ideas are supported by information and logic; Conclusions do not follow from ideas presented; Some appropriate use of models, diagrams, charts, and graphs | No main idea presented; Ideas are presented in an order that distracts from clear communication; Ideas are not supported by information and are illogical; Inappropriate conclusions are presented No use of models, diagrams, charts, and graphs |

* How will you determine that the students achieved the objective(s)?
	+ Comparing the journal writings to the end of lesson work sheet performance.
* How will you determine that the students learned what was intended for them to learn.
	+ By examining journal writings for comprehension of the essential questions from the objectives.
* Describe how you will provide feedback to individual students on their progress toward the objective(s)
	+ Student worksheets and science notebooks will be individually assessed and specific feedback will be noted upon their work sources.
1. **Engaging the Learner**

[**http://www.youtube.com/watch?v=97Ob0xR0Ut8**](http://www.youtube.com/watch?v=97Ob0xR0Ut8) **Bill Nye Solar System Scale**

[**http://www.youtube.com/watch?v=g4iD-9GSW-0**](http://www.youtube.com/watch?v=g4iD-9GSW-0) **Sun comparison**

The students will view the following videos before watching a portions of a power point presentation. The power point ties previous learning about the phases of the moon into the current lesson as a review source.

1. **Methods, Activities and Resources**

**Methods**

Whole Group Instruction: Introduction of materials, power point presentation

Guided Practice: Calculating speeds, distances, and converting units (to be done during presentation when the appropriate charts are visible)

Independent practice- Completing the solar distances handout

Whole class investigation- completing the solar scale activity

* Closure
	+ Review of lesson referring to the objectives

I will compare the distance of the sun to Earth.

\*I will compare the distance of the next nearest star to Earth.\*I will describe how astronomers measure distance to stars.

\*I will calculate the rate at which we would have to travel to other stars and planets in our solar system using current technology.

* + Solicit summary of learning from students/feedback to students
		- What went well/what did we learn?
		- What do we need to learn more about?
		- What can we do better next time?
	+ Preview of next lesson- Asteroids, meteors, and comets
	+ Connect to future learning and real-world experiences

**Activities**

**Day 1:**

* Set up science notebooks- 3 min
* Engaging the learner (play videos)- 5 min
* Power point presentation (review moon phases then stop)- 7 min
* Whole class investigation (setting up solar system scale)- 25 min
* Power point presentation -until 5 minutes before class is up
* Conclusion- 3 min
* Transition to next class- 2 min

**Day 2:**

* Set up science notebooks- 3 min
* Power point presentation (stopping for guided practice on appropriate slides)- 30 min
* Solar Distance and Speed Worksheet 20 min
* Conclusion- 5 min

**Resources**

* Computer, document camera, overhead projector, Mobius Pad, and Internet
* Resources for classroom use and to extend content knowledge and pedagogy
	+ Printed materials- photocopies of the Solar Distances and Speed handout
	+ Supplies- tape measurer, weights, 3x5 cards, and tape
	+ Audio/video- Power point presentation
	+ Visuals- Solar system bulletin board
	+ Manipulatives- representations of solar bodies from the Schoolyard Solar System link

[**http://www.iop.org/activity/outreach/resources/pips/topics/earth/**](http://www.iop.org/activity/outreach/resources/pips/topics/earth/) **Link to the basis of the heavily modified power point presentation**

[**http://nssdc.gsfc.nasa.gov/planetary/education/schoolyard\_ss/sss\_sun.html**](http://nssdc.gsfc.nasa.gov/planetary/education/schoolyard_ss/sss_sun.html) **Solar System Scale**

[***http://astronomy.nmsu.edu/tharriso/ast105/Interstellar.html***](http://astronomy.nmsu.edu/tharriso/ast105/Interstellar.html)**Interstellar Travel Information**

[**http://www.youtube.com/watch?v=97Ob0xR0Ut8**](http://www.youtube.com/watch?v=97Ob0xR0Ut8) **Bill Nye Solar System Scale**

[**http://www.youtube.com/watch?v=g4iD-9GSW-0**](http://www.youtube.com/watch?v=g4iD-9GSW-0) **Sun comparison**

1. **Potential Adaptations to the Lesson {PAL}**

***What if:***

* Technology fails- refer to printed notes and use the white board to present information
* Schedule changes at last minute- the two day lesson has several components which can be re-arranged to suit the needs of the current schedule.
* Material grasped or completed faster or slower than expected- if slower than expected perform more guided practice with changing units. If material is grasped faster than expected proceed to meteors, asteroids, and comets.
1. **Collaboration**
	* This lesson was developed with coordination from my mentor.