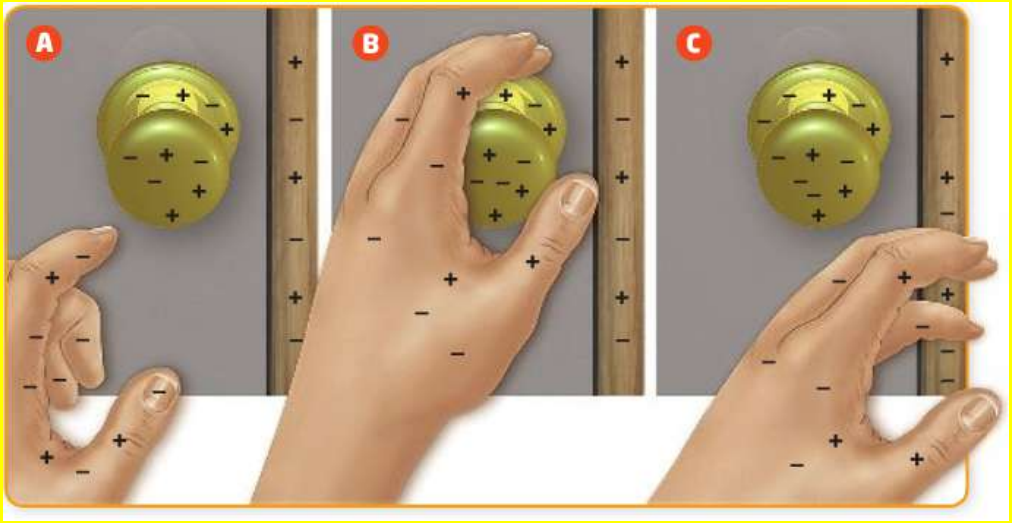
Charging by: Friction, Contact and Induction

1. Friction
2. Contact
3. Induction



Material	Strength of Hold on Electrons
Glass	Weak
Human hair	
Nylon	
Wool	
Fur	
Silk	
Cotton	
Lucite (a clear plastic)	
Rubber balloon	
Polyester	
Foam	
Grocery bags (low density polyethylene)	
Ebonite (a hard form of rubber)	Strong

Static Electricity - Review

1) Opposites attract
2) Likes repel
3) + and – attracts neutral objects

Pith Ball – Neutral non-conductive object which hangs from an insulting string → Demonstration

Static Electricity Puzzles

Using the law of electric charges, identify the charge of the pith balls described below:

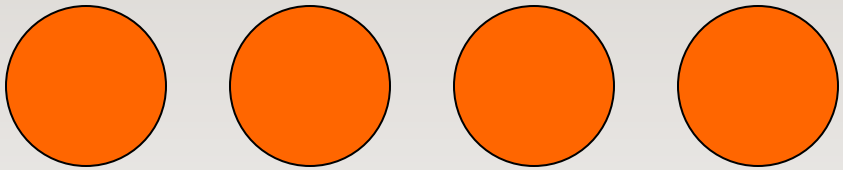
Four pith balls are suspended by insulating threads. The following observations are made:

a) Pith ball #3 is negatively charged
b) Pith ball #4 attracts all the other pith balls
c) Pith balls #1 and #2 repel each other
d) Pith ball #3 attracts all other pith balls

Static Electricity Puzzles

Start by drawing what you know

4 balls



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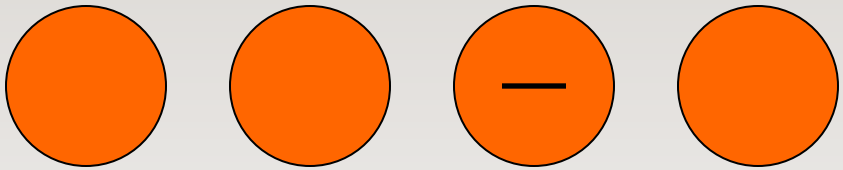
Static Electricity Puzzles

Start by drawing what you know

#3 is negative



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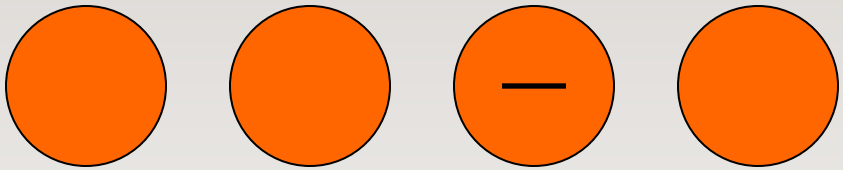
Static Electricity Puzzles

Use the remaining information to help solve the problem. Remember the law of attraction!!!!



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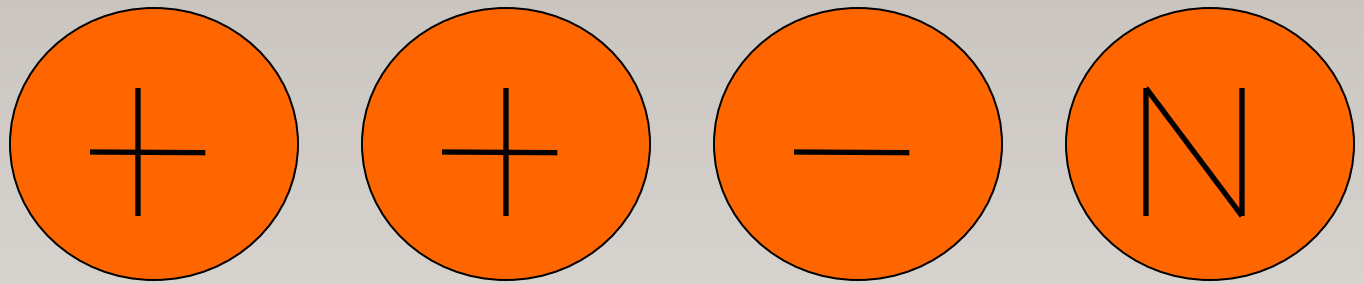


Reasoning:

Observation c tells us that **#1 and #2 are the same charge and the neither is neutral**

Observation d tells us that **#1 and #2 must both be positive since #3 is negative**

Observation b tells us that **#4 is neutral since it attracts both negatives and positives.**

Charging Objects

There are 3 ways an object can become charged

1) **Friction**
2) **Contact**
3) **Induction**

Friction Review

- Static electricity is produced by rubbing different surfaces together
- This causes both surfaces to obtain a different charge
- Before rubbing: both objects are neutral
- **After rubbing, one object loses electrons (becomes positively charged), the other object gains electrons and becomes negatively charged**

Electrostatic Series

- The electrostatic series is a list that is used to determine the charge an object gains by friction
- Objects higher on the chart hold their electrons weakly

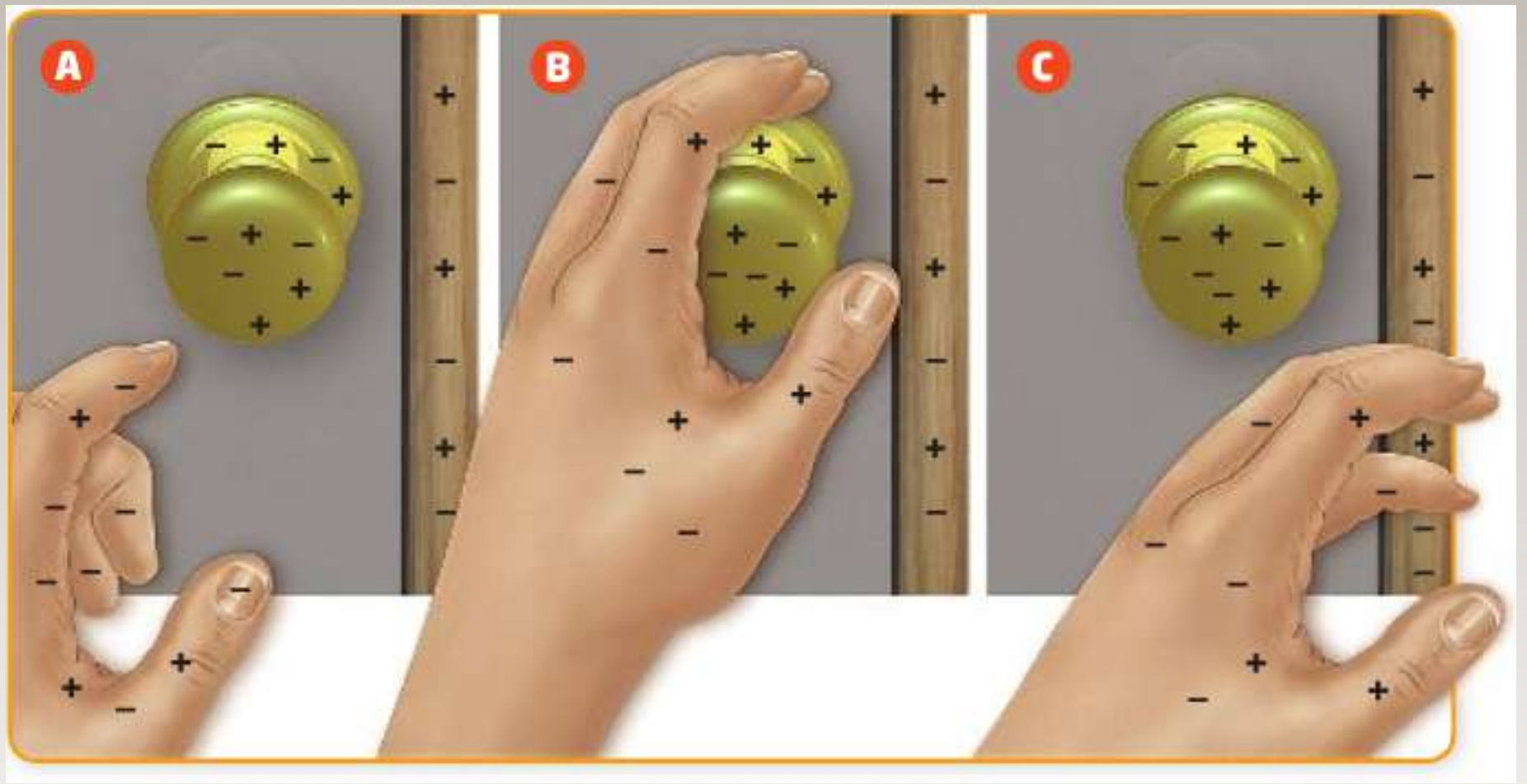
Material	Strength of Hold on Electrons
Glass	Weak
Human hair	
Nylon	
Wool	
Fur	
Silk	
Cotton	
Lucite (a clear plastic)	
Rubber balloon	
Polyester	
Foam	
Grocery bags (low density polyethylene)	
Ebonite (a hard form of rubber)	Strong

Contact Transfer

- Contact is common and is the cause of static shocks.
- Contact transfer occurs when a charged object is brought into contact with a differently charged object.
  (This includes neutral objects)
- **Some or all of the electrons will transfer between the two objects in an attempt to balance the charge.**

Static Shocks

- In the case of static electricity, your body has developed some level of negative charge.
- When you move your hand towards an uncharged objects (especially metals) the excess electrons you have transfer to that object.
- The movement of the electrons can sometimes be seen as a spark and can occasionally be painful due to the speed at which the electrons transfer.



A The hand has a negative charge (a surplus of electrons).

B If the hand touches the metal doorknob, there is a rapid transfer of electrons, and a shock is felt.

C If the hand touches the wooden doorframe, there is a slower transfer of electrons, and no shock is felt.

Charging by contact using a negative rod.

Charging by contact using a positive rod

Induction

- An electric charge is transferred from one substance to another without direct contact.

- **The induced charge is opposite to that of the charged object producing the charge**

Induced Charge Separation

- A shift in position of the electrons that produces opposite charge on TWO sides of a particle

-

+

Charging by induction

- To charge the neutral object, the neutral object MUST be grounded using a conducting wire (not shown)
- **This gives the electrons a place to leave**

-

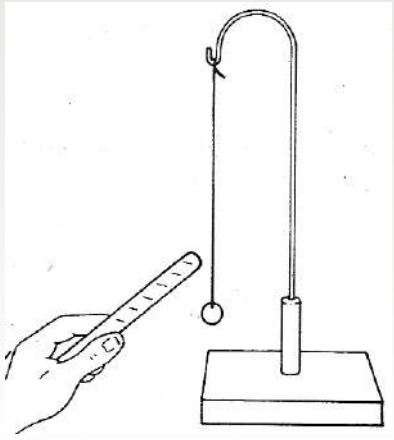
+

Charging by induction using a positive rod

Charging by induction using a negative rod

Pith Balls and Charge Transference

- **Pith balls by nature are usually uncharged to begin with (as are most objects)**
  - How would you expect them to react to a charged object brought nearby?
- If a charged object and a pith ball are brought in contact some of that charge will transfer to the pith ball. (Either the pith ball will gain or lose electrons)



Pith Balls and Charge Transference

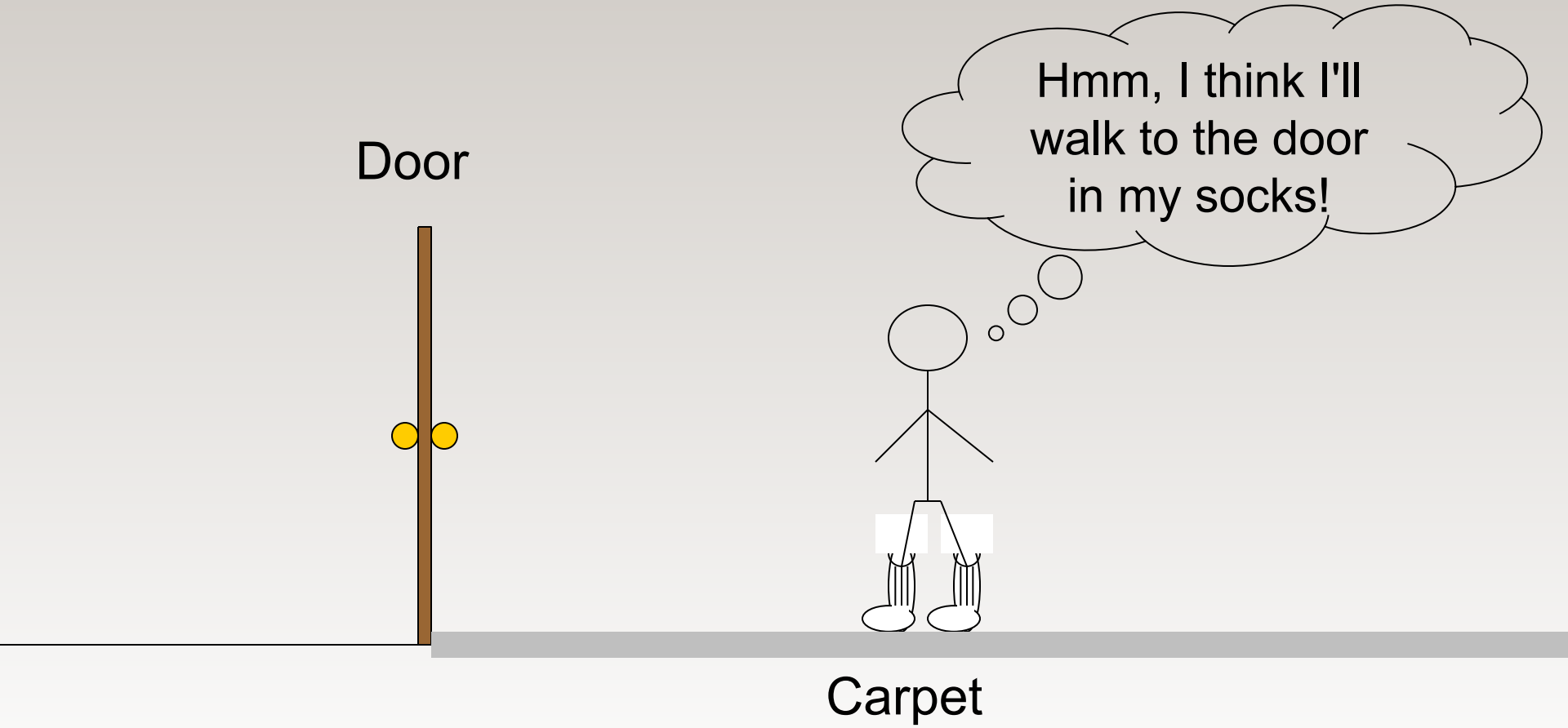
- **Once the charged object is removed the charge remains on the pith ball**
  - How would you expect the pith ball to react if another similarly charged object were brought near to it?
  - How would it react if an oppositely charged object were near?

Drawing!

- In your notes draw a picture of the following situation. You should have at least three pictures to depict the scene.

- A neutral pith ball is brought near to a negatively charged rod. The pith ball and the rod touch. The rod is removed and a different negatively charged object is brought near.

Static Electricity In Action



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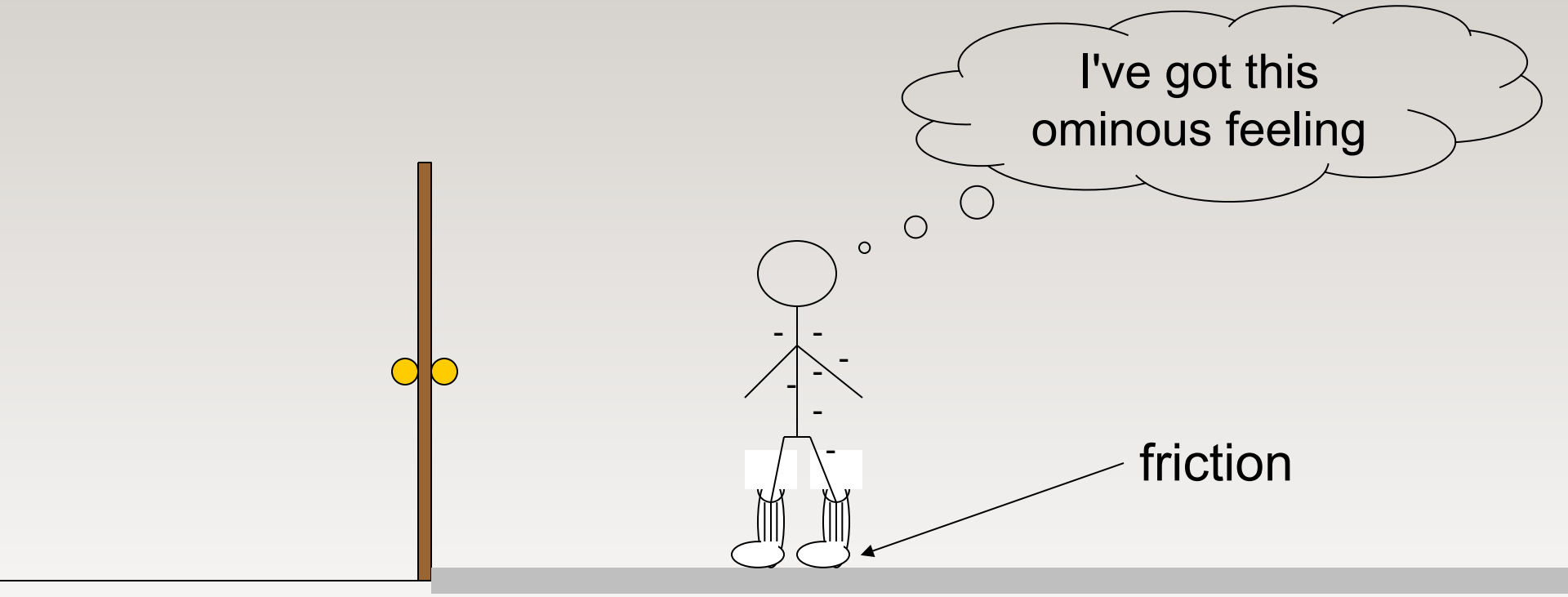

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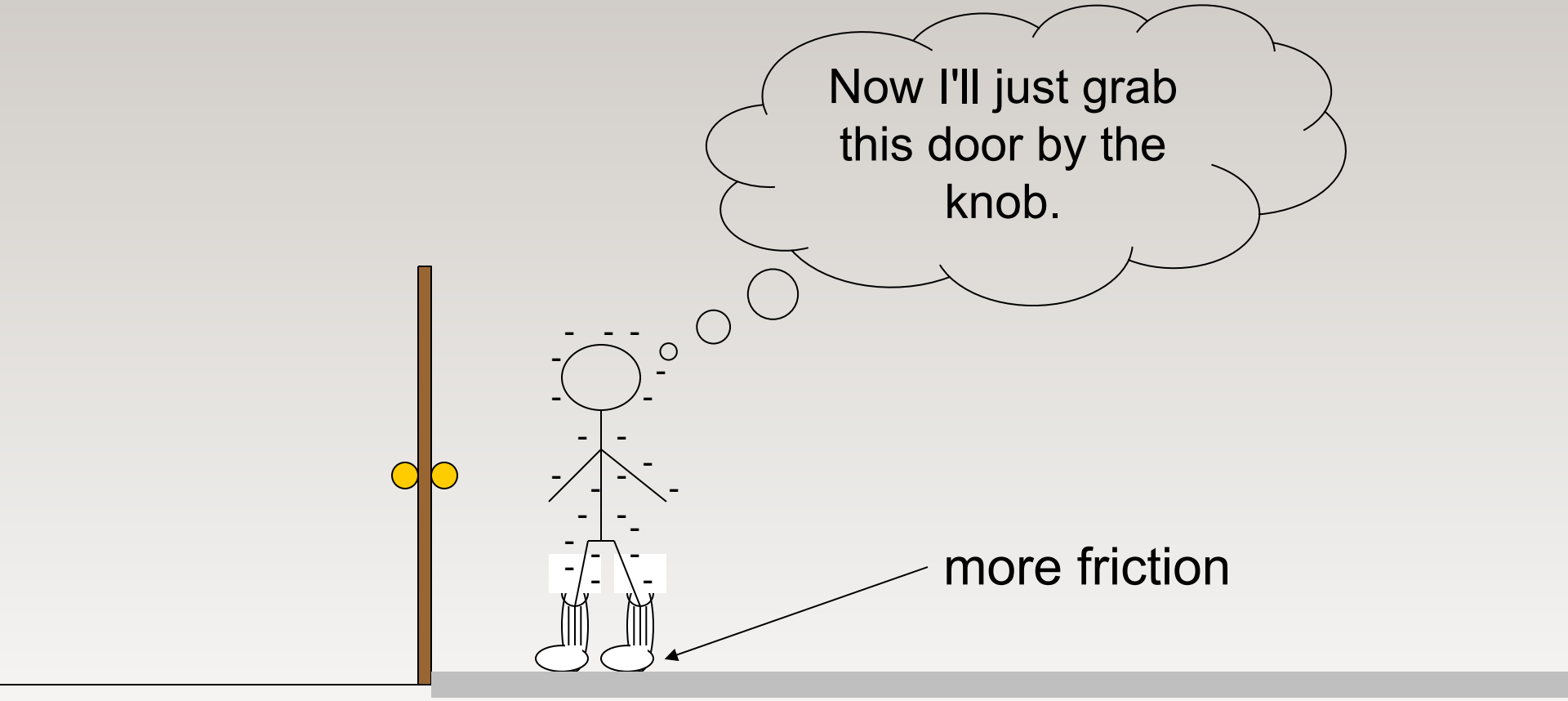

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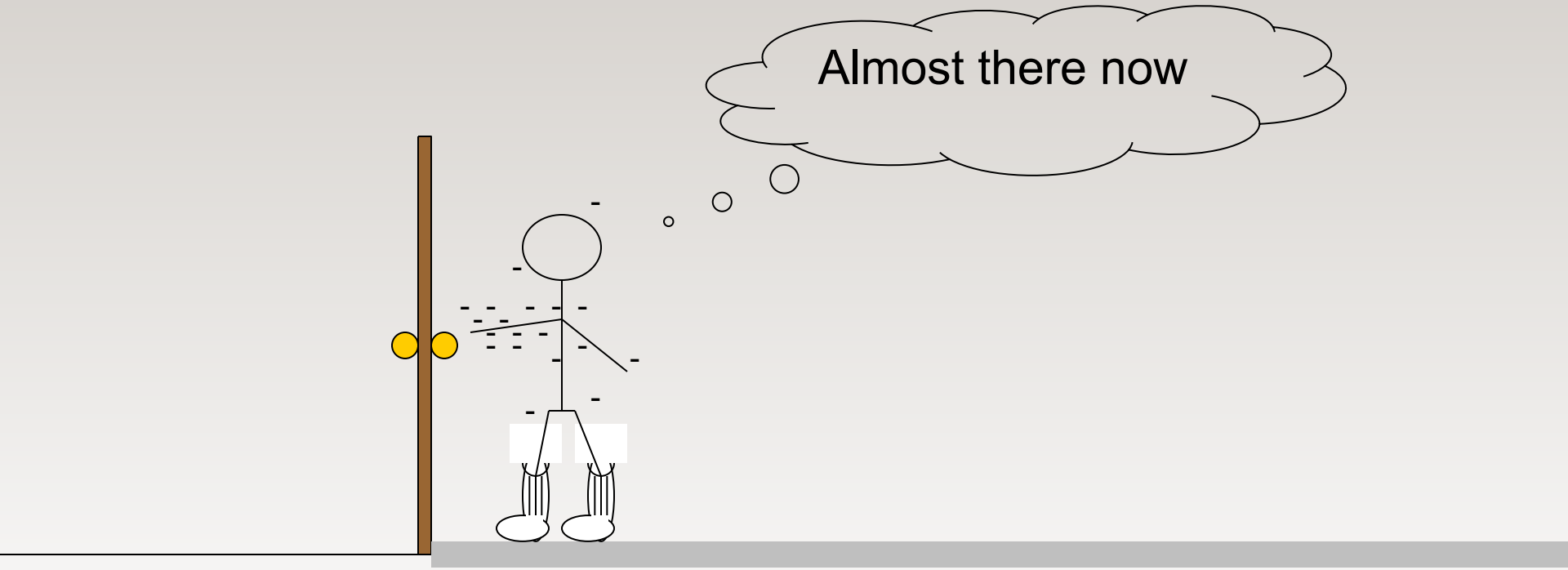
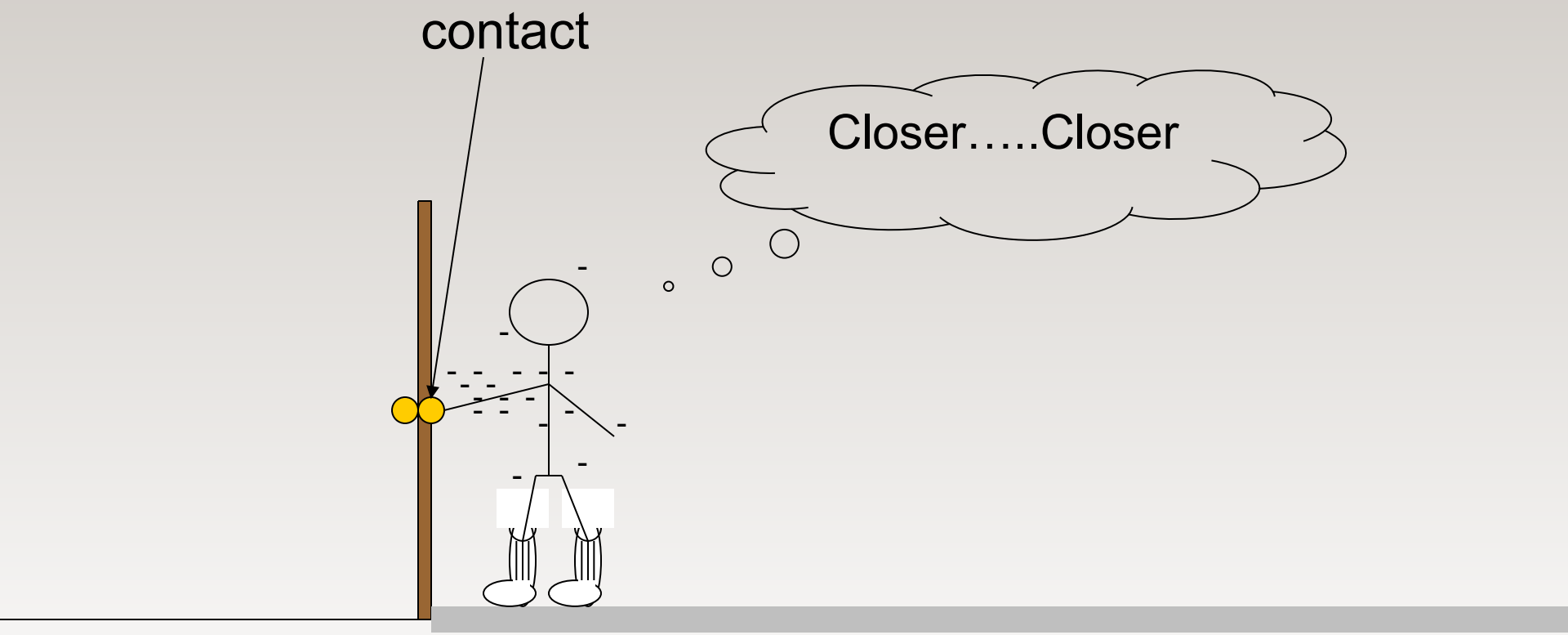


Static Electricity In Action




KA-ZAP

Create a comparison chart

- Use a chart to compare the following topics covered so far
  - Charging by friction
  - Charging by contact
  - Charging by induction
- Your chart should have the following headings for each topic

Topic	How it's charged	Charge it receives relative to charged exposed to	Does the altered charged last?
From above	*Describe how the object becomes charged*	*Is the charge the object receives the **same**, or **opposite** to the object that gave it that charge?*	*When the object is isolated will it retain the charge it was given?*