MESSAGES IN SPACE

Overview

Book: *Feed* by M.T. Anderson

Grades 8-12

Friends in the book *Feed* could communicate with each other even if some of them were on the moon or Mars. But, how long would it really take a message to get to someone on another planet? In this math lesson, students calculate answers to problems with large numbers and scientific notation.

Standards

MP.1	Make sense of problems and persevere in solving them.
MP. 6	Attend to precision.
8 EE.4	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.
N.Q.1 (HS)	Use units as a way to understand problems and to guide the solution of multi-step problems.

Objectives

Students will convert numbers written in scientific notation into standard notation.

Students will use calculators to convert kilometers to miles.

Students will use calculators to determine length of time it will take a message to travel through space.

Materials Required

Minutes to Message chart and answer key (see PDFs listed under this lesson on STEM Read site)
Paper and pencil
Calculators

Procedure

Note to teachers: Answer Key is on the last page of this lesson.

1. Explain to students that radio waves travel at the speed of light. For the purposes of this lesson, that has been rounded to 186,000 miles per second.
2. Show students the Minutes to Message chart. Ask students to convert ten of the distances listed in scientific notation to standard notation.
3. Explain that students are to determine how long it will take a message to travel between two planets.
4. Assign the task to students: Select 5 different pairs of planets. Determine how long it would take a radio message to travel between each set of selected planets. Answers throughout this lesson have been rounded to the nearest 100^{th} of a minute.
5. Formatively assess to determine if students understand the concept.
6. Then give the students the following narrative problems:
   a. You are on Earth. One friend is on Mars, another is traveling around the rings of Saturn. You want to meet them in a chatroom in exactly 48 hours. If you send a message now, will it reach both friends in time? Why or why not?
   b. There are space flights to the Earth's moon every hour from 7 AM until 9 PM. You are on Earth. It is Wednesday at 10 AM. One of your parents is on Mars. The other is on one of Jupiter's moons. You need to ask both parents for permission to take a flight to the moon. If both answer

one hour after receiving your message, what is the earliest day and time you could catch a flight to the moon?

c. Each morning an operator on Earth sends a signal to various relay stations to verify operational systems are working. Because of asteroid interference, this morning's signal must travel from Earth to Venus to Mars and then back to Earth. There is a 3 second delay each time the received message is rerouted to another location. How long will it take for the signal to return to the operator on Earth?

Extensions

1. View this fun site that explores what you would hear as you travel away from earth. http://www.lightyear.fm/
2. Challenge students to complete the entire Minutes to Message chart.

W.8-12.3	Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
W.8-12.3a	Engage and orient the reader by setting out a problem, situation, or observation, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.

3. Have students write a story about what happens when a message does not arrive in time. The story should be written from at least two different points of view.

Rubric

RUBRIC	Exceeds (3)	Meets (2)	Partially Meets (1)	Does Not Meet (0)
Scientific Notation	Student converted all 10 numbers correctly	Student converted 8-9 numbers correctly	Student converted 5-7 numbers correctly	Student converted 4 or fewer numbers correctly

Time calculation with pairs of planets	All five problems were set up correctly, all calculations are correct	All five problems were set up correctly, 1-2 calculation errors were made	Three or four problems were set up correctly, but 3 or more calculation errors are present	Two or fewer problems were set up correctly with 4 or more calculation errors present
Story problems	Student set up all 3 problems correctly and all 3 answers were correct	Student set up all 3 problems correctly and 2 answers were correct	Student set up 2 problems correctly and 2 answers were correct	Student set up 1 or fewer problems correctly with 1 or fewer correct answers
Total N/9				

ANSWER KEY is on last page.

Answer Key

FROM	TO	KILOMETERS	MILES	TIME REQUIRED
Mercury	Venus	5.029×10^7	31,248,757	2.80 min.
Mercury	Earth	9.1961×10^7	56,974,146	5.11 min.
Mercury	Mars	1.7003×10^8	105,651,144	9.47 min.
Mercury	Jupiter	7.2042×10^8	447,648,234	40.11 min.
Mercury	Saturn	1.36669×10^9	849,221,795	1 hour 16.10 min.
Mercury	Neptune	2.81564×10^9	1,749,638,696	2 hours 36.78 min.
Mercury	Uranus	4.44309×10^9	2,760,936,126	247 hours 23.74 min.
Venus	Earth	4.14×10^7	25,724,767	2 hours 18.31 min.
Venus	Mars	1.1974×10^8	74,402,987	6 hours 40.02 min.
Venus	Jupiter	6.7013×10^8	416,399,477	37 hours 18.71 min.
Venus	Saturn	1.3164×10^9	817,973,037	73 hours 17.70 min.
Venus	Uranus	2.76535×10^9	1,718,388,490	153 hours 58.65 min.
Venus	Neptune	4.3928×10^9	2,729,685,920	244 hours 35.73min
Earth	Mars	7.834×10^7	48,678,219	4 hours 21.71 min.
Earth	Jupiter	6.2873×10^8	390,674,710	35 hours 0.40 min.
Earth	Saturn	1.275×10^9	792,248,270	70 hours 59.40 min.
Earth	Uranus	2.72395×10^9	1,692,662,530	151 hours 40.34 min.
Earth	Neptune	4.3514×10^9	2,703,959,960	242 hours 17.42 min.
Mars	Jupiter	5.5039×10^8	342,012,346	30 hours 38.78 min.
Mars	Saturn	1.19666×10^9	743,604,524	66 hours 17.87 min.
Mars	Uranus	2.64561×10^9	1,643,982,054	147 hours 18.61 min.
Mars	Neptune	4.27306×10^9	2,655,279,484	237 hours 55.70 min.
Jupiter	Saturn	6.4627×10^9	401,592,178	35 hours 59.10 min.
Jupiter	Uranus	2.09522×10^9	1,301,969,708	116 hours 39.83 min.
Jupiter	Neptune	3.72267×10^9	2,313,267,138	207 hours 16.92 min.
Saturn	Uranus	1.44895×10^9	900,377,530	80 hours 40.74 min.
Saturn	Neptune	3.0764×10^9	1,911,674,960	171 hours 17.82 min.
Uranus	Neptune	1.62745×10^9	1,011,297,430	90 hours 37.08 min.

Answer to story problems:

a. No, because it takes almost 71 hours for a message to reach Saturn.
b. Saturday at 9 AM
c. Add 3 seconds to the Venus relay and 3 seconds to the Mars relay - 13 hours 20.14 minutes