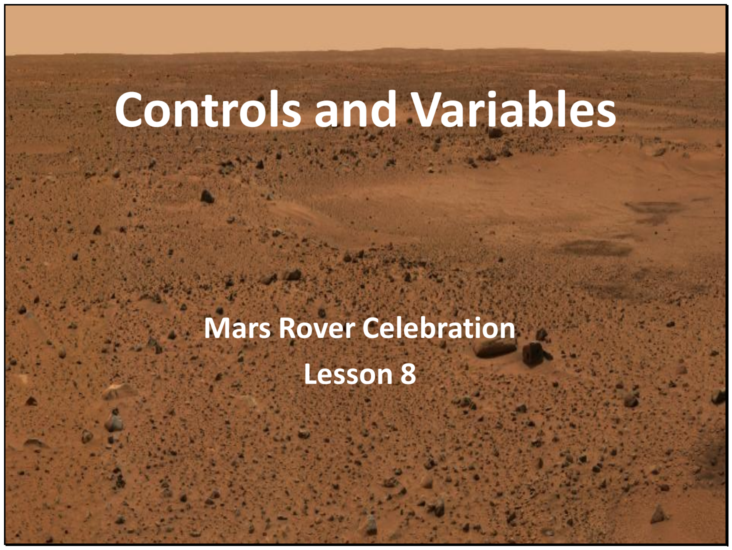
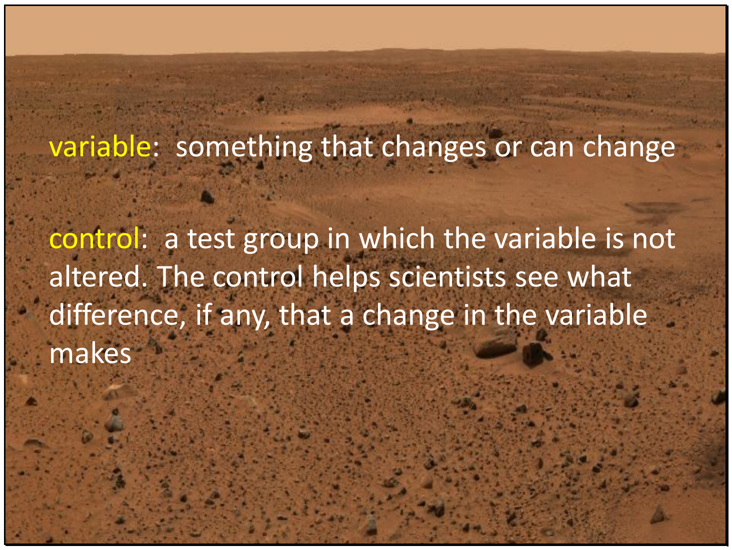
Slide 1



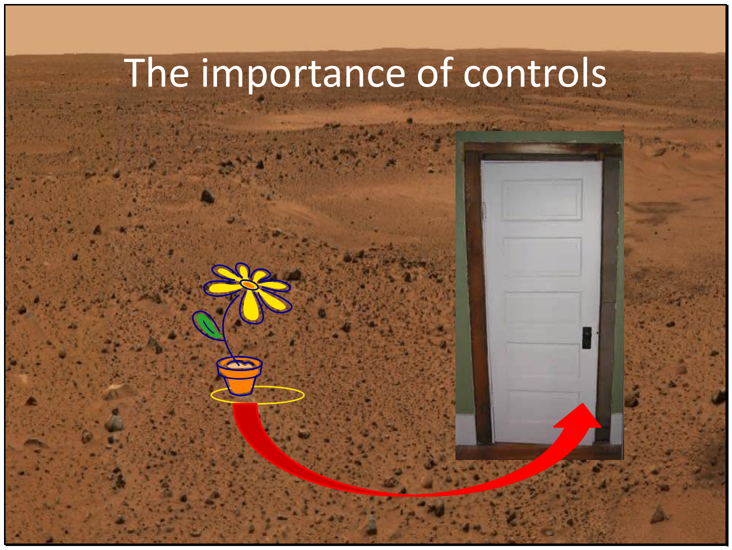
Today you will be working to identify the variables you want to test during your mission an the controls you will need to account for.

Slide 2



Review the definitions of control and variables with your students.

Slide 3

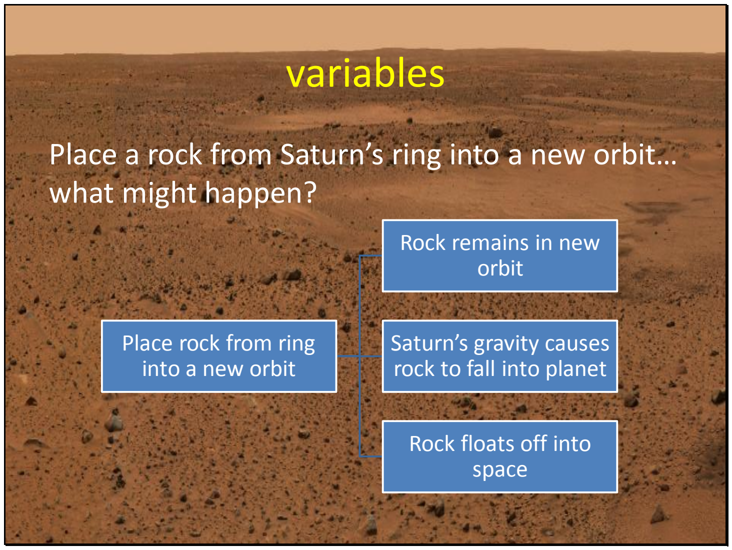


Suppose that we decided to conduct an experiment with a plant. We know that plants require sunlight so we decide to see what would happen if a plant gets no light at all for a week. So, we decide to place the plant if we put in a dark closet for seven days. Unfortunately, we also forget to water the plant during that entire week. When we go into the closet at the end of the experiment, we find that the plant has died.

Unfortunately, we have no way of knowing whether the plant died because of the lack of light or because of the lack of water. We should have controlled for water by setting up a system by which the plant would have received adequate water in the closet.

Real science works very much the same way. Scientists have to be very careful that they control for all the things that might change in an experiment that they don't want to change so that they can see the effect that making a single change has.

Slide 4

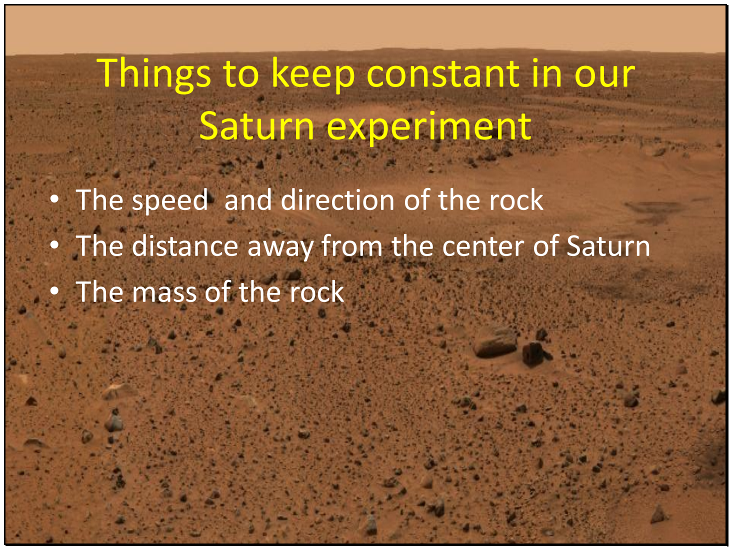


If we think back to my example of a mission to Saturn, I decided to test what would happen if I moved some of the millions of rocks that form the rings around Saturn into a different orbit. In this case, my variable is what might happen to the rock once I place it into a new orbit. It is a variable because it is something that might change. The rock might remain in the new orbit. It might crash into Saturn or it might float away into space.

Slide 5

During any experiment, scientists are very carefully that ONLY the variable changes. They try to keep everything else in the experiment exactly the same. The reason is that they want to be certain that any change that happens is a result of the variable they changed. If several things change at the same time, they really won't know which one might have caused the variable to change.

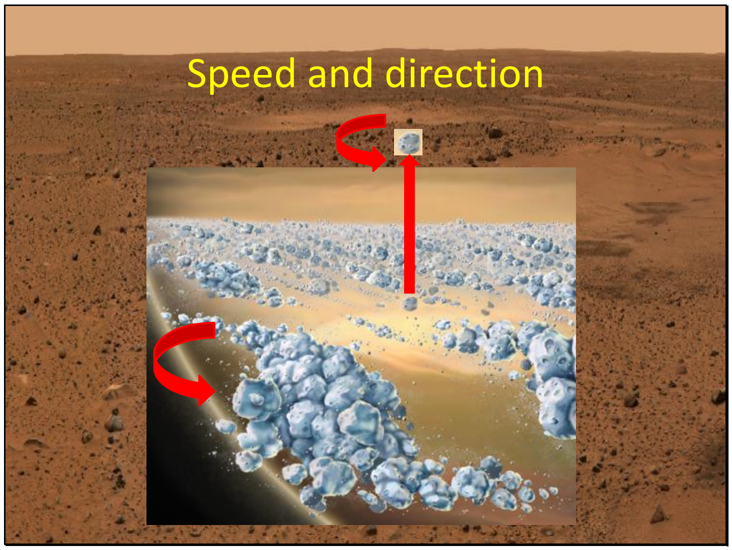
Slide 6



In my Saturn experiment, here are a few things that I will want to remain constant. Let me explain each to you:

Let's look at each of these constants one at a time.

Slide 7

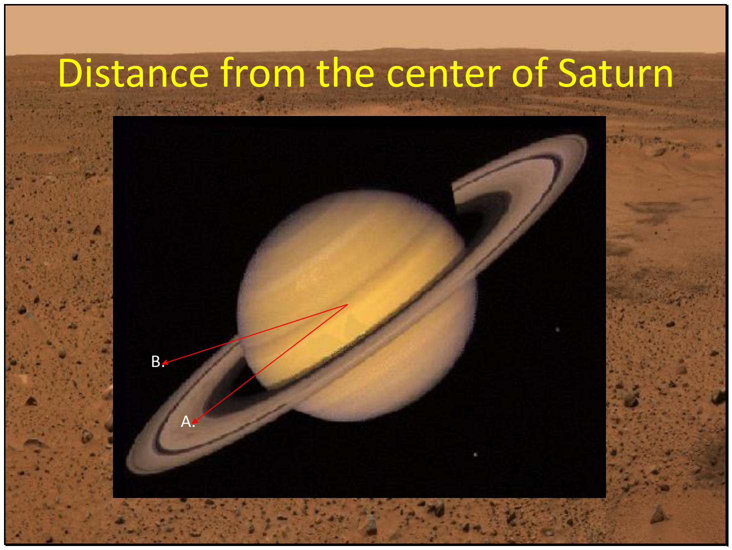


THE SPEED AND DIRECTION OF THE ROCK: Even though it may seem that objects in space are floating without moving, in reality they are moving a very high speeds. When I pull a rock from it's orbit, I am changing the speed and the direction of the rock. After I move the rock where I want it, I have to make sure that the rock is moving in the same direction and at the same speed it was before.

Why would this be important? Allow students to discuss this. Help them to come to the realization that if the rock is moving faster or slower than the others, it might move differently than it would otherwise. Also, if the rock still has some upward momentum once it is in its new orbit, this could also affect how it might move.

Illustration: http://www.jpl.nasa.gov/images/cassini/2007-12-12/pia10081-browse.jpg

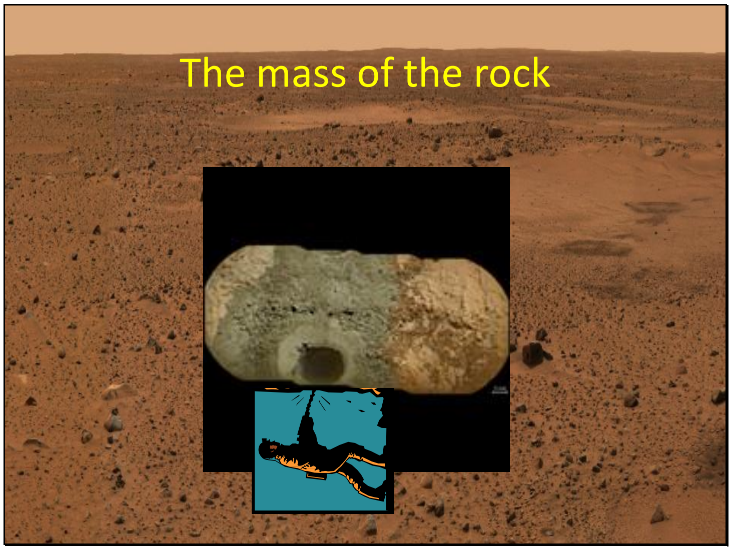
Slide 8



DISTANCE FROM THE CENTER OF SATURN: Explain to students that the gravitational pull of a planet lessens as the distance from the planet increases. For that reason, when they jump, gravity pulls them back to Earth but satellies can remain in orbit for years miles above Earth. For this reason, I want to make sure that once I move the rock from its orbit, that I maintain the distance from the center of Saturn constant. In the example here, if my rock was 25,350 kilometers from the center of Saturn when it was in its original position (A), when I move it to be it should still be 25,350 kilometers away when it is moved to position (B).

Illustration: http://apod.nasa.gov/apod/image/saturn_2moons.gif

Slide 9



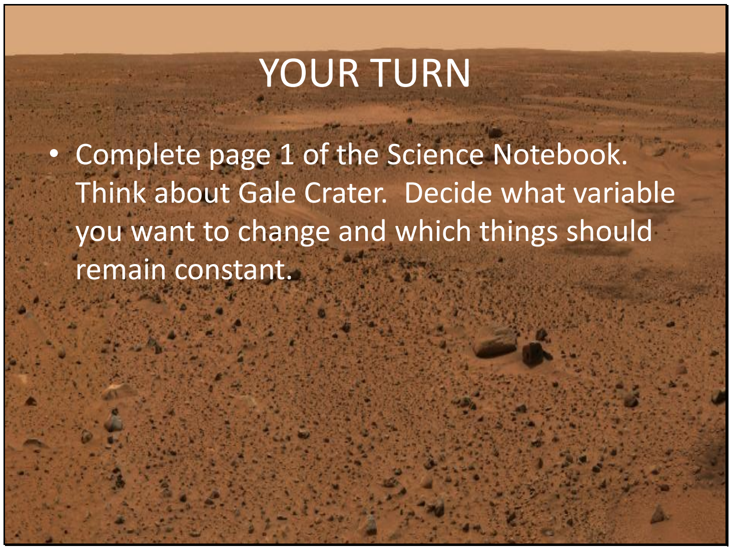
THE MASS OF THE ROCK: In lesson 6, one of my ideas for moving the rock from the ring into a new orbit was to drill holes into a stone and pull it into its new orbit using cables. However, doing this runs the risk of changing the mass of the rock. During the drilling, bits of stone could break away and lessen the mass of the rock. If the cables I attach are left on the rock permanently, this will add mass. If the rock is lighter or heavier than it was in its original position, it might behave differently in its new orbit. To account for this, I would want to leave the rock in its original orbit after drilling for a while to make certain it does not behave differently. Once we know that the change in mass hasn't changed its behavior, then I could move it to its new orbit.

In the same way, if I planned on leaving the cables I attach to the rock, I would want to attach them while the rock is in its original orbit and observe it to see if its behavior change. Once, I am certain that there isn't a change, then I could pull the rock into a new orbit.

In this way, I eliminate the possibility that a change in mass could affect measurements of my variable.

Illustration:
http://www.jpl.nasa.gov/spaceimages/images/thumbnailhires/PIA16765_hithumb.jpg

Slide 10


YOUR TURN
• Complete page 1 of the Science Notebook. Think about Gale Crater. Decide what variable you want to change and which things should remain constant.