Lab: Electric Fields AP Physics

Background
This electrophorus is a charge-storing device first invented by Volta in 1775. The one used in this lab is made of simple items, and can be used to perform a number of electrostatic experiments.

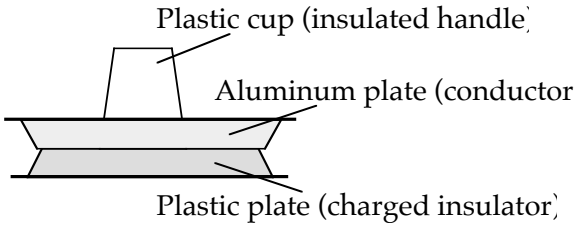
The concept of an electric field is difficult to demonstrate well in a lab. The computer model used in this lab may go further toward giving the student a strong understanding of what an electric field "looks like."

Objectives
To construct an electrophorus, and perform simple experiments that illustrate simple electrostatic principles. Also, to use a computer-based model to better understand the nature of electric fields.

Equipment
Small plastic cup, plastic plate, disposable aluminum pie plate, glue, paper towel,
Physlets to model electric fields on computer[1]

Procedure

Part A. The Electrophorus



1. Construct the electrophorus
i. Place the plastic plate upside down on the table. This will be referred to as the "insulating base."
ii. Place the aluminum plate right-side up on the insulating base. This will be referred to as the "metal plate."
iii. Glue the small plastic cup upside down onto the center of the metal plate. This will be referred to as the "insulating handle."

2. Prepare the electrophorus for use
i. Remove the metal plate and rub the base with a piece of silk, fur, wool, or paper towel to charge it.
ii. Touching only the insulating handle, place the metal plate on the charged base.
iii. Briefly touch the metal plate with your finger.

3. Perform experiments with the electrophorus
i. Touching only the insulating handle, pick the metal plate up off the base.
ii. Try touching the metal plate to different surfaces, and observe carefully what happens.
iii. Try touching the metal plate to a graphite-covered pith ball.

4. Recharge the electrophorus
i. To recharge the electrophorus, place the metal plate back on the base.
ii. Briefly touch the top of the metal plate again with your finger.
iii. Remove the metal plate by holding its insulated handle as before.

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[1] Physlets, i.e., the Java applets themselves, are authored by Wolfgang Christian and his students at Davidson College. The term Physlet® is a registered trademark of Wolfgang Christian.

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Part B. Computer Models of Electric Fields

1. Using a suitable browser, go to the URL *https://www.compadre.org/Physlets/electromagnetism/*. We'll be focusing on Chapters 22 and 23 for this exercise.
2. Take a few moments to play with some of the applets--especially informative might be Exploration 22.3, Exploration 22.6, and Exploration 23.2. As the site warns, much of its functionality has been deprecated. You should be able to click through the warning screens on the computers in our lab to get it running, however. (NOTE: I would not ordinarily recommend bypassing security warnings on a computer.)
3. Once you've had a little time to experiment/play, move on to examining the following three problems:
   - Problem P 23.1
   - Problem P 23.4
   - Problem P 23.7

   You'll need to write up an analysis, including a sketch, explanation, and answers to the questions posed, **for two of these three problems.**

Questions

Part A. The Electrophorus

1. After the silk material was rubbed on the base in procedure A.2.i., electrons were removed from the plate. Indicate the net charge on the base by drawing a sketch of the electrophorus set-up, with pluses (+) and minuses (-) in the appropriate places on your diagram.
2. When the metal plate is placed on the base, it actually only touches the base in a few places, and very few charges are conducted from the base to the metal. In your sketch, add + and - signs to indicate the location of charges on the metal plate while it's sitting on the base.
3. When you touch the metal plate on the base with your finger, your body acts as an electrical *ground*, a source of charge. Draw a new diagram of the electrophorus that indicates the net charge on the metal plate *after* you have touched it.
4. Why can the electrophorus be repeatedly recharged without rubbing the base again every time?

Part B. Computer Models of Electric Fields

Answer questions as posed in the two problems you investigated.