

## Warm-Up

## Electrostatics



## Lesson Question

How do electric charges behave?

## Lesson Goals

**Analyze** the relationship between electric **charge** and electric force.

**Distinguish** between conductors and insulators.

**Examine** charging by friction, **conduction**, and induction.



## Words to Know

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

- |  |   |
|--|---|
| <u>  C  </u> field lines               | A. the area around a charged object that can exert a force on other charged objects                       |
| <u>  A  </u> electric field            | B. the SI unit for electric charge  |
| <u>  B  </u> coulomb                   | C. lines in a diagram that indicate the direction of flow of the electric field between charged particles |
| <u>  E  </u> electric force            | D. the potential energy an electric charge has due to its location in an electric field                   |
| <u>  F  </u> electric potential        | E. a force between two charged particles, ions, or objects  |
| <u>  D  </u> electric potential energy | F. the electrical potential energy of a charged particle divided by its charge                            |

W  
2K**Words to Know**  J   insulator

G. a material that allows electricity or thermal energy to easily move through it

  G   conductor

H. the process in which an object acquires a charge without direct contact

  H   induction

I. the transfer of electric charge by direct contact

  I   conduction

J. a material that restricts the flow of electricity or thermal energy

**Objects with Like Charges**Charges that are the same **repel** each other.**Objects with Unlike Charges**Charges that are different **attract** each other.

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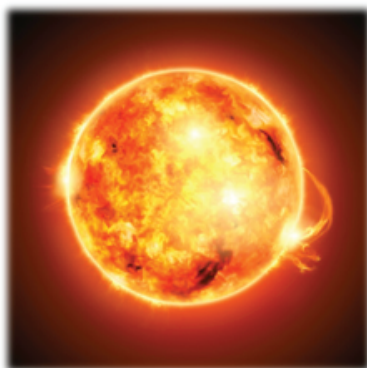
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## Ions

An **ion** is an atom or molecule with a net **charge**, due to the loss or gain of **electrons**.

## Ion Sources

### REAL WORLD CONNECTION



Two great sources for heat are stars and molten planet cores. A lot of the ions and free floating electrons come from solar winds being pushed out of stars. In fact, there's one **hydrogen** atom in every 6 cubic meters of space. Earth is picking up ions from space. But it can create ions as well from the molten core at the **center** of the Earth.

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## Electric Fields

### LOOK AHEAD

An **electric field** is the **area** around a charged object that can exert a **force** on other charged objects.

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### Electric Force on a Charged Particle in an Electric Field

An **electric force** is a force between two charged particles, **ions**, or objects.

- $q$  = electric charge
  - Can be **positive** or negative
- $E$  = electric field
- The SI unit for electric charge is the **coulomb** (C).

$$F = qE$$

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### Field Line Diagrams

**Field lines** are lines in a diagram that indicate the **direction** of flow of the electric field between charged particles.

- Point **away** from positively charged particles
- Point toward negatively charged particles

### Force Exerted by Charged Particles

#### STRATEGY

When two charged objects come near each other, the electric fields of both objects are changed.

- When like charges are near each other, their field lines **bend** away.
- When unlike charges are near each other, their field lines **combine**.

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### Electric Potential Energy

**Electric potential energy** is the potential energy an electric charge has due to its **location** in an electric field.

- $U$  = electric potential energy

$$U = Fd$$

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### Electric Potential

**Electric potential** is the electrical potential energy of a charged particle divided by its **charge**.

- $V$  = electric potential

$$V = \frac{U}{q}$$

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### Conductors

A **conductor** is any material that allows **electricity** or thermal energy to easily move through it.

- Metals
- Water
- **Ionic** solutions

### Insulators

An **insulator** is a material that **restricts** the flow of electricity or thermal energy.

- Rubber
- Glass
- Wood

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### Static Charge as a Result of Friction

In charging by friction, **electrons** transfer from one object to another by rubbing.

- When you rub the glass rod with a piece of silk fabric, electrons move from the glass rod to the silk fabric.

### Static Charge as a Result of Conduction

**Conduction** occurs when electrons are transferred from one object to another by direct contact.

- Electrons move from the rod to the sphere. The sphere becomes **negatively** charged.
- Electrons move from the sphere to the rod. The sphere becomes **positively** charged.

### Static Charge as a Result of Induction

**Induction** occurs when electric charges are transferred without direct contact.

- A positively charged rod placed near two neutral spheres attracts the **electrons**.
- When the two spheres are separated, sphere A is **negatively** charged and sphere B is positively charged.

**Lesson  
Question**

How do electric charges behave?

**Answer**

(Sample answer) Electric charges in a field put forces on one another. Like charges repel, and opposite charges attract. Charges move from place to place through friction, conduction, and induction.

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**2****Review: Key concepts**

- Charges apply forces to each other.
  - Like charges repel and **opposites** attract.
  - Field lines can be used to diagram those forces.
- Charges move in three different ways:
  - Friction
  - Conduction
  - Induction
- **Conductivity** is determined by the number of free electrons.



# Summary

## Electrostatics

*Use this space to write any questions or thoughts about this lesson.*