Name: _____ **Date:** _____

MARVLS: Plasma Examples & Applications

Learning Objective I can explore and connect natural phenomena and man-made instruments utilizing plasma.

Think → Write → Pair → Share

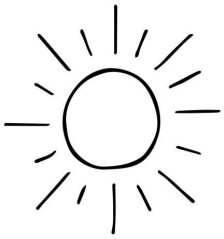
What, if anything, do you know about the Northern Lights?

Materials

- Pencil
- Smartphone
- Merge Cube
- MARVLS: Plasma App
  to install: Scan QR Code below
  And follow prompts to install.

App Store
MARVLS: Plasma Physics

Google Play Store
MARVLS: Plasma Physics

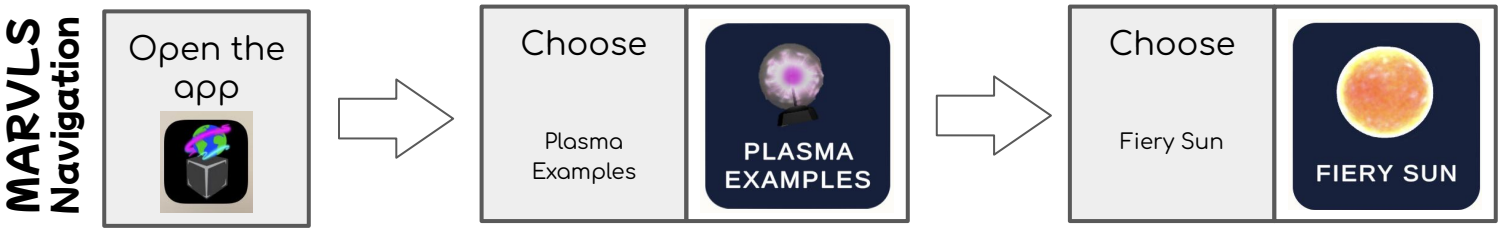


The Biggest Star in the Solar System

The _____ is the star at the center of the Solar System.

It is a massive, hot ball of _____.

MARVLS Navigation



1. **Click** the red camera button on the bottom of the screen.
2. **Point** your phone's camera toward the Merge Cube. Change the cube's orientation until the sun appears.

Press and toggle the **E field** button.

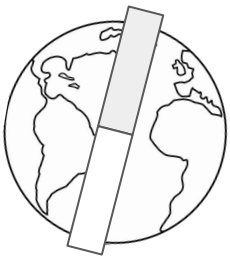
How would you describe the electric field of the sun?

Press and toggle the **B field** button.

How would you describe the magnetic field of the sun?

The Biggest Magnet on the Earth

Have you ever thought about how the North Pole and South Pole got their names? The Earth has a magnetic field!



Use your knowledge of geography and magnets to:

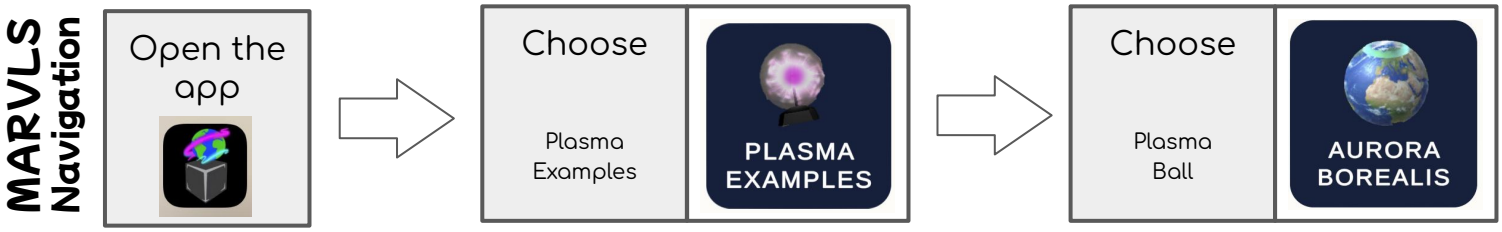
- Label the magnet at the center of the earth North (N) and South (S)
- Sketch the magnetic field that surrounds the earth.

* Need help? Check out the magnetic field model using the navigation below.

Aurora Borealis

Aurora Borealis is the scientific name for the Northern Lights. (Aurora Australis is the scientific name for the Southern Lights.) Let's use the MARVLS app to see how the solar wind and earth's magnetic field cause the Aurora phenomenon.

The solar wind is a continual stream of protons and electrons from the sun's outermost atmosphere.



1. **Click** the red camera button on the bottom of the screen.
2. **Point** your phone's camera toward the Merge Cube. Change the cube's orientation until the sun and earth (with its magnetic field) appears.

Solar Flare

Press the **Small Solar Flare** and **Large Solar Flare** buttons to see the simulations.

Watch the aurora simulations and put the following events in order (label each event 1 - 4)

Labels 1-4	Events
	The earth's magnetic field protects the earth from the charged particles in the plasma of the solar wind.
	When these charged particles reach the ionosphere, they recombine with charged particles and release the light of the aurora.
	Charged particles from the sun travel through space to the earth as the solar wind.
	Most of the charged particles in the solar wind are deflected around the earth. Some of the charged particles follow the earth's magnetic field lines to the poles of the earth.

Final Thoughts

1. When a larger flare is ejected from the sun, what happens to the aurora?

2. Why is the aurora only visible near the North and Sole poles?

Pause: We have looked at examples of plasma in nature. Next we will look at how scientist have used plasma in man-made applications.

The Plasma Ball

A plasma ball is a glass globe filled with special gases.
At the center of the ball is a metal sphere, when turned on it builds up a large electric charge creating an electric field.

MARVLS Navigation

1. **Click** the red camera button on the bottom of the screen.

2. **Point** your phone's camera toward the Merge Cube.
   Change the cube's orientation until the three dimensional model appears.

Observation 1: Do not click any buttons on the bottom of the screen. Watch the plasma ball. *Notes:*	If you were describing a plasma ball to a friend, how would you describe what you see in the glass ball?
Observation 2: Click through the different color buttons at the bottom of the screen. ☐ Purple ☐ Blue ☐ Green	What conditions might change the colors of plasma?
Observation 3: Click the Fluorescent Bulb button. *Notes:*	Why do you think the state of the light bulb changes?

Predict

Sketch or describe what may happen after the following events:

Rubbing a balloon against your head/hair:	Rubbing your foot against carpet and touching a friend with your finger:

Static Electricity

is the result of an imbalance between negative and positive charges in an object. These charges can build up on the surface of an object until they find a way to be released or discharged

Van De Graaff Generator

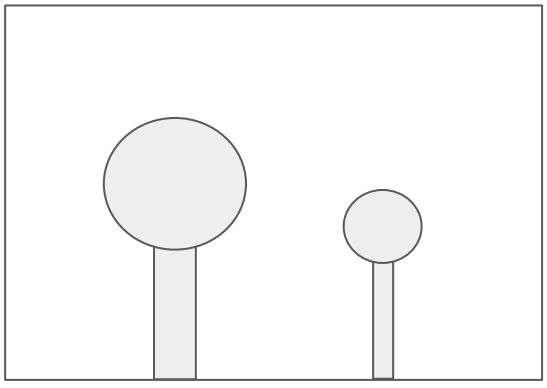
The Van De Graaff generator creates static electricity that can be used for experimentation! Let's use the MARVLS app to see how the Van De Graaff generator builds static electricity using a belt and two hollow metal spheres.

MARVLS Navigation

1. **Click** the red camera button on the bottom of the screen.
2. **Point** your phone's camera toward the Merge Cube. Change the cube's orientation until two grey spheres appear.

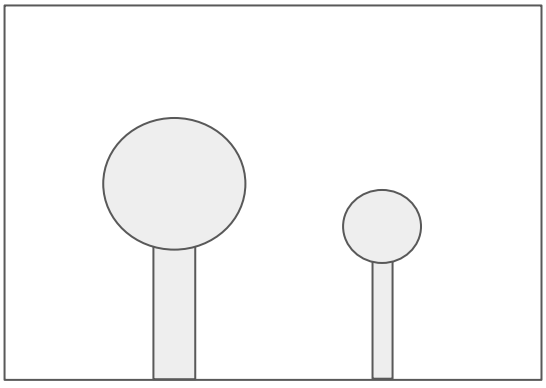
Press the **charge** button.

Sketch the field created on each sphere.



Press the **discharge** button.

Sketch and describe what happens during a discharge..



Final Thoughts

1. In the plasma ball, why do the lines move around and not stay straight?

2. In the plasma ball, why don't we see the plasma outside of the globe?

3. In the Van de Graaff generator, how is the generator creating the charge?

4. In the Van de Graaff generator, why are the electrons spreading across the top of the large sphere?

5. In the Van de Graaff generator, we refer to the smaller sphere as the "grounded" sphere. Why does a nearby grounded sphere create a discharge?

Think → Write → Pair → Share

We've looked at how plasma is used in nature and things people make. Can you think of more ways we could use plasma in our everyday life?