**Demonstrations for Toronto PI Workshop Oct.23, 2013**

1. **Aluminum Can Race: What will happen if you bring a charged balloon near the can?** **Materials**: empty aluminum cans lying on their side, pop bottles, PVC tubing, inflated balloons, animal fur, wool etc. <http://weirdsciencekids.com/Balloonracerstaticelectricity.html>

**Grade 9 Unit E: Electricity (charging by friction and induction)**This open exploration can be turned into a contest as students vie to get a can to roll down the hallway the fastest. To encourage everyone to get involved it can be done as a relay race. Which works better – the balloon or the tube? Which combination of materials gives the strongest effect? Why do charged objects sometimes attract and sometimes repel, but always attract neutral objects? <http://phet.colorado.edu/en/simulation/balloons>

1. **Coupled Pendula: What will happen if you set one mass swinging**?

**Materials**: support, string and masses. <http://www.youtube.com/watch?v=izy4a5erom8>

**Grade 11 Unit E: Waves and Sound (resonance)**

This open exploration can precede a student-designed quantitative investigation. What happens if the masses are different? What if the string length is different? What if the amplitude is changed? What affects the time it takes to transfer the energy from one to the other?

1. **Super cooling water: What happens if you put salt on ice? What happens if water is cooled below 0o C?**

**Materials:** Ice cubes, salt, thermometer, test tubes, cloth and hammer, pure water, tap water and containers. <http://www.fizik.si/index.php/en/fizikalni-eksperimenti/toplota?videoid=5m8qvQHdxuA#youtubegallery> and <http://www.fizik.si/index.php/en/fizikalni-eksperimenti/toplota?videoid=SbxRzvvKbaQ#youtubegallery>   
**Grade 9 Unit C: Chemistry (melting points of pure substances and mixtures)**

This experiment can also be turned into a competition. Who can get their salt/water mixture the coldest with a limited amount of salt? Students will need to consider concentration of solute and particle size among other things.

1. **Do not open the bottle**: **What will happen if we do open the bottle?**

**Materials:** Plastic bottles, push pins, nails, water and containers. <http://www.youtube.com/watch?v=nIBTrWcWik0>

**Grade 11 Unit C: Forces (equilibrium, gravity, surface tension)**

1. **The tea bag rocket: What will happen when the tea bag burns down to the bottom?**

**Materials:** Teabags - both flow-through and normal style, paper and tape, matches, scissors, saucer or equivalent. <http://www.youtube.com/watch?v=YPp0JwHnSOA>    
**Grade Unit D: Climate Change (convection)**

This can be a fun break in a very serious unit. It may look dangerous, but it isn’t. The flying teabag contains very little combustible material. It makes convection in air very visible. What happens if you use only half a teabag? What if you use paper? What if you don’t use the tea?

1. **Pinhole Camera: What will happen if you look at the lights through the tube?**

**Materials**: A pinhole camera made of two toilet paper rolls, aluminum foil and waxed paper. Variety of lights to observe; like a candle flame, a compact incandescent bulb and LED flashlights. Additional rolls, foil, tape, pins and waxed paper. What if there are two or three holes? What if the holes are made bigger? What if the holes are triangular in shape?

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You need two toilet paper rolls. Cover the top of one with tin foil and the other with wax paper. Put the one with tin foil on top of the wax paper and tape them together so that no light leaks in. Put a small pin hole in the tin foil. Put the open end around one eye and close the other. Use this to look at bright light sources.

**Grade 10 Unit E: Optics (image formation)**

The image formation of lenses and mirrors is very complicated. It helps to start with a pinhole camera as it only involves straight line optics – no reflection or refraction. This is a really simple and effective pinhole camera. Each student can have one and the toilet paper completely covers your eye and therefore forms a dark display area. It even works when the lights are on in the classroom.

1. **Magnus force**:  **What will happen as a cylinder of paper rolls off a ramp?**

**Materials**: Paper of different weights, scissors, tape and a long smooth board. <http://www.youtube.com/watch?v=23f1jvGUWJs>

**Grade 12 Unit B: Dynamics (projectile motion, air resistance, addition of velocities)**

This could be turned into a short competition. Devise a cylinder that will demonstrate the largest effect from the Magnus force. What weight of paper should you use? What angle should the ramp be at? What diameter sand length should the cylinder have?

1. **Cartesian Diver**: **What will happen if you squeeze the bottle?**

**Materials**: A working model, a reverse diver (made with a mouthwash bottle), other bottles, droppers and water. <http://www.youtube.com/watch?v=sNOXFiJ4IDU>

**Grade 12C Unit F: Hydraulic and Pneumatic Systems (density, pressure, volume)**

This could be turned into a short competition. Devise the most sensitive Cartesian diver. The water in the stopper must be adjusted, so that it is almost neutrally buoyant- the top should float just below the surface. The bottle should be filled to the top with water, so that only air that compress is in the stopper. The bottle should be a fairly stiff one without indentations that can pop out when squeezed.