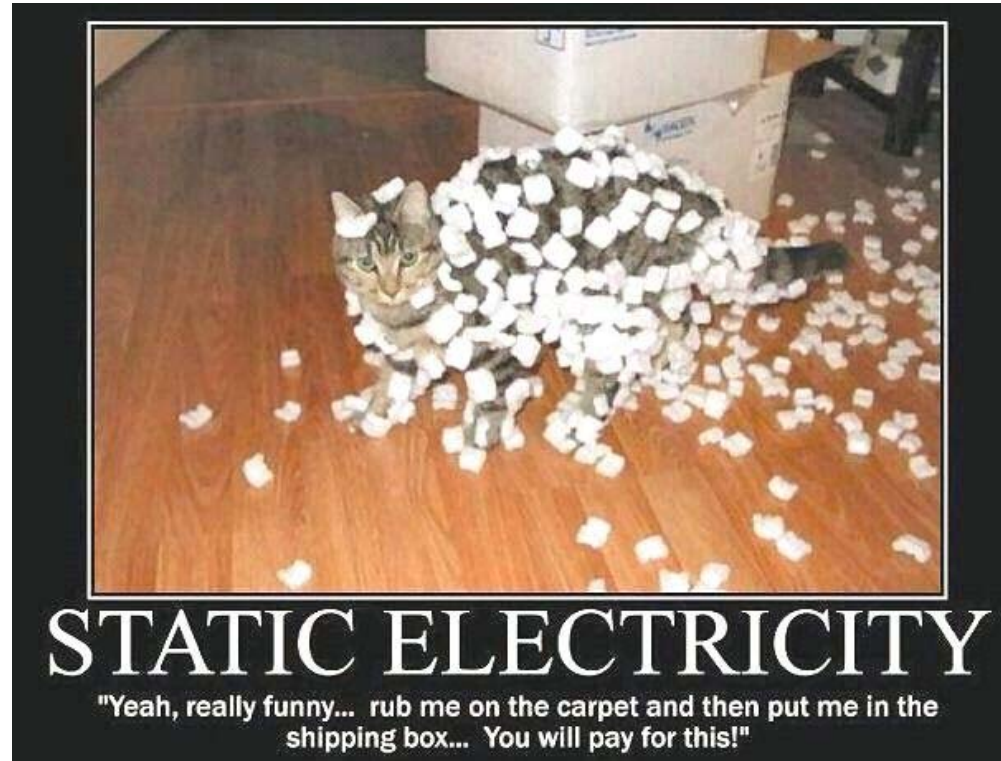


# Models of Static Electricity



S1-03-02 Discuss the early models of electricity. Include one-fluid model, two-fluid model, and the particle model.

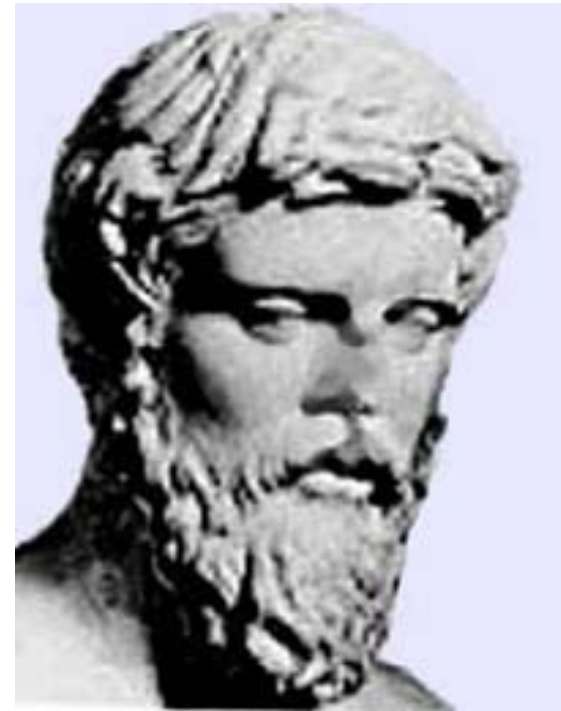
S1-03-04 Relate the particle model to atomic structure.

# Air Model...

## 1. Plutarch – Greek Philosopher

- Explained electric charge using the “AIR MODEL”
- Said that a CHARGED OBJECT will HEAT the AIR around it, the AIR SWIRLED around nearby OBJECTS and PUSHED them back to the CHARGED OBJECT.

→ *How can we challenge this model?*



# “Sticky Hand” Model...

## 2. William Gilbert

- Proposed a SUBSTANCE called EFFLUVIUM came from the CHARGED OBJECT and ATTACHED itself to the nearby object.
- We will call it the “STICKY HAND MODEL”



→ *What is a problem with this model???*

# One-Fluid Model...

## 3. Benjamin Franklin

- Came up with the “ONE-FLUID MODEL”
- He said that every object contains a “NORMAL amount of ELECTRIC FLUID.”
- If an object GAINS FLUID it becomes POSITIVELY CHARGED, and if it LOSES FLUID, it becomes negatively CHARGED.



Neutral  
(Normal amount of Fluid)



Positive  
(Gained Fluid)



Negative  
(Lost Fluid)

# One-Fluid Model...

## 4. Charles Dufay

- Came up with the “TWO-FLUID MODEL”
- An object becomes charged if it LOSES or GAINS one of two FLUIDS.
- Similar to our current particle model, but with fluids...



vitreous resinous

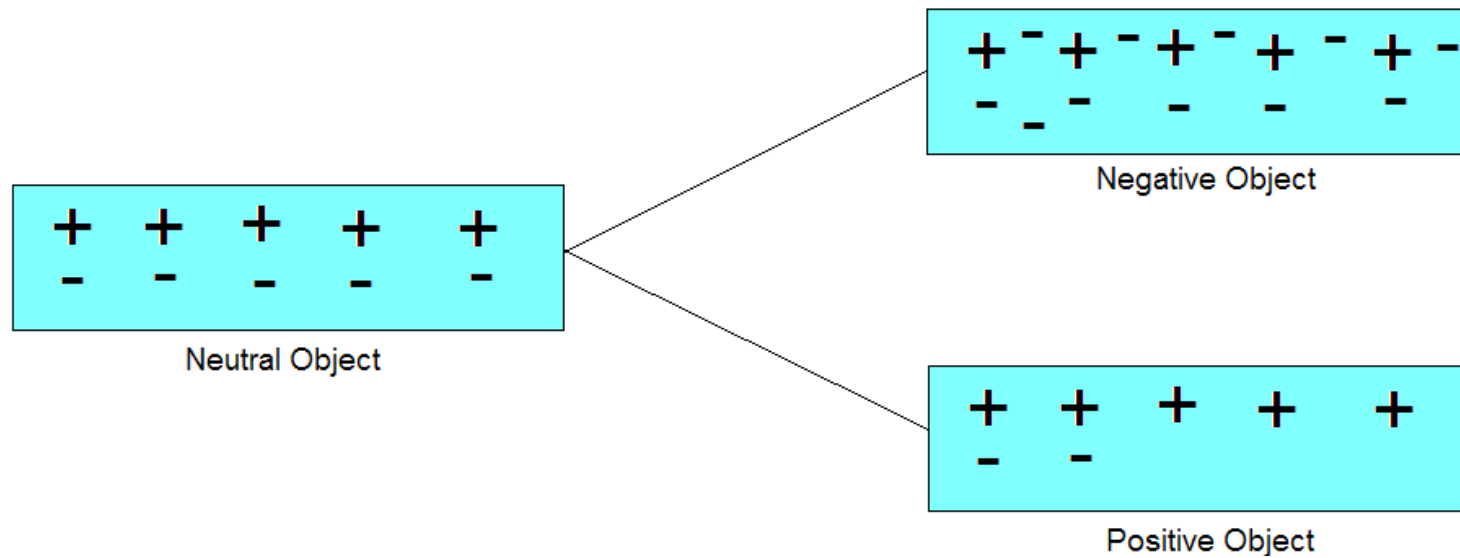
vitreous resinous

# Particle Model...

## 5. Particle Model

- Today we know that everything is made of ATOMS, and that atoms are made of PROTONS, ELECTRONS, and NEUTRONS.
- Since protons and neutrons are stuck in the NUCLEUS, they cannot be ADDED or TAKEN AWAY.
- Since the electrons are moving around outside the nucleus, they can be GAINED or LOST, which is what causes a STATIC CHARGE. This means that:
  - An object becomes NEGATIVELY charged by GAINING ELECTRONS.
  - An object becomes POSITIVELY charged by LOSING ELECTRON.

# Particle Model...



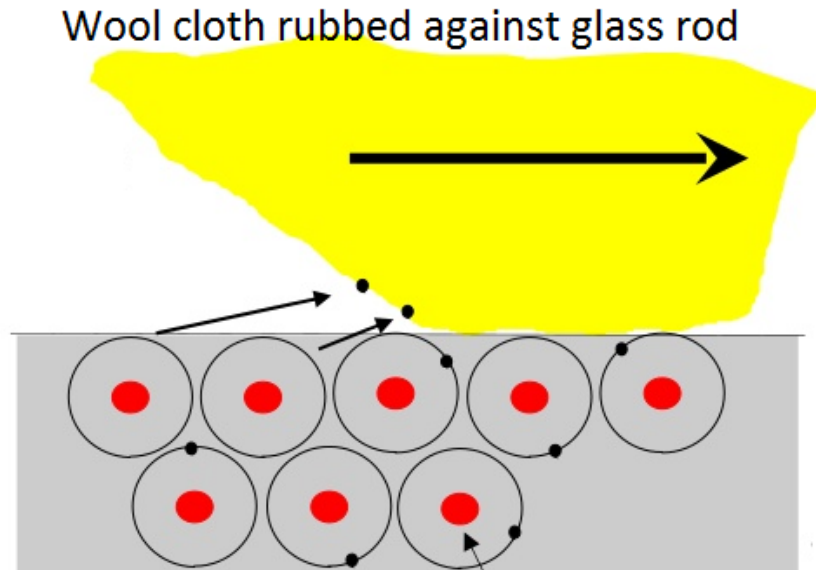
Charges cannot be **CREATED** or **DESTROYED** → they are **CONSERVED**.

→ Notice the number of protons is the same in all three examples above.

# Particle Model...

When two materials are rubbed together to create a charge:

- The **VALENCE ELECTRONS** are simply being **TRANSFERRED** from one material to another material.
- The **PROTONS STAY** in one place – they are stuck in the nucleus!



**NOTE:**

**RUBBING** the **SAME** materials together will **NOT** result in a static **CHARGE**.

→ see the **“ELECTROSTATIC SERIES**



# Electrostatic Series...

Acetate	Weak Hold on Electrons
Glass	
Wool	
Cat's Fur, Human Hair	
Calcium, Magnesium, Lead	
Silk	
Aluminum, Zinc	
Cotton	
Paraffin Wax	
Ebonite	
Polyethylene (plastic)	
Carbon, Copper, Nickel	
Rubber	
Sulfur	
Platinum, Gold	Strong Hold on Electrons

Increasing Tendency to Gain Electrons

# Determining the Charge...

Your electrostatic series shows that different materials have different strengths of hold on their electrons. If two different materials are rubbed together:

***The stronger material will gain electrons and become negatively charged***

***The weaker material will lose electrons and become positively charged***

## **Examples:**

Determine the resulting charge on each material when the following are rubbed together:

1. Rubber and Acetate
2. Fur and Ebonite
3. Cotton and Wax
4. Cotton and Cotton