Date of Lab_____ Date of Submission 2/6

Laboratory Report

Title Electric charge - Static Electroscope

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K	1		

Lab Partners Ayano Chiba

Summary

In this lab, we did experiments that help us see the electricity we normally cannot see. By rubbing two different objects, I learned that electrons move and the objects can have charges. Objects with different charges attract each other but objects with different charges repel against each other.

· Meet a deadline · Write logically · Write clearly · Write with your own words

Teacher's Comments

many, many

With small simple figures, Madoka explains her observations as well as her ideas on mechanisms. Elaborate work!

Surprisingly precise descriptions.

1	2	3	4	5	6	7	8	9
Due	Summary	Intro.	Method	Results	Table/Fig.	Discussion	Clearness	General

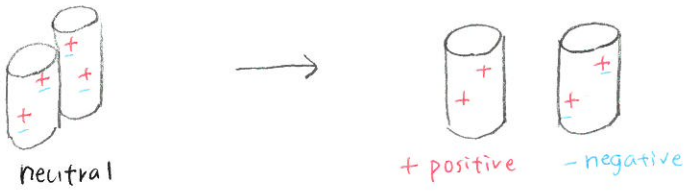
* Use this form as a cover sheet.

* Submit your reports by the seventh day after your lab.

Theory:

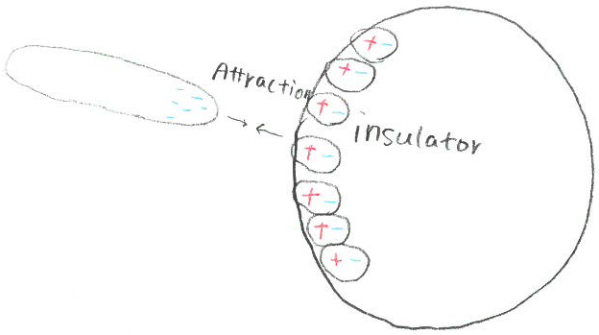
- **Frictional Electricity （摩擦電気）**

When objects are rubbed, electrons of one object move to the other object. The object that gained electrons becomes negatively charged and the object which lost electrons becomes positively charged. Movements of electrons are based on electronegativity, if an object has stronger electronegativity, then it tends to attract electrons more so it is more likely to become charged negatively. On the other hand, objects with weaker electronegativity tends to repel electrons so it is more likely to become charged positively.



- **Polarization （誘電分極）**

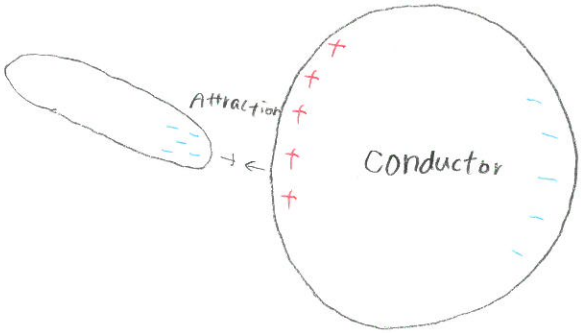
When a charged object is put near an insulator, the charge opposite within the insulator is attracted. The charged particles move in pairs because there are no free electrons.



good figures

- **Induction （帯電物同士の作用）**

When a charged object is put near a conductor, the charge opposite within the conductor would be attracted to the object and the same charges would repel because electrons are free to move.



- **Insulator**

  Materials in which charges are not free to move

- **Conductor**

  Materials that allow charges to move freely from one location to another

- **Semi-conductor**

  Materials that have properties intermediate between those of a good conductor and a good insulator

Experiment

Equipments

- Ebonite Rod
- PVC Rod
- Fur
- Acryl Rod
- Glass Rod
- Silk
- Suspender
- Polystyrene Balls
- Aluminum coated Balls
- Stand
- Baby Bottles
- Cup
- Water
- Aluminum Tray
- Plastic Cup
- Leaf Electroscope
- Van de Graaff Generator
- Insulation stool
- Grounding wire

Lab-1 Generate Frictional Electricity

Methods

1. Hang the polystyrene balls and aluminum coated balls to the suspender
2. Rub the rod with the fabric and make the rod gain charges
3. Move the rod close to the polystyrene balls (insulator) and aluminum coated balls (conductor).
4. Observe the reactions of balls and record the result
5. Repeat the experiment using different combinations of rods and fabrics

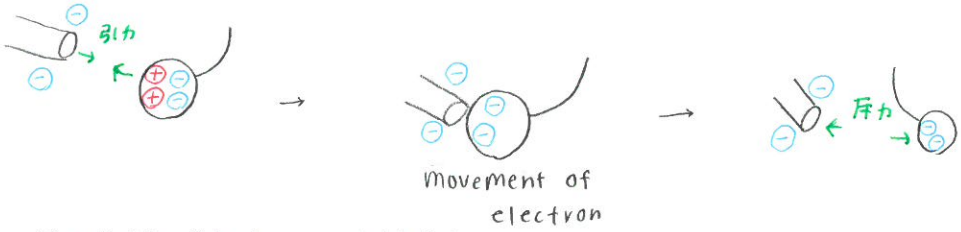
Results

	Aluminum coated	Polystyrene balls
PVC / Fur (+)	Attract then Repel	Attract then Repel
Ebonite (-) / Fur (+)	Attract then Repel	Attract then Repel
Glass (+) / Silk (-)	Attract then Repel	Attract
Acrylic Resin (+) / Silk (-)	Attract then Repel	Attract

Discussion

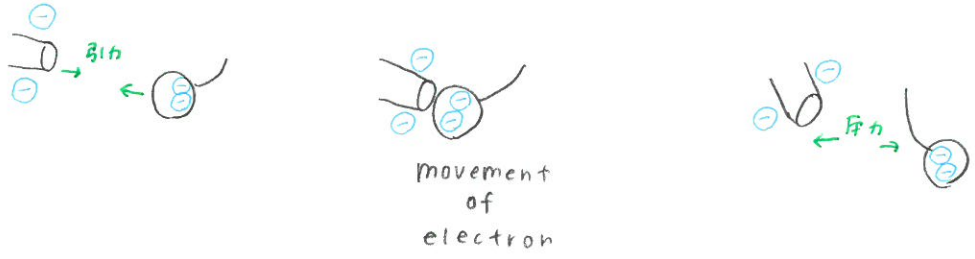
- **PVC / Fur (Aluminum coated balls)**

PVC is more likely to get charged negatively and fur is more likely to get positively charged. So, when I rubbed the PVC with the fur, electrons from fur move to the PVC and the PVC becomes negatively charged. Induction occurs between the negatively charged PVC and aluminum coated balls and attract each other. The electrons of PVC move to the aluminum coated balls and the aluminum coated balls become negatively charged. Because the PVC and aluminum coated balls are both negatively charged, they repel.



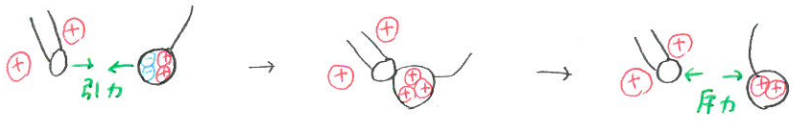
- **Ebonite / Fur (Aluminum coated balls)**

Ebonite is more likely to get charged negatively and fur is more likely to get positively charged. So, when I rubbed the Ebonite with the fur, electrons from fur move to the Ebonite and the Ebonite becomes negatively charged. Induction occurs between the negatively charged Ebonite and aluminum coated balls and attract each other. The electrons of Ebonite move to the aluminum coated balls and the aluminum coated balls become negatively charged. Because the Ebonite and aluminum coated balls are both negatively charged, they repel.



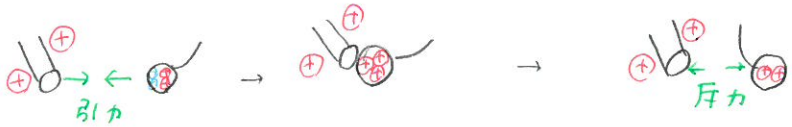
- **Glass / Silk (Aluminum coated balls)**

Silk is more likely to get charged negatively and glass is more likely to get positively charged. So when I rubbed the glass with the silk, the electrons of the glass moved to the silk and the glass becomes positively charged. Induction occurs between the positively charged glass and aluminum coated balls and attract each other. When the glass and the aluminum coated balls touch each other, the protons of the glass move to the aluminum coated balls and the aluminum coated balls become positively charged. The positively charged glass and the positively charged aluminum coated balls repel against each other.



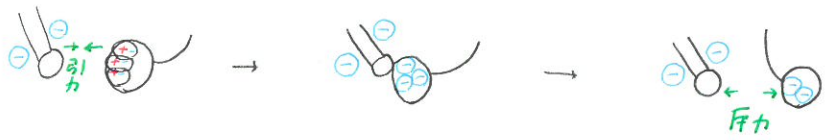
- **Acrylic Resin / Silk (Aluminum coated balls)**

Silk is more likely to get charged negatively and glass is more likely to get positively charged. So when I rubbed the acrylic resin with the silk, the electrons of the acrylic resin moved to the silk and the acrylic resin becomes positively charged. Induction occurs between the positively charged acrylic resin and aluminum coated balls and attract each other. When the acrylic resin and the aluminum coated balls touch each other, the protons of the acrylic resin move to the aluminum coated balls and the aluminum coated balls become positively charged. The positively charged acrylic resin and the positively charged aluminum coated balls repel against each other.



- **PVC / Fur (Polystyrene balls)**

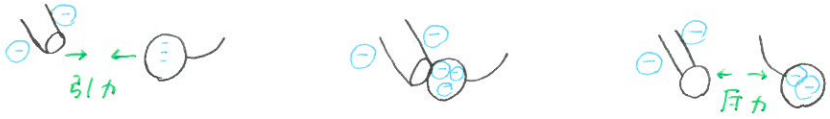
Induction occurs between the negatively charged PVC and polystyrene balls and attract each other. When the two touches, the electrons of the PVC moves to the polystyrene balls and the polystyrene balls become negatively charged. The negatively charged PVC and polystyrene balls repel against each others. This reaction occurred slowly compared to when we use the aluminum balls because polystyrene balls are an insulator.



- **Ebonite / Fur (Polystyrene balls)**

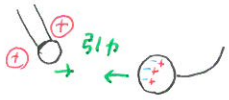
Induction occurs between the negatively charged ebonite and polystyrene balls and attract each other. When the two touches, the electrons of the ebonite moves to the polystyrene balls and the polystyrene balls become negatively

charged. The negatively charged ebonite and polystyrene balls repel against each others. This reaction occurred slowly compared to when we use the aluminum balls because polystyrene balls are an insulator.



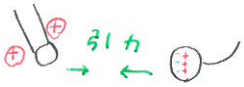
- **Glass / Silk (Polystyrene balls)**

Induction occurs between the positively charged glass and the polystyrene balls and attract each other. The reason why a reaction like the experiment with PVC and polystyrene balls didn't occur is because polystyrene balls are an insulator and electrons could not freely move around.



- **Acrylic resin / Silk (Polystyrene balls)**

Induction occurs between the positively charged acrylic resin and the polystyrene balls and attract each other. The reason why a reaction like the experiment with PVC and polystyrene balls didn't occur is because polystyrene balls are an insulator and electrons could not freely move around.

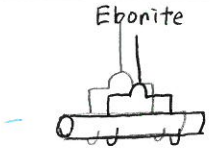
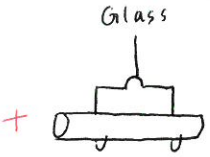
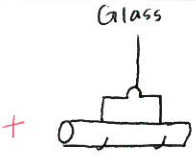
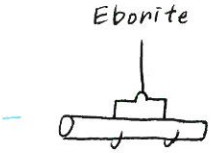
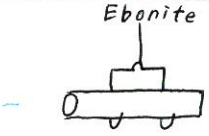


Lab-2-a Reaction between two charged insulators, reaction between a charged and an uncharged insulators

Methods

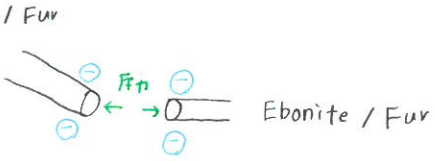
1. Set up the apparatus
2. Rub half part of the rod with fabric so half of it has the charges
3. Put the half charged-rod on the suspender
4. Rub the other rod with the fabric and make it charged
5. Move the charged rod close to the rod which is put on the suspender
6. Observe the reactions of the charred and uncharged part of the rod
7. Repeat the experiment using different combinations of rods and fabric

Results

		Charged Side	Uncharged Side
Charged PVC − w/ Fur	Ebonite 	Repel	Attract
Charged PVC − w/ Fur	Glass 	Attract	Attract
Charged Glass + w/ Silk	Glass 	Repel	Attract
Charged Acrylic Resin + w/ Silk	Ebonite 	Attract	Attract
Charged Acryl + w/ Fur	Ebonite 	Attract	Attract

Discussion

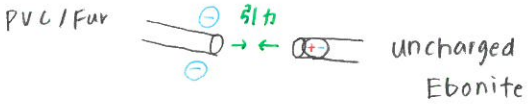
- **Charged PVC w/ Fur (Ebonite on the suspender)**
  - **Charged Side**



When I put the negatively charged PVC close to the negatively charged ebonite, they repel against each other.

  - **Uncharged Side**

Induction occurred between charged body and uncharged body and attracted each other.



- **Charged PVC w/ Fur (Glass on the suspender)**
  - **Charged Side**

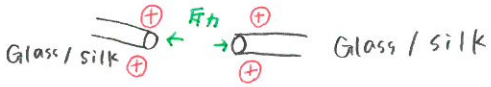
When I put the negatively charged PVC close to the positively charged glass, they attracted each other.

  - **Uncharged Side**

Induction occurred between charged body and uncharged body and attracted each other.

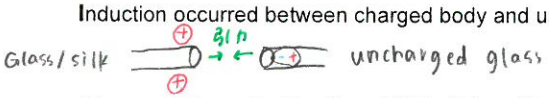
- **Charged Glass w/ Silk (Glass on the suspender)**
  - **Charged Side**

When I put the positively charged glass close to the positively charged glass, they repel against each other.



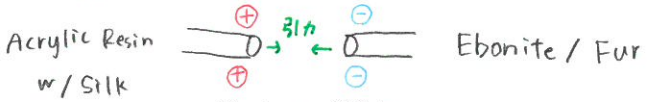
  - **Uncharged Side**

Induction occurred between charged body and uncharged body and attracted each other.



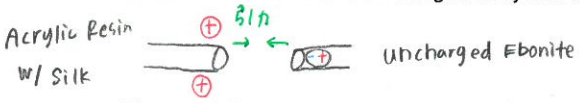
- **Charged Acrylic Resin w/ Silk (Ebonite on the suspender)**
  - **Charged Side**

When I put the positively charged acrylic resin close to the negatively charged ebonite, the protons and electrons attracted each other.



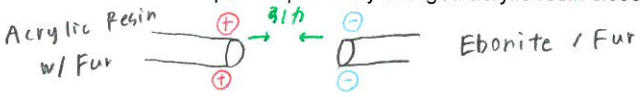
  - **Uncharged Side**

Induction occurred between charged body and uncharged body and attracted each other.



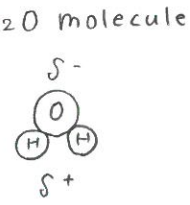
- **Charged Acrylic Resin w/ Fur (Ebonite on the suspender)**
  - **Charged Side**

When I put the positively charged acrylic resin close to the negatively charged ebonite, they attracted each other.



  - **Uncharged Side**

Induction occurred between charged body and uncharged body and attracted each other.

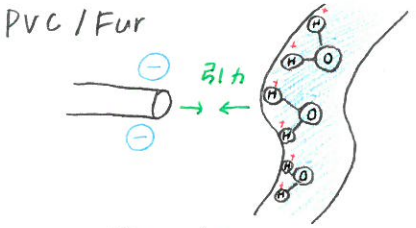


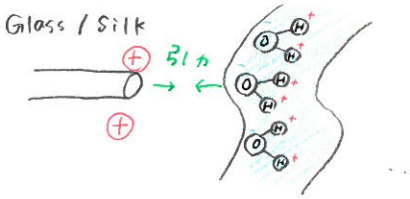
Lab-2-b Reaction between a charged insulator and water

Methods

1. Fill the baby bottle with water
2. Prepare a cup to catch the water
3. Rub the rod with the fabric
4. Move the charged rod close to the water released from the baby bottle
5. Observe the reactions of water
6. Repeat the experiment using different combinations of rods and fabrics

Results





Discussion

- **Charged PVC w/ Fur**

When I put the negatively charged PVC close to the water, the protons of the hydrogen faced the electrons of the PVC and attracted each other.

- **Charged Glass w/ Silk**

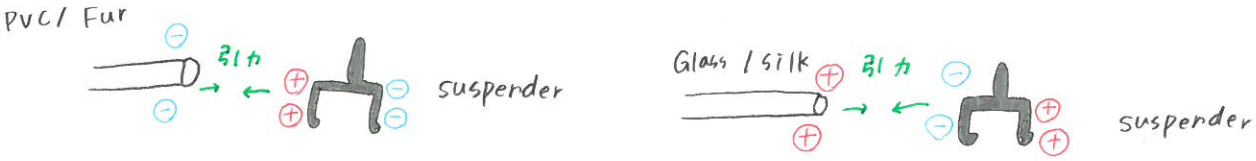
When I put the positively charged glass close to the water, the electrons of the oxygen faced the positively charged glass and attracted each other.

Lab-2-c Reaction between a charged insulator and a conductor (metal)

Methods

1. Prepare the suspender
2. Rub the rod with the fabric
3. Move the charged rod close to the suspender
4. Observe the reactions of the suspender and record the result
5. Repeat the experiment using different combinations of rods and fabric

Result



Discussion

- <u>Charged PVC w/ Fur</u>

When I put the negatively charged PVC near the suspender, induction occurred and the electrons of the PVC and the protons of the suspender attracted each other.

- <u>Charged PVC w/ Silk</u>

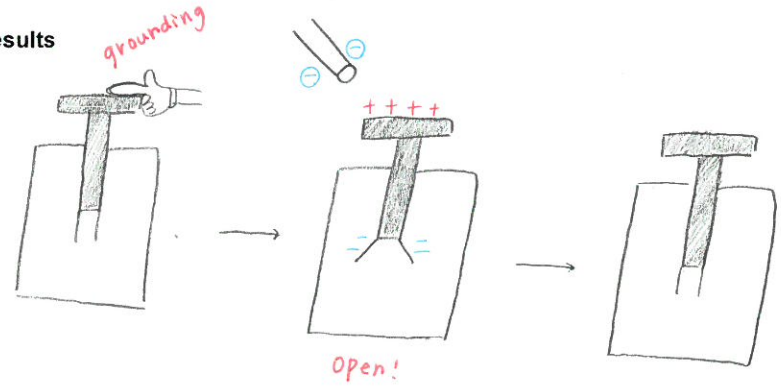
When I put the positively charged glass near the suspender, induction occurred and the protons of the glass and electrons of the suspender attracted each other.

Lab-3 Leaf Electroscope

Methods 3-a

1. Put the finger on the metal part of the leaf electroscope for grounding
2. Rub the PVC rod with the rabbit fur
3. Move the rod close to the metal part of the leaf electroscope, make sure it doesn't get discharged nor contacted
4. Remove the rod
5. Observe the reaction of the gold leaf

Results



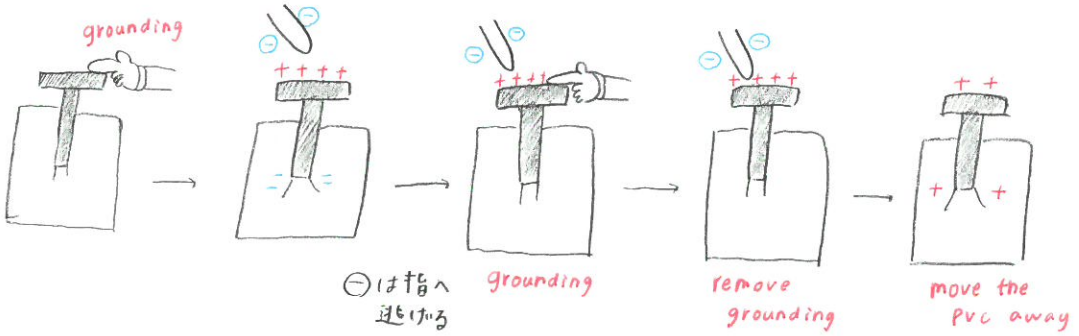
Discussion

When I put the negatively charged PVC near the leaf electroscope, induction occurred and protons were gathered on the surface of the electroscope and the electrons were gathered in the bottom. Because of the repulsive forces between the electrons repel against each other and the gold leaves open. When I released the PVC, induction stops too so the inside of the electroscope becomes neutral again and the gold leaves closes.

Methods 3-b

1. Put the finger on the metal part of the leaf electroscope for grounding
2. Rub the PVC rod with the rabbit fur
3. Move the rod close to the metal part of the leaf electroscope, make sure it doesn't get discharged nor contacted
4. Keep the rod close to the leaf electroscope and put the finger on it for grounding
5. Remove the finger first, then remove the PVC rod
6. Observe the reaction of the gold leaf

Results



Discussion

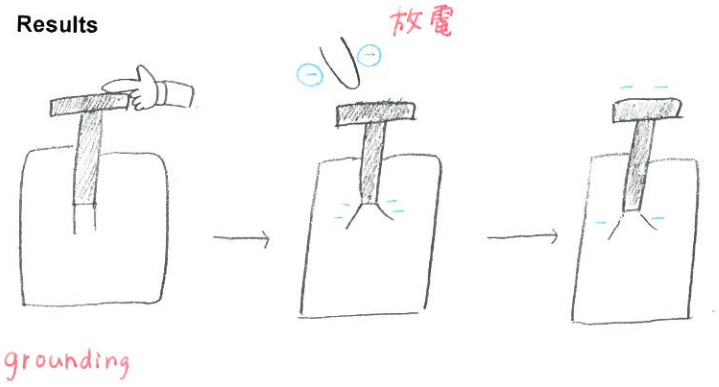
When I put the negatively charged PVC near the leaf electroscope induction occurred and protons were gathered on the surface of the electroscope and the electrons were gathered in the bottom. When I did the grounding with the finger, the protons on the surface of the electroscope remain the same but the electrons escape through the finger so the golden leaves close. When I took the PVC away from the electroscope, the protons spread through the electroscope. The protons are still in the electroscope so the protons repel against each other and the gold leaves remain open.

Methods 3-c

1. Put the finger on the metal part of the leaf electroscope for grounding
2. Rub the PVC rod with the rabbit fur
3. Move the rod close to the metal part of the leaf electroscope, and get it discharged but not contacted
4. Remove the PVC rod from the leaf electroscope

5. Observe the reaction of the gold leaf

Results



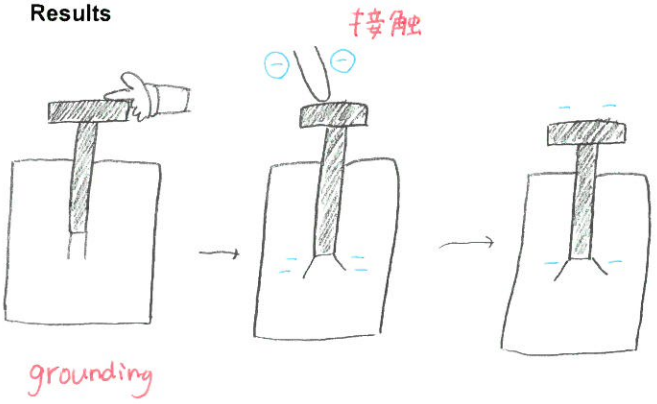
Discussion

When I let the negatively charged PVC discharge, the electrons of the PVC move through the metal part and repulsive force occurs between the electrons and repels so the gold leaves remain open. Even if I remove the PVC from the electroscope, the electron still remains so the gold leaves remain open.

Methods 3-d

1. Put the finger on the metal part of the leaf electroscope for grounding
2. Rub the PVC rod with the rabbit fur
3. Move the rod close to the metal part of the leaf electroscope, and get it contacted
4. Remove the PVC rod from the leaf electroscope
5. Observe the reaction of the gold leaf

Results



Discussion

When I let the negatively charged PVC touch the electroscope, the electrons of the PVC moves through the metal part. Repulsive force occurs between the electrons so the gold leaves remain open as the electrons repel against each others. Even if I remove the PVC from the electroscope, electrons remain in the electroscope so the gold leaves remain open.

Lab-4 Tray Generator

Methods

1. Rub the polystyrene board with the fabric
2. Hold the plastic cup of the aluminum tray
3. Bring the aluminum tray close to the polystyrene board
4. Bring the finger near the aluminum tray and make it grounding
5. Separate the aluminum tray from the polystyrene board and the grounding again
6. Observe and feel the movement of the charges with the finger

Results:

I had a little pain in my finger and I felt the electricity run through my finger.

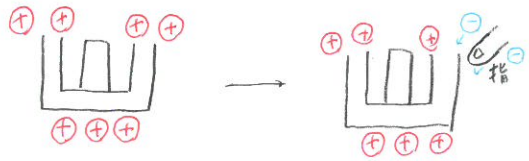
Discussion

First Touch:

When I put the negatively charged saran close to the tray, induction occurred between them. The protons of the tray moved to the bottom of the tray and electrons gathered to the edge of the tray. When I touched the edge of the tray with my finger, the electrons that were gathering at the edge of the tray flowed to my body and I felt a little pain with a little beep sound.

Second Touch:

The electrons gathering at the edge of the tray flowed to my body so when I took the saran away from the tray, protons spread through the tray. When I touched the edge of the tray, the protons that were gathering there flowed into my body and I felt a little pain with a little beep sound.



Lab-5 Van de Graaff Generator

Methods

Set up the Van de Graaff Generator on the table

Put the stool (insulator) on the floor

One person stands on the stool and put their hand on the Van de Graaff Generator before it is turned on

Turn on the switch and observe the charges kept on that person by observing the hair of the person touching the Van de Graaff Generator

Other people hold hands in a circle

The person at the end of the circle holds the grounding wire

Turn the switch of the Van de Graaff Generator off

The person on the stool remove one hand from the Van de Graaff Generator and points one finger to the person at the beginning of the circle

The person at the beginning of the circle also points their finger at the person on the stool

.They move their fingers close to each other's

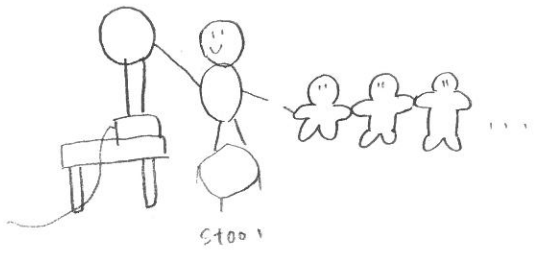
Observe and feel the movement of charges that came from the person on the stool and absorbed through grounding

Results

There was no reaction to the hair. The person on the stool and the person closest to the person standing on the stool felt the most pain. The rest of the people also felt the pain but it was not as strong as the first two people.

Discussion

Humans are made out of atoms and the atoms are made out of protons, electrons, and neutrons. Our bodies are a conductor so there are electrons freely floating around our body. When the electricity ran through the Van de Graaff Generator, the electricity floated in are body through the hands we held.



Conclusion:

In this experiment we could observe the reactions of electric charges. Polarization, induction and the movement of charges were involved in this experiment. Polarization occurred between charged objects and neutral insulators. Induction occurred

between charged objects and neutral conductors. Movement of charges occurred between charged objects. All three reactions seemed to be all the same to me at first but I found out they were all different tin functions.

Opinion:

I liked this lab because it was easy to see the reaction than using numbers and having to compare them. Not only was I able to understand the system of charges and movements of electrons but this lab helped me solve questions I had against the electrical shocks that occur when I touch some things. It was my first time to see the Van de Graaff Generator other than TV shows and I enjoyed doing the lab with all of my classmates.

Reference:

Lab report of Yamato Oishi (2017)
Lab report of Saori Shiba (2017)