

12.4 Electric Potential Difference

In this section, students study the concepts of electric potential difference as it relates to the charge and the work of electrical energy.

Achievement Chart Categories	Assessment Opportunities/Specific Expectation Addressed	Assessment Tools
Knowledge/Understanding	Practice questions Understanding Concepts, q. 1–6 EM1.01 Section 12.4 Questions Understanding Concepts, q. 1–6 EM1.01	Rubric 1: Knowledge/Understanding
Inquiry	Section 12.4 Questions Applying Inquiry Skills, q. 11–2 EM1.01	Rubric 2: Inquiry Skills
Communication	Section 12.4 Questions Understanding Concepts, q. 7 EM1.01	Rubric 3: Communication
Making Connections	Section 12.4 Questions Understanding Concepts, q. 8–10 EM1.01	Rubric 4: Making Connections

Expectations Addressed

Overall Expectations—EMV.01

Overall Skills Expectations—SIS.08, SIS.09

Specific Expectations:

- EM1.01 define and describe the concepts and units related to electricity and magnetism (e.g., electric charge, electric current, electric potential, electron flow,

magnetic field, electromagnetic induction, energy, power, kilowatt-hour)

BACKGROUND INFORMATION

The notion of electric potential is difficult to teach and difficult for students to understand. We have approached electric potential as the ability (energy) of a unit of charge (coulomb) to do work by virtue of the fact that work has been done on it to move it through an electric field that opposes its motion. Ample use of the gravitational analogy can be a great aid to comprehension.

Gravitational

Work is done on a ball to pull it away from Earth, against the force of gravity pulling down on it. The mass can then move back to Earth and do work, giving up its energy as it moves in the direction of the gravitational field.

Electrical

Work is done on a positive charge to pull it away from the negative sphere, against the electrical force pulling back on it. The positive charge can then move back toward the negative sphere, giving up its energy as it moves in the direction of the electric field.

ADDRESSING ALTERNATIVE CONCEPTIONS

Students have a lot of trouble understanding what electric potential difference represents. Most will be able to use the equations for calculations, but they may not understand what it is they are calculating.

Students often confuse electric potential difference with electrical energy. Some will think that a 12-V battery has more energy than a 6-V battery. The two quantities should be carefully defined and contrasted. Explain that a smaller or older 12-V battery could have a lot less energy than a larger or newer 6-V battery. However, compared with the 6-V battery, the 12-V battery will supply double the energy to each charge.

The same types of problems encountered with ammeters are encountered again when students first use voltmeters. Since voltmeters have a high resistance, these errors are usually less damaging to the meter and less expensive to repair. A short lesson or lab on measuring electric potential difference could be very helpful.

Related Background Resources

“High Tech Drainage Calls for More Power,” *The Toronto Star*, April 22, 2000. This article describes why cars of the future will need 42-V electrical systems rather than 12-V systems.

Nelson Web site:
www.science.nelson.com
for specific Web links

PLANNING

Suggested Time

Narrative/Practice—25 to 35 minutes

Section Questions—20 to 30 minutes

Core Instructional Resources

- Solutions Manual
- Colour Transparencies

Supplemental Resources

- Lab and Study Blackline Masters

TEACHING SUGGESTIONS

- Carefully present the concept of electric potential difference, with an emphasis on what it represents. Comparisons with gravity will help. After defining electric potential difference, students should be encouraged to think and talk about this concept as a measure of electrical energy per unit charge (i.e., charges at 24 V have twice the ability to do work as charges at 12 V).
- Contrast electric potential difference with electrical energy.
- Avoid using electric potential (which is studied in a later course).
- If time permits, practise measuring electric potential difference.