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

**Curriculum Connections**:

Unit A: Scientific Investigation Skills (any grade), grade 9 science (astronomy), grade 12 physics (fields, forces), grade 12 SES (planetary science)

Grade 9’s and the SES classes will not analyse the forces, but contest will help them get a feel for orbital concepts, like how the speed needs to match the radius and inward force.

1. **Orbiting**: You will be given a large piece of stretchy fabric and a selection of balls. You will try to get your ball to orbit the most times, while holding the fabric stationary.
2. Draw a force diagram of the ball that is orbiting.

The normal force is perpendicular to the surface of the fabric. The horizontal component makes the ball go in a circle. Friction has not been shown because it is perpendicular to the page and opposite the velocity. It causes the ball to slow down and spiral in.

1. Describe how you will launch the ball and why.
* The ball needs to be given a velocity that is perpendicular to the slope, so that the force will just turn it and not speed or slow it.
* The ball’s speed has to be at some moderate speed that will work well with the force and radius. Too fast and it will fly off the edge and too slow and it will fall in.
* The ball should be launched near the edge so that the whole fabric is used.
1. Describe how you will hold the fabric and why.
* The fabric needs to be level or the ball might roll off.
* The fabric needs to be pulled as far down as possible – for maximum gravitational potential energy to counteract the frictional losses.
* The fabric should be as taut as possible to reduce energy losses from flexing the fabric.
* If the fabric is stretched over a hula hoop, large embroidery hoop or bicycle wheel without spokes, it will be easier to implement and demonstrate these requirements.
1. Describe which ball you will use and why.
* The ball should be high density so air resistance will have little effect. No ping pong balls.
* The ball should be low mass, so it will not deflect the fabric much.
* The ball should have good grip, so it rolls. If it slides, there will be energy losses from the friction.
1. What aspects did you realize after working with the equipment?