**Electrostatics Contests – Contest Problem Solving** **Grade-9 Science to Grade-12 Physics**

**Curriculum Connections**:

Unit A: Scientific Investigation Skills (any grade), grade 9 science (electricity), grade 11 physics (electricity, forces), grade 12 physics (fields, forces)

1. **Balloon Contest**: You will hang a balloon from the ceiling and you will use electrostatic forces and another balloon to give the hanging balloon the largest horizontal deflection.

Students will learn more content and develop more transferable skills, if they are required to use their knowledge to plan and write down their strategy before using the materials. They usually don’t like to do this. Explain how is a real situation you will usually not have the time or resources to play around with the material until you get it right. You can emphasize this by giving them only a short time to implement their plan.

1. Draw a force diagram of the hanging balloon at maximum deflection.
2. What should you use to suspend the balloon? Explain.

* The lightest thread – not string – should be used to keep the weight low, because the electrostatic force will be small.
* The thread should be as long as possible, because the ratio of the two forces sets the angle and a longer thread at that angle, will give a larger horizontal deflection.

1. How should you prepare the balloons? Explain.

* The balloons should be as large as possible. They will be able to hold more charge.
* The balloons should be charged all over. This puts more charge on the balloon and it means the balloon won’t rotate to put the charged side to the outside.
* The balloons should be rubbed vigorously with whatever material seems to work the best – probably hair that doesn’t have a lot of conditioner.
* The balloons should both be charged just before testing, especially if air is moist.

1. How should you hold the balloon? Explain.

* The balloon should be held horizontal for maximum effect.
* The balloons must line up or else the suspended balloon will fall off to one side.

It might be worth suspending the balloon by two threads forming a large triangle, to prevent this. However, that will mean doubling the weight.

* Hold it far from your body so that you don’t affect the charges.
* Have a team mate on the far side to attract the balloon.

1. How far was your balloon deflected? What could you have done better?

* It is unlikely that any group will think of all of these points.

1. **Container Race**: You will be provided with a selection of aluminum cans, plastic bottles and balloons. You will use electrostatic forces to make a container roll down the hallway the fastest.
2. Use a diagram and words to explain why the can will roll.

Students have trouble explaining why a neutral object is attracted to a charged object. The charged object induces a charge separation in the neutral object. In this case, the negative charge moved closer to the positive balloon. The balloon attracts the negative charge and repels the positive one. The negative charge is closer, so the attraction is greater than the repulsion.

1. What container should you choose? Why?

* They should choose a metal container because it will have a greater charge separation.
* They should choose aluminum, not steel because it is lighter and easier to accelerate.
* They should choose one that rolls easily and is not dented.

1. How will you prepare and hold the balloons? Explain.

* The balloon should be thoroughly charged all over.
* A second person with a second balloon should be ready to take over if the charge is lost.
* The balloon should be held at whatever angle works best. Over head won’t work, but neither will a purely horizontal position. This will try to make the container slide against friction rather than roll.
* You have to stay ahead of the rolling container, which isn’t easy.

1. What could you have done better?

* Even with the planning, it might take a while to master the technique. It might be worth having one race - give them time to practice – and then another race.

1. What are other electrostatic contests that you could have?

* Separating pepper from salt.
* Getting a balloon to stay on the wall the longest.
* Electric Field Hockey! <http://phet.colorado.edu/en/simulation/legacy/electric-hockey>

1. What are current electricity contests that you could have?

* Making an electric cell or a battery of cells with the greatest voltage. Provide fruit, vegetables and different metals.
* Get the largest voltage from a set of photocells.
* Get the largest voltage by turning a motor that isn’t geared.