

Welcome to the exciting world of Electricity!

- ▶ In this unit we will explore:
 - ▶ static and current electricity
 - ▶ circuits, how to build and design them
 - ▶ the cost/benefit of our own electrical usage and the impact this has on our lives

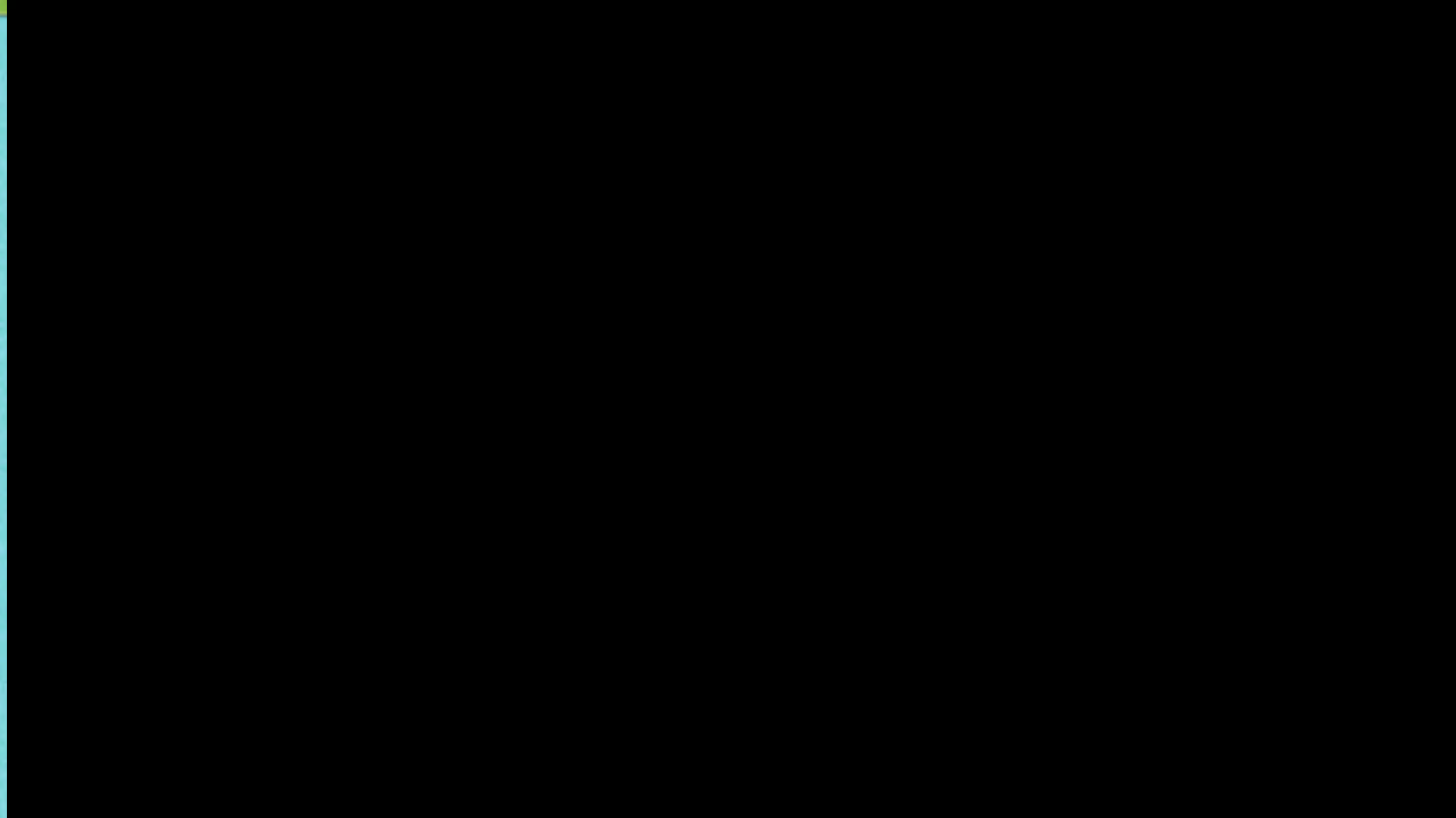
Have you ever?

- ▶ Have you ever been shocked by someone touching you?
- ▶ Have you ever taken your hat off and your hair is sticking straight up?
- ▶ Have you ever seen lightening?
- ▶ Have you ever reached for a doorknob AND ZAP?
- ▶ Have you ever rubbed a balloon on your head, and your hair went BOING?

That shock is caused by
STATIC ELECTRICITY!



Static Electricity



How is it created?

Where does it come from?

Static vs. Current Electricity



- ▶ There are two types of electricity; **static** and **current**
- ▶ Static electricity means “not moving” and the electrons are not moving in a path
- ▶ Static is the build up of electric charge on the surface of an object

Static v. Current Electricity

- ▶ Current electricity is electric charge that moves from a source of electrical energy along a controlled path in an electric circuit



ATOMS

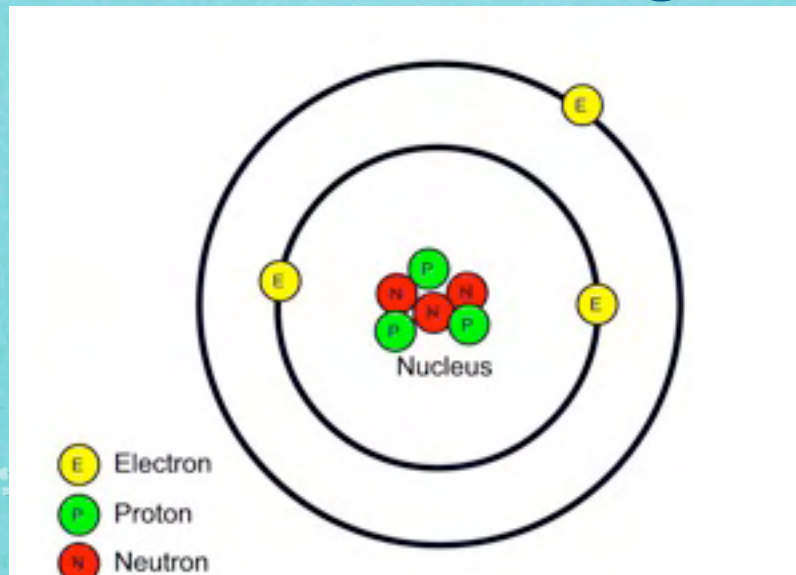
- ▶ Everything is made up of atoms
- ▶ Basic unit of matter
- ▶ Atoms cannot be divided further.....

Parts of an Atom

Subatomic Particle	Charge	Location in Atom
Protons		
Neutrons		
Electrons		

Neutral Objects

- ▶ All objects start out as neutral
- ▶ Atoms
 - # of protons = # of electrons
 - the atom has no overall charge, it is neutral



Electrons

- ▶ Are the only part of the atom that can move, they are light weight and always in motion.
- ▶ The protons and neutrons in the nucleus are heavy weight and DO NOT go anywhere!

Ions

Type of Atom	Gain or Loss?	More protons or electrons?	Charge?
Anion			
Cation			
Neutral			

Charged objects

- ▶ Some electrons are held very loosely to the atom and therefore they can move from one atom to another
- ▶ If an atom loses electrons, it has more positive charges (protons) than negative charges (electrons). Therefore the atom is positively charged.
- ▶ If an atom gains electrons, it has more negative charges (electrons) than positive charges (protons). Therefore the atom is negatively charged.

A victim of Static!



Two atoms are walking down the street one day, and one of them says to the other:

"Hey, wait up a second. I think I lost an electron"

The first atom replied, "Are you sure?"

The second atom exclaimed, "Yes, I'm positive!"

A neutron goes into a bar and asks the bartender, "How much for a beer"?

The bartender replies, "For you, no charge".

Fun with Friction Lab

Let's explore static electricity! Here are your tasks:

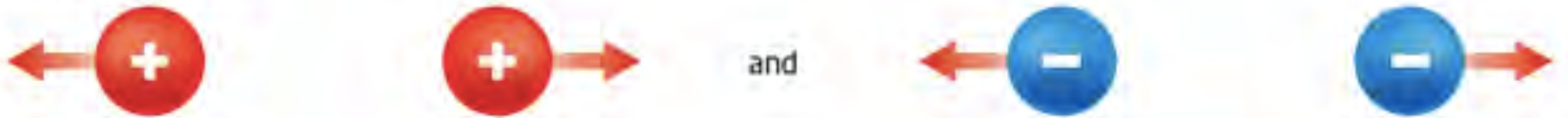
- 1) Make a balloon stick to the wall
- 2) Make one balloon attract another balloon
- 3) Make one balloon repel another balloon

Explain how you did it!

Laws of Electric Charges

Laws of Electric Charges

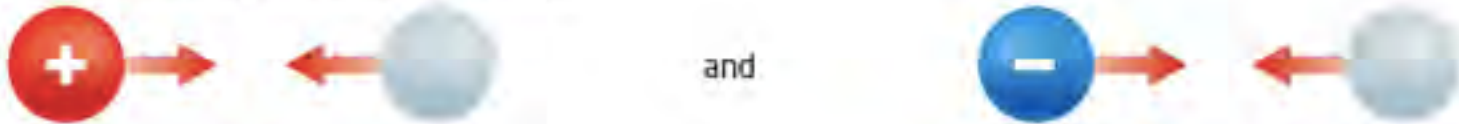
1. Like charges repel.



2. Opposite charges attract.



3. Charged and neutral objects attract each other.



Ways of Charging Objects

1. Charge by friction
2. Charge by contact
3. Charge by Induction

Charging by Friction

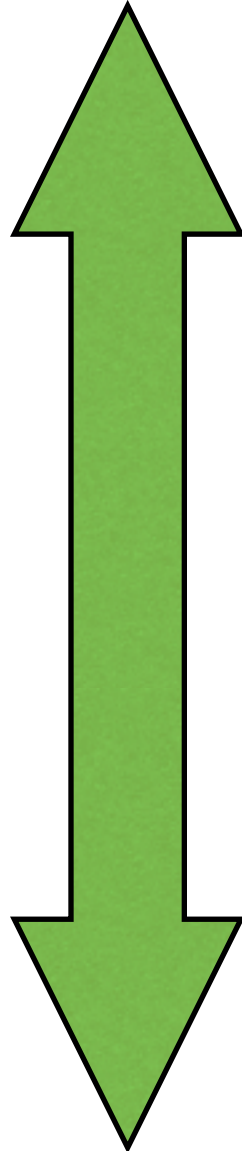
- ▶ Rubbing removes lightly held **electrons** from atoms, transferring them from one object to another.
- ▶ **Protons** can't be moved

Electrostatic Series

- ▶ Electrons will move from an object with a **weak** hold to those with a **strong** hold.
- ▶ Materials with a weak hold will **lose** electrons and become **positive**
- ▶ Materials with a strong hold will **gain** electrons and become **negative**
- ▶ In general, charging by friction starts with two **neutral** materials and works when materials have a **different** hold on electrons

Electrostatic Series

Dry air
Rabbit fur
Glass
Wool
Silk
Aluminum
Cotton
Lucite
Ebonite
Balloon
Plastic
Grocery bags
Vinyl
Teflon



**Weak hold on
Electrons**

+++++

**Strong Hold
on Electrons**

Electrostatic Series

- ▶ A list in order of tendency to **gain** electrons
- ▶ Materials with a weak hold are at the **top**
- ▶ Materials with a strong hold are at the **bottom**
- ▶ Materials higher will **lose** and be **positive**
- ▶ Materials lower will **gain** and be **negative**
- ▶ The **farther** the separation in the table, the greater the effect

Electrostatic Series

Materials hold on electrons	Location	Gain or lose?	Charge
Weak			
Strong			

Homework!

- ▶ Complete p. 3 in your workbook

Friction Around You

- ▶ Plastic food wrap - “cling wrap”
- ▶ Static clothes, static hair - “fly aways”
- ▶ Dragging your feet across the carpet
- ▶ Gasoline rushing out a hose
- ▶ Air rushing over your car

Electrostatic Series

- ▶ When rubbing a balloon with a piece of fur, which object becomes negatively charged and which one becomes positively charged?
- ▶ What about when silk and glass are rubbed together?
- ▶ What about ebonite and cotton?

Homework!

+ -

- Cotton & Vinyl

+ -

- Hair & plastic comb

+ -

- Wool & rayon

Anti-static Sheets

Clothes are made from many different materials, such as cotton, wool, and nylon. These materials hold on to their electrons with different strengths. A clothes dryer generates static charges on the different materials when they tumble and rub against each other as the dryer drum rotates. In other words, charging by friction occurs. An anti-static sheet is a small piece of cloth that contains a waxy compound. Hot air from the dryer vaporizes the waxy compound, which then coats the clothes. This causes the clothes to behave as if they were made from the same material, so no static charges build up.

What do these have in common?

A: Most metals (Cu, Al, Fe,
Ni, Au, Ag, Pt, Hg),
Human body, Earth, Salt

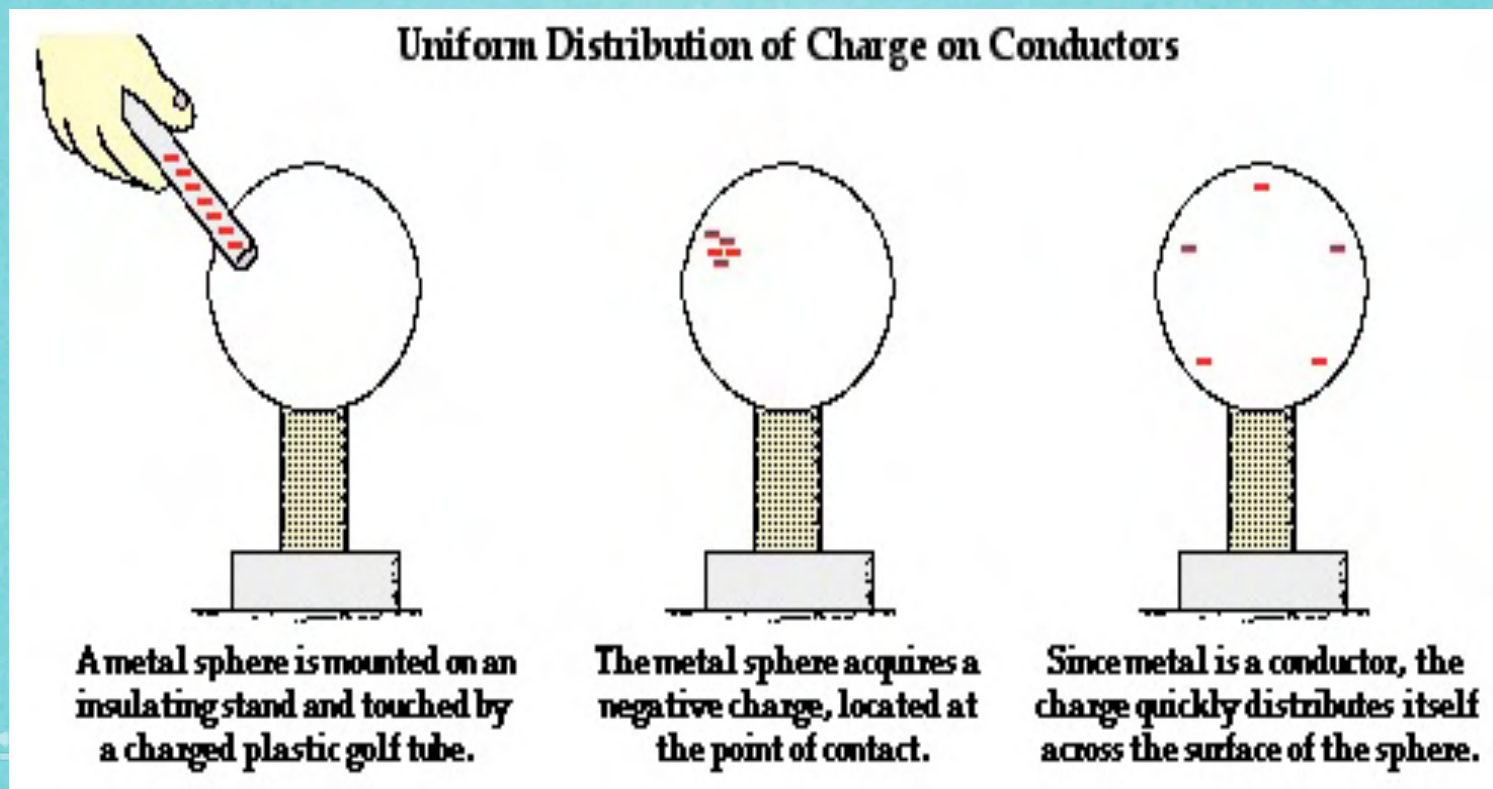
CONDUCTORS

B: Rubber, Plastic, Glass,
Ebonite, Wood, Paper,
Wool, Cotton, Fur, Pure

INSULATORS

Conductors

- **Conductors**: materials which allow electrons to flow freely through them



Conductors

- Excess electrons do not remain in one place but will move as far away as possible to keep the atom and the conduction neutral
- Conductors will not become charged because excess charges will not collect onto its' surface
- Uses: wires (Copper), switches (Mercury)

Insulators

- Insulators: materials that hold onto their electrons and do not allow them to move freely
- Uses: covers for wires (rubber), covers for electrical outlets (plastic)



In the winter, the air is dry. In the summer, the air is humid and moist with water vapour. Explain why we get static hair in the winter but not in the summer.

**Complete
p. 401 #1-5
in Investigating Science 9**

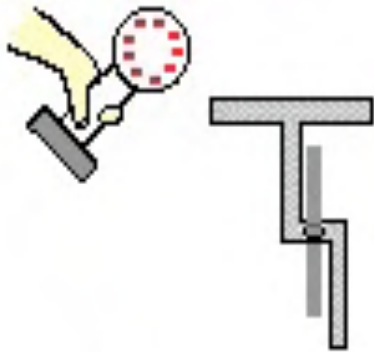
Charging by Contact

- ▶ Involves the contact of a charged object, (either positively or negatively charged), to a neutral object

Charging by Contact

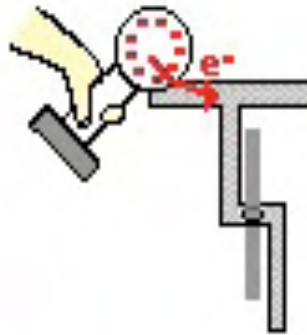
Charging a Neutral Object by Conduction

Diagram i.



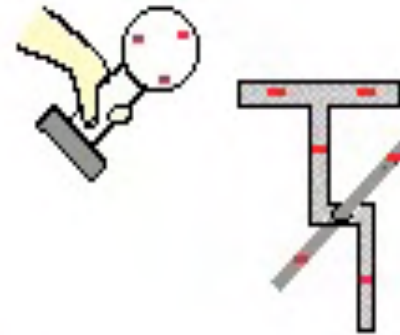
A metal sphere with an excess of - charge is brought near to a neutral electroroscope.

Diagram ii.



Upon contact, e^- move from the sphere to the electroscope and spread about uniformly.

Diagram iii.



The metal sphere now has less excess - charge and the electroscope now has a - charge.

Charging by Contact

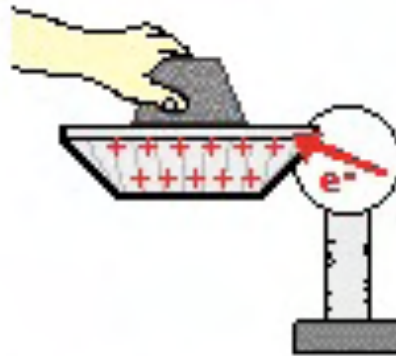
Charging a Neutral Object by Conduction

Diagram i.



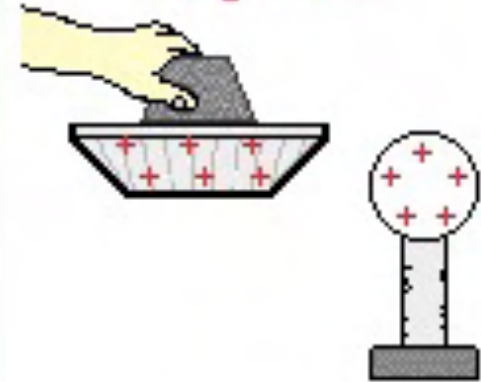
A neutral metal sphere rests upon an insulating platform.

Diagram ii.



When the + aluminum plate is touched to the metal sphere, electrons are drawn off the sphere and onto the aluminum plate.

Diagram iii.



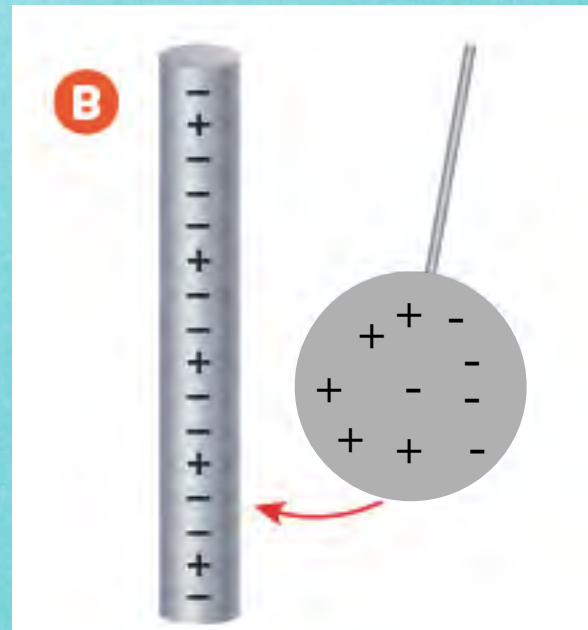
The aluminum plate has less excess + charge and the metal sphere now has an excess of + charge.

Results

- Results in the **SAME CHARGE** on both objects

Charging by Induction

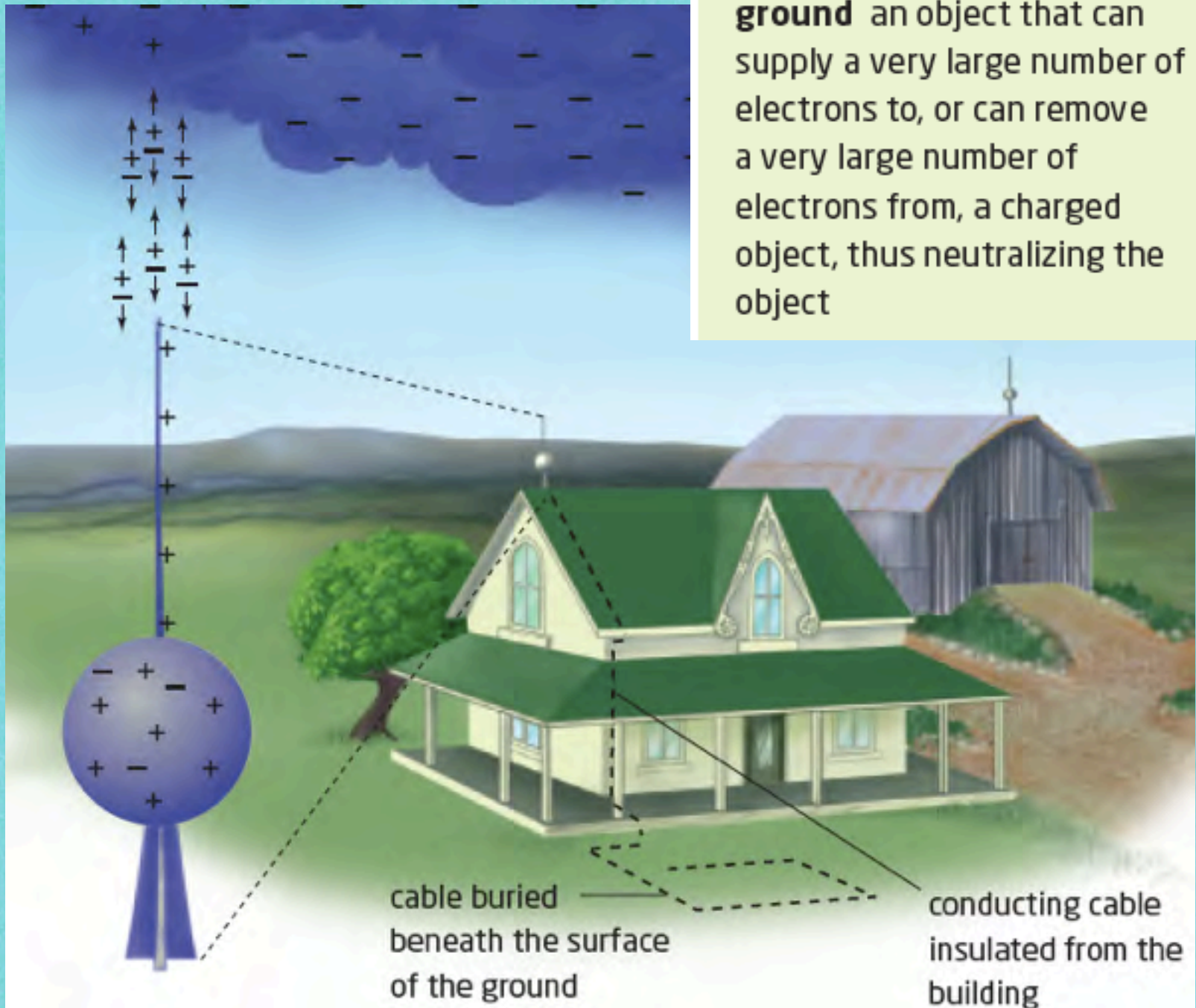
- This involves bringing a charged object **CLOSE TO** but **NOT TOUCHING**
- This creates a temporary charge on the object
- The charges move according to the Law of Static Electricity



Results

- The **opposite charge** is developed on the object

ground an object that can supply a very large number of electrons to, or can remove a very large number of electrons from, a charged object, thus neutralizing the object



Complete:

p.5 (workbook)

p. 409 #1-5 (textbook)

Print Static Lab