Ozobot Solar System Exploration

Your 4th grade students will love this engaging self-guided tour of the solar system! They will get a feeling for the true immensity of space, compare the size of the sun as viewed from each planet, and observe how the distance from the sun dictates the speed at which the planets orbit the sun. They will also use 2x2 multiplication to calculate the distance each planet is from the sun!

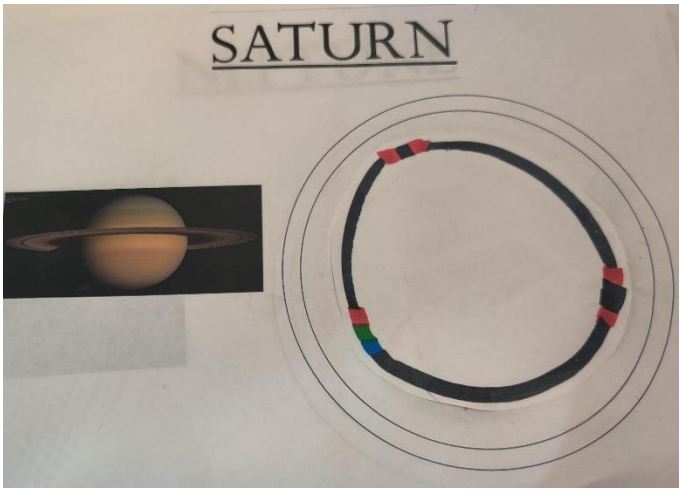
Note: This project takes a lot of setup the first time you do it, but will be extremely easy to setup and run for years to come after you have the materials in place. It also requires access to a 3D-Printer. If you do not have a 3D Printer, you can modify the lesson plan using paper planets attached to each ozobot. The 3D print files can be found at: https://www.thingiverse.com/thing:6027242 and https://ozobot.com/3d-cad-library/.

Setup: Print the accompanying Powerpoint Presentation on a color printer. You will need one Ozobot per planet. You will also need to print the accompanying picture of the sun with a diameter of 28.8 cm (11.3”). You will need to 3D print the planets to scale found on the thingiverse file, and the slotted Evo Cap found on the ozobot library. You will need one stand per planet. Superglue each planet to a stand and paint the planets if you would like. The small rocky planets will be extremely difficult to see because they are so small. That’s part of the fun! Paint them or print them in a different color than the stand so they are more visible!

On the powerpoint, draw the track that each planet will travel as it orbits the sun. The planets should orbit counterclockwise. An example is shown below.

Use the color codes provided with the ozobot. There are 8 planets but only 6 speeds, so the gas giants will need to use a combination of codes. You will need to put the codes in multiple locations on the track. Once completed, test each one and then laminate to use year after year!

Mercury (Nitro Boost): Blue/Green/Red
Venus (Turbo): Blue/Green/Glue
Earth (Fast): Blue/Black/Blue
Mars (Cruise): Green/Black/Green
Jupiter (Slow): Red/Black/Red
Saturn (Slow x 2 and Short Super Slow): Red/Black/Red and Red/Green/Blue
Uranus (Slow x1 and Short Super Slow x2): Red/Black/Red and Red/Green/Blue
Neptune (Short Super Slow only): Red/Green/Blue



Setting up the Calculations

You will need a long hallway or outdoor area with a length of 44.2m (or 145 ft). We used a long school hallway, where each tile was approximately 33cm (13in). At this scale, each tile was equal to approx. 22 million miles (1.5 cm=1 million miles, or 0.6 inch= 1 million miles). The approximate millions of miles from the sun to each planet is:

Mercury: 35 million
Venus: 67 million
Earth: 93 million
Mars: 142 million
Jupiter: 484 million
Saturn: 889 million
Uranus: 1790 million
Neptune: 2880 million

Tape the sun where students can see it on one end of the hallway. Then place each track in it's corresponding location. Neptune will be quite a distance! On a piece of tape, mark how many tiles away each planet is from the sun, or some other measurement they can use to depending on your circumstance. We found that having students count the number of tiles on their own was too chaotic. When you are ready to begin, place one ozobot with it's corresponding hats and planets on each track and let them go!

Class Discussion and Student Setup

1. Divide students up into groups of 4. Each group will need: a ruler (imperial or metric), a code card (should be provided with each ozobot, if not they can be found on ozobot.com), a blank table/chart, a piece of scratch paper and 2 pencils.

2. Ask a student their approximate height. Stand next to the student with your ruler and measure them. Then, stand back 5-10 feet from the student, hold up the ruler, and say that from that distance they are only about 5 inches tall! Explain that is how the sun looks to us. It is way bigger than it would seem! Also explain that while to scale, the planets and the distance the planets are from the sun are on two different scales. At this scale, the planets and the sun are really each **100x** bigger than they should be!

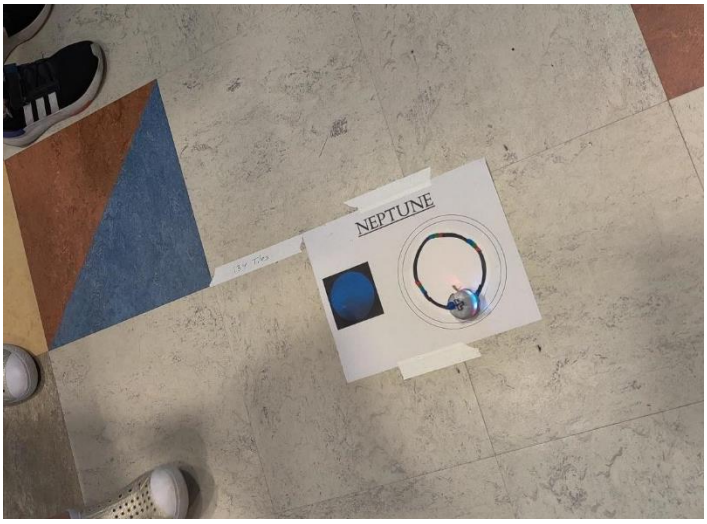
3. Each group will need a scribe, someone to measure the sun, someone to check the ozobot codes to determine the planets orbiting speed, and a multiplier. They will work together to fill out the chart. It should take them about 30 minutes once they get going. Tell the multiplier, to round the "number of tiles" to the nearest whole number before multiplying. We do not need to be exact, just get a general idea.

Activity Wrap-Up

Have students discuss what they observed. What patterns did they see? (Sun got smaller, planets moved slower). Why might this be? (Further from the sun and less tug on planet from sun's gravity further out). Hold up the tiny earth Ozobot. Explain that Earth is actually 100x larger than it should be in this example. Explain that Proxima Centuri, the closest other star to our solar system would be over 350 miles away at this scale! That would put it somewhere around Denver, Colorado for many places in Utah. We have this tiny planet in a vast galaxy. What does that tell you about how we should treat our planet? Discuss.

Supplementary Pictures

Planet	Tiles from the Sun	Millions of Miles from Sun 1 Tile =22 Million Miles	Speed of Orbit	Size of Sun from the Planet
Mercury	1.6	35	nitro	10"
Venus	3	67	turbo	5"
Earth	4.2	93	fast	1"
Mars	6.5	142	cruise	$\frac{1}{2}$"
Jupiter	22	484	slow	$\frac{4}{16}$"
Saturn	40.4	889	slow/superslow	$\frac{3}{16}$"
Uranus	81.4	1790	slow/superslow	$\frac{3}{16}$"
Neptune	131	2880	superslow	$\frac{1}{16}$"



Names: _____

Solar System Scale

The Solar System is a vast place! Let's take a look at how big it really is! Follow the teacher's instructions and, with your groups, fill in the chart as you explore our hallway solar system!

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Mercury				
Venus				
Earth				
Mars				
Jupiter				
Saturn				
Uranus				
Neptune				