SN EDUCATOR GUIDE

October 28, 2017

Origami Outfits Help Bots Retool

Activity Guide for Students: Solo for Solenoid

Purpose: To gain a better understanding of how solenoids work and to explore the uses of solenoids.

Procedural overview: Construct your own simple solenoids and conduct experiments to measure their properties.

Procedure and questions:

1. Make a solenoid: Cut a piece of wire 1 meter in length and strip the insulation off the ends. Wrap the wire around a paper, glass or plastic tube, with all the loops of wire going the same way around the tube. What is the diameter of the tube and the number of loops in the coil around the tube? You can keep the solenoid coil on the tube, or pull it off if it will keep its shape.

2. Hold a small magnetic compass level. Which way is north? Put the compass a short distance inside the wire-wrapped tube and keep the compass level. Does its direction change or stay the same?

3. Connect the ends of the solenoid wire to one 1.5-volt battery. What happens to the compass needle? Which way does it point? What does that tell you? Which direction can you point the solenoid to make the change as large as possible? Disconnect the battery after a few seconds or it will start to overheat.

4. Connect the ends of the solenoid wire to one 1.5-volt battery in the opposite direction. What happens to the compass needle? Which way does it point? What does that tell you? Disconnect the battery after a few seconds or it will start to overheat.

5. When the solenoid is on, use the same or a similar compass inside the solenoid coil versus in various positions outside the coil. What do you learn about the strength of the magnetic field? Disconnect the battery after a few seconds or it will start to overheat.

6. Try connecting two or more batteries to the solenoid. Try batteries in series or in parallel. Check the magnetic field strength at various positions inside and outside the solenoid, and notice how much the compass needle deflects in each case. What do you learn? Remember to disconnect the batteries after a few seconds.

7. Make an identical solenoid but use a much longer piece of wire. How long is the wire and how many loops does it make around the tube? Using a magnetic compass, what do you notice about the effect of the number of loops on magnetic field strength?

8. Make a similar solenoid but use a tube with a smaller diameter, and the same number of coils as in one of your previous solenoids. What is the tube diameter and how many loops are around the tube? Using a magnetic compass, what do you notice about the effect of the tube diameter on magnetic field strength?

9. Especially for the smaller diameter solenoid, what happens to the magnetic field strength if you put a steel rod through the center of the solenoid?

10. Connect a straight piece of wire to a battery for a few seconds and then disconnect it. Now connect a solenoid to the battery for a few seconds and then disconnect it. Which case creates a larger spark when you disconnect from the battery?

11. Connect a solenoid to a multimeter or voltmeter instead of a battery. How much voltage does the solenoid have? How much current?

12. With the solenoid still connected to a multimeter or voltmeter, pass a bar magnet back and forth through the coil very quickly. What happens to the voltage and current on the meter?

13. Can you use a solenoid to make a nearby object (other than a compass needle) move when the solenoid is connected or disconnected from a battery? The stronger you can make the solenoid, the better for this purpose.

14. Can you make a solenoid coil move when the solenoid is connected or disconnected from a battery? Make the solenoid as light as possible by removing the cardboard/glass/plastic tube and just keeping the coiled wire shape.

15. Fill a test tube most of the way with water. Stick a steel or iron nail through a small cork, and let it float freely on top of the water inside the test tube. Wrap the test tube with as many loops as possible to make a solenoid. What happens when you connect the solenoid to a battery, and then disconnect it?

16. What have you learned about how solenoids create magnetic fields?

17. What have you learned about how solenoids can be used to control motion?

18. Now that you know more about the properties of solenoids, what are some of their applications?