Plasma Globe 8”

P2-7110

INSTRUCTIONAL GUIDE

Contents

- 8” Plasma Globe
- AC Power adaptor
- Instructional Guide

Recommended for activities:

- Holographic Diffraction Grating (33-0985)
- Neon Wand (P6-3360)
- Red LED (Pack of 10) (P6-8110)

Background

Plasma is the fourth state of matter. Everyone is familiar with the other three: solids, liquids, and gases. To understand what plasma is, think about how matter changes states. In all states of matter, the atoms are constantly in motion. In solids, molecules vibrate about fixed positions. If the rate of vibration is increased by adding energy, then the molecules slowly start to shake apart and wander throughout the material, vibrating in non-fixed positions - liquids. If even more energy is added, the liquid might boil. In this case, the molecules break away from each other altogether and form the gaseous state. If we heat the gas even more, then the atoms themselves actually start to shake apart. This produces a gas of free electrons and bare atomic nuclei. This is the plasma state.

It takes energy to loosen electrons from their orbits. In the case of lightning, this energy is supplied by the electrical potential energy of the cloud and ground. For a brief time, the individual atoms in the atmosphere lose an electron or two. We say that the gas changes into plasma, or ionizes. Ions don’t roam freely for very long, however, especially when there are recently freed electrons floating around. So, the electrons find their homes again in an atom with open energy levels where an electron was removed. This in turn causes the electrons to release the energy it took to separate from the atom. This energy is released in the form of light and heat.

Introduction

The plasma globe consists of a partially evacuated glass sphere containing a mixture of inert gases. The smaller glass sphere at the center contains a power source similar to a Tesla coil. It supplies an alternating, high voltage, high frequency, yet small current to the inner sphere.
Why don't you get a shock from the globe? An electrical shock is caused by electric current flowing through body parts. The larger the current, the more severe the shock.

The current from the plasma globe is very small, but more importantly, it is a high frequency alternating current. This type of current flows on the outside of a conductor (including a body), not through it. However, if you leave a finger at one spot on the globe, it will get hot. After a long time, the heat can be enough to burn skin. Do not leave a finger or anything else stationary on the surface of the globe.

The plasma globe simulates lightning. The Tesla coil generates a large potential difference between inner and outer spheres, just as a cloud has a high potential difference with other clouds and the ground underneath it. Like all potential differences, this one tries to even itself out - by discharging. The plasma globe uses the inert gases trapped inside as the vehicle. They complete the circuit to the outer sphere. These gases give off light and heat as electrons jump off and on the atoms that make up the gas. During this stage, the gas is said to be in the plasma state, or ionized.

Activities

1. The first thing you and your students will notice about the sphere is that by placing a conductor (your finger will do nicely) near the surface of the globe, the streams of plasma seem attracted to it. Since the plasma streams are composed of ionized gas molecules, these charged particles are attracted to an uncharged object, similar to the way a charged balloon is attracted to a neutral object (like the wall of your room). You may want to encourage your students to experiment and see if they can attract more streams with different types of conductors or insulators. (How about a magnet?)

2. The Electric Field created by the Tesla coil reaches beyond the glass dome and into the air surrounding the plasma ball. This Electric Field can easily be investigated with a small light emitting diode (LED). Bring either of these near the plasma ball and they will light up when aligned radially, but not circumferentially. This demonstrates that the voltages are decreasing with radial distance or (equivalently) that the Electric Field is radial.

3. The gasses in the plasma globe give off distinctive colors while the globe is operating. These colors are characteristic of the specific gasses in the tube. Your students can see the individual frequencies of light emitted by the globe if you darken the room and allow them to view the glowing gas through small pieces of diffraction grating.

4. You may want to try placing a neon light bulb near the globe. Your student's will see the bulb light up. Try holding the bulb at different distances from the globe.

Resources

Top 10 Demonstrations with the Plasma Globe: https://www.arborsci.com/blogs/cool/top-10-demonstrations-with-the-plasma-globe

Related Products

Tesla Coil (P6-3550) The Hand Held Tesla Coil - 48,000 volts in the palm of your hand. If you've seen a Plasma Globe, you've seen our Hand-Held Tesla Coil in action. Create impressive 3-inch sparks and more.

Wimshurst Machine (P6-3350) Produce a higher current with a lower voltage! Produce static electric charges and discharges with our Wimshurst Machine. This is always an impressive demonstration.

Hand Crank Van de Graaff Generator (P6-3400) Now you can demonstrate all of the classic Van de Graaff experiments for less! Our new hand-crank model can develop potentials of up to 200 kV and produce a spark 3.2 inches long.