

Electrical Circuits Extension Activity (optional) - Parallel and Series Batteries

Focus Question How are circuits with batteries wired in series different from circuits with batteries wired in parallel?

Overview Students will compare and contrast circuits with batteries connected in series to circuits with batteries connected in parallel.

Objectives Students will:

- identify the properties of a circuit with batteries wired in parallel and batteries wired in series
- compare and contrast the two types of circuits

Concept Words parallel circuit
series circuit
volt
voltage

Materials *For the class*
variety of battery operated devices (i.e. flashlights, toys, remote control)*

For each group of 4 students

8 15 cm copper wires
4 batteries
4 battery holders
1 #40 bulb
1 bulb holder
1 screwdriver
1 switch

For each student

Parallel and Series Batteries Activity Sheet

**provided by teacher or student*

Preparation The Parallel and Series Batteries Activity Sheet can be found in the Activities and Resources section of the *Electrical Circuits* CD ROM. Copies of the activity sheet will need to be made for students.

Safety No more than 20 batteries should be connected in series because they will produce an unsafe amount of voltage.

Inquiry and Process Skills comparing and contrasting
creating models
inferring
manipulating materials
observing
predicting

Science Core Curriculum Concepts

Elementary

S1.1a

4.1 a, 4.1b, 4.1d, 4.1e

ELA Core Performance Indicators

Grades 2-4

W-3, W-4, W-6, W-8, L-1, L-2, L-3, L-4, S-1, S-2, S-3

Background

When batteries in a circuit are connected in series the voltage increases with every battery added. A circuit with four 1.5 volt batteries connected in series would produce 6 volts of power (1.5 volts x 4 batteries). When batteries are connected in parallel they produce the same amount of voltage as one battery, but they will maintain this amount of voltage for a longer period of time. A circuit with four 1.5 volt batteries connected in parallel will produce only 1.5 volts of power.

Many battery operated devices such as flashlights, remote controlled cars, and radios have their batteries connected in series. Only a few devices such as battery chargers and electric automobiles connect batteries in parallel. To find out how batteries are connected, look at their alignment inside the device. If the batteries are placed side-by-side and are facing in opposite directions, they are connected in series.

Classroom Management

Students work in groups of four to complete the activity sheet.

Procedure

Students are to complete questions 1 and 2 on the Parallel and Series Batteries Activity Sheet. Discuss the results as a class.

Students can then go on to complete questions 3 and 4 on their activity sheet. Again, discuss the results as a class and make comparisons between Circuit A and Circuit B.

Once students have an understanding of how a circuit with batteries set-up in series is different than a circuit with batteries set-up in parallel, examine a variety of battery powered devices (i.e. flashlights, toys, remote control, etc.) as a class, and identify whether the batteries are connected in series or parallel. Discuss why the battery powered devices would have batteries set-up the way they do. Do the devices need higher power to function or are the batteries set-up so they last for a longer period of time? Complete the rest of the activity sheet as a class.

DQ

Why does the brightness of the bulb increase when batteries are connected in series? (When batteries are in series, the voltage increases.)

Why does the brightness of the bulb remain the same when batteries are connected in parallel? (When batteries are in parallel, the voltage remains the same.)

When would you want batteries connected in series? When would you want batteries connected in parallel? (Batteries should be connected in series when higher voltage is needed to operate a device. When batteries are in series, the

Electrical Circuits Parallel and Series Batteries (cont.)

voltage increases every time a battery is added to the circuit. Batteries should be connected in parallel when battery power is needed for a longer period of time.)

How are batteries connected in most battery-operated devices? Why? (series, to increase voltage)

Processing Students are to complete the question 8 on the Parallel and Series Batteries Activity Sheet.

Assessment The processing activity can be used to assess student understanding of the differences between batteries wired in series and batteries wired in parallel. Use the class record sheet to record students' successful completion of objectives.

Answer Key to Parallel and Series Batteries Activity Sheet

1. Series. If one battery is removed from the circuit, the bulb goes out.
2. Predictions vary. The bulb gets brighter when I add two more batteries to Circuit A.
3. Parallel. If one battery is removed from the circuit, the bulb stays lit.
4. Predictions vary. The bulb stays the same brightness when I add two more batteries to Circuit B.
5. 1.5 volts
6. 6 volts (1.5 volts x 4 batteries), 10.5 volts (1.5 volts x 7 batteries)
7. 1.5 volts, 1.5 volts
8. Answers vary. Sample paragraphs:

I am taking a battery powered nightlight camping. I hope the batteries in the nightlight are wired in series. If the batteries are wired in series, there will be more voltage to light the nightlight. The greater voltage will make the light in my nightlight very bright. The bright light will be good for playing games and reading in the tent.

I am taking a battery powered nightlight camping. I hope the batteries in the nightlight are wired in parallel. If the batteries are wired in parallel, the batteries will last long into the night. The batteries will not have to be changed as often. This means my friends and I can play card games in the tent late into the night. We can also read our books late at night, as well.