## II. Dependability: Nature is Reliable and Consistent (Day #2)

A. Introduction: All physicists believe that nature is dependable.
   1. Things in nature can be counted on to behave always in the same way.
   2. No matter who asks the questions about nature, the answers should be the same.
      a. For example: If a physicist finds a new atomic particle in an experiment in Berkeley, California. Then, another physicist should be able to duplicate these findings in an experiment in Novosibirsk, Russia.
   3. You expect nature to be dependable, too.
      a. Shooting a basketball with the same push.
      b. Boiling an egg.

B. All scientists depend upon nature to be consistent. They expect the same set of conditions to always produce the same results.
   1. In the 17th Century, Isaac Newton discovered how gravity controls the motions of objects in space. In the 20th century, 300 years later, Newton's findings about gravity are still valid.
      a. The astronauts to the moon depended on Newton's discoveries about gravity to make the trip.
   2. When the same conditions do not seem to produce the same result, physicists ask why. This is how they question nature.
      a. In the 16th century, Galileo measured how long it took balls to roll down a grooved board. He found a mathematical relationship between the length of time the balls rolled and the speeds they reached.
      b. In the 17th Century, Newton shined a light through a glass prism and is discovered that white light was composed of different colors.
      c. The same activities are done today in science classes all over the world.
   3. Scientists study the past as well as the present.
      a. Geophysicists who study the earth try to determine it's age by measuring how much radioactivity remains in certain minerals. They can determine how long the mineral have been in existence by assuming the rate of radioactive change has been the same for millions of years. (They are depending on the consistency of nature).
      b. Astrophysicists study stars that are tremendous distance from the earth. Light from these stars has taken many years to reach the earth. The events on these stars that are just being seen now took place thousands of years ago. The events on distant stars seem to follow the same patterns as the events on stars much closer to the earth. (The rules of nature that are working now were working thousands of years ago.)

c. Nature is consistent in time.

## C. Questions:

1. What can scientists rely on in their work?
2. Why will scientists list exactly what they have done to get a result?

3. Why would you expect the same result from bouncing a ball in your yard as you would from bouncing a ball in your neighbor's yard?

4. Why would you expect to get the same result from bouncing a ball on Friday as you did when you bounced it on Monday?

## D. Activity:

Part A: Materials: 1 liter pop bottle, medicine dropper, lid and water

1. Fill the 1 liter pop bottle with water. It should be almost full. Put enough water in the medicine dropper so that it barely floats.
2. Put the dropper in the pop bottle. Put the stopper in the top of the pop bottle.
3. Tighten the lid on the pop bottle with your dropper inside floating in the water. Gently squeeze the pop bottle and then release it. Keep the bottle right side up.
4. Squeeze the pop bottle a second time, then release it. Be sure you tightened the lid.
5. Test to see if it matters who squeezes the pop bottle. Have your lab partner squeeze the pop bottle.
6. What happened to the dropper when you squeezed the pop bottle?
7. What happened when you stopped squeezing the pop bottle?
8. What happened the second time you squeezed and released the pop bottle?
9. What happens if you squeeze and release the bottle a few more times?
10. What happened when your lab partner squeezed the bottle?
11. Does it make any difference if the bottle is squeezed by someone who is tall or short, male or female, blond or brunette?
12. How different are conditions in the tube if different people squeeze the bottle just as hard?
13. How consistent was nature in this activity?

Part B: Material: String, paper clip, washer, tape

1. Take a piece of string about 60 cm long. Bend a paper clip into a hook. Tie it to one end of the string.

2. Tape the other end of the string to the table.
3. Hang a washer on the hook. (Create a pendulum)
4. Pull the washer sideways about 10 cm. (the width of your hand)
5. Let the pendulum go. Count the number of swings (full round trips) it makes in one minute.
6. Pull the pendulum aside 10 cm and let it go again. Count the number of swings for one minute. Repeat this action a third time.
7. Change conditions a little. Pull the washer sideways about 20 cm (two hands). Count the swings in one minute.
8. Have different people start the pendulum and count the swings per minute.
9. How many swings did you get per minute the first time?
10. How many swings per minute did you count for the second two trials?
11. How do the first three trials compare?
12. What was your count when you pulled the washer sideways 20 cm?
13. How does this compare with the shorter pull?
14. What was you count of the swings per minute when different people started the pendulum?
15. Does it matter who pulls the washer if nothing else is changed?
16. Do your results show that nature is reliable? Explain your answer.

## C. Key FACTS and CONCEPTS:

1. Nature is dependable.

2. The same set of conditions will produce the same set of results.

3. The same test today will produce the same results as it did in previous centuries.