# VanCleave Science Experiments

Extra tips, explanations and questions from Doc Brown!

## Cycle 2, Weeks 1-6

Welcome everyone! This is for all my CC family out there who would like to add a little Doc Brown to their VanCleave science experiments for Classical Conversations Cycle 2, Weeks 1-6. Please follow the wisdom of your Director and Tutors and allow me to add to what they are already having you do! Lets get going…

## Cycle 2, Week 4

Both experiments this week are trying to simulate different aspects of planetary orbit. This is difficult to do on Earth so encourage a little extra imagination this week!! Both experiments are using centripetal force and the first three laws of motion (Newton's laws, Science weeks 16-18) to explain how planets orbit the sun. Centripetal force is the force that keeps an object, marble or washer, moving at a constant speed along a circular path. Basically the centripetal force keeps the planet orbiting the Sun because the Sun's gravity is constantly pulling on the planet but the planet it is also traveling "sideways" to the Sun. This sideways force balances the gravitational force and the planet travels in a circular (or in the case of most of the planets elliptical) path.

### VanCleave #011: On the Move

This experiment shows us how inertia affects an object moving in a circular path. Above we said that planets are traveling sideways and that this plus gravity resulted in a circular path around the Sun. Newton's first law of motion states an object at rest tends to remain at rest and an object in motion tends to continue moving in a straight line at constant speed unless an outside force acts upon it Gravity acts on an object and there by changes the object, in this case the Sun's gravity acts on the straight line motion of the planet, pulling it towards it. Big vocabulary word this week is *Inertia*. VanCleave defines inertia as "the resistance that all object have to any change in motion." We need a way to see inertia at work here on Earth where we cannot

change gravity! *Friction* is one of the most important forces on the planet. It keeps our cars on the road and our feet on the ground. When we lose friction, we slip and slide all over the place!! Friction allows us to open a jar or get a nasty rug burn!!

If you can cut the paper before hand, especially with the littles, it will help with time management and waiting. When you place the paper in the cake pan (or other round container) it makes the surface more rough than the cake pan surface. Friction increases inertia, it makes the marble in the pan on the paper harder to keep spinning. When the paper is removed, the marble travels with less inertia, less resistance to change and keeps moving longer. This is what happens in space where is there almost no friction to interfere with ta planet's orbit around the Sun.

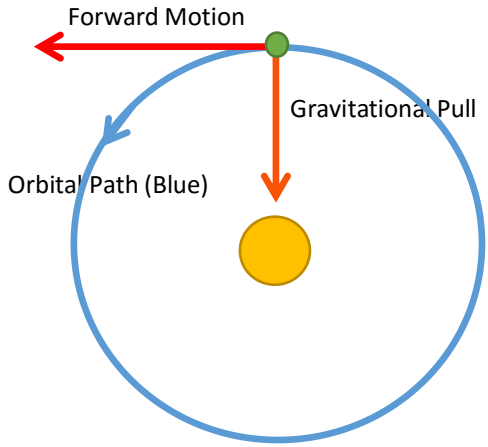
Now for some questions:

1. What are the steps of the Scientific Method?
2. Why kind of hypothesis do we want to use (ex. a yes/no question or IF/THEN statement)?
3. What are the materials?
4. What is the procedure?
5. Define Inertia and Friction, perhaps Gravity as well.
6. Why is friction good for keeping a car on the road but bad for an ice skater or hockey player?
7. What happens if you spin the marble to slow?
8. What happens if you spin the marble to fast?
9. Is spinning the marble easier or harder with the paper in the pan or container?
10. Bonus question: What part of this experiment is do the work of gravity? The sides of the cake pan. Ask them what is keeping the marble from flying off, (which it will do it you spin it to fast, boys!) or what is keeping it on the circular path?

## VanCleave #011: Speedy

As before, the experiment is closely relate to #011. We are talking about centripetal force and gravity. The best way to get good results for this one is to only spin from your hand. If you spin your whole arm, you are basically making the string longer

by the length of your arm. This means every one is using a different length of string and trying to get the same results may be difficult. In this experiment you will be acting as the Sun and the washer will be a planet. You will be the force of gravity and at the same time giving the forward motion to the washer. The washer will want to go in a straight line, which is what will happen if you let go. A good demonstration but not recommend for every student to do, otherwise we may have to many suns and planets colliding, if you get my drift!! Ouch!! Here is a very simplified graphic:




While your hand is causing the washer to spin, giving the washer forward motion, your grip on the string is the force of gravity, keeping the washer connected to you and together giving the washer its orbital path. The length of the string represents how much gravity you are pulling the washer with. The closer a planet is to the Sun, the more effect the Sun's gravity has on the planet. Mercury is the planet closest to the Sun (Science, week 9) and thus it spins around the Sun faster than any other planet. Neptune is the farthest planet from the Sun and thus takes the longest to go around the Sun. This is how it will be with the washers. The shorter the sting is, the faster you have to keep it spinning, the longer the string, the slower you can keep it spinning. Why? Because the gravitational pull has to be the same as the force of the forward motion, so as the gravitational force becomes less (or more), the forward motion must also become less (or more) or the planet will fly off and not orbit the Sun!

Now for some questions:

1. What are the steps of the Scientific Method?

2. Why kind of hypothesis do we want to use (ex. a yes/no question or IF/THEN statement)?
3. What are the materials?
4. What is the procedure?
5. Define gravity and orbit. Gravity is a force based on mass, the Sun's mass is about 333.000 times that of the Earth.
6. What happens when you let go? Why, ie which force was greater? (Forward motion)
7. Why won't the washer spin if you go to slow? Which force is greater (Gravity)
8. Spin the washer as fast as you can SAFELY…do you feel like to have to hold on tighter? Do you feel like the washer is pulling you?
9. If you hold both hands with a partner and spin around slowly can you still hold hands? What about if you go faster? BE CAREFUL!!

Next week's post will be VanCleave Wk5 by MomBrown