Electrostatics using Scotch tape

Procedure:

Take a 2-3 inch strip of scotch tape and stick it to a smooth surface, and quickly pull it off. You’ll find the tape has an electric charge. It’ll be strongly charged when pulled off some materials and relatively weak when pulled off others.

You’ll want to fold over a small bit of the end to provide a “handle” to make the tape easier to work with.

1. Pull off another piece of tape from the same surface as your first piece. **Do the strips attract or repel each other?** Try this again with 2 pieces of tape pulled off other surfaces. (Be sure to describe the surfaces in you use) Can you make a general rule about them?
2. Stick a strip of tape on back of another (parallel, not crossed), and then stick both on the some surface. Quickly pull them off the surface, and pull them apart.

**What do you notice about these strips?**

Put both strips on the edge of the table so that they hang down, and make them far enough apart that they do not interact. You now have 2 “leaves” which are somehow charged. **Make a note of which is the “top” strip and which is the “bottom” strip.** The 2 leaves will serve as an electroscope.

1. Prepare another pair of strips of tape as before, and bring each (in turn) near each of your electroscope leaves. **(Write down what you observe). Is there always an interaction between charged objects?**
2. Stick and pull off pieces of tape from several different surfaces and bring them near each of your electroscope leaves. You’re not limited to bits of tape; try rubbing glass and fur together, rub your glasses on your shirt, etc.
3. **Do you ever see a charged object that repels both strips of your electroscope? Do you ever see a charged object that attracts both strips?**
4. From your observations, what do you conclude about how many kinds of electric charge there are? Defend your conclusion from your observations only, not from any previous knowledge or from a textbook.
5. Does the strength of the attraction or repulsion vary with distance? Can you see Newton’s Third Law in action with strips of Scotch tape? Be very specific in describing how you see the 3rd law manifested. Can you see it if you bring a charged plastic comb near a strip of tape?
6. Hold a charged object near your arm, or the back of your hand. (A comb or balloon rubbed on your hair works well.) **Do you feel anything? What is it you are actually feeling?**
7. Can you **explain** any of your observations with gravitational forces? Do an order-of-magnitude calculation for the gravitational force between a strip of tape and your hand. A rough estimate will suffice. Use **Newton’s law** of gravitation:

**F= G M1M2/r2**

To estimate the mass of the tape guess the mass of a whole roll and divide by the length of the roll (written on the package). Guess the mass of your hand and use a rough distance like 10cm for the distance between masses. Is the force you calculate enough to cause bending of the tape you observe? **Explain** how you know (HINT: to estimate how much force is required to bend the tape try estimating how much force would be required to lift a 2-inch strip of tape. The force to bend it won’t be different by more than an order of magnitude.)

1. You ought to have noticed that a piece of metal or even your hand by itself attracts both strips of electroscope. This is due to “induced charge” in the conducting material (the metal or your hand). **DRAW** a diagram illustrating how this happen. **SHOW** a neutral object attracting a positively charged strip and another diagram for a negatively charged strip.
2. Make a **list** of the similarities and differences between the electrostatic and gravitational forces.