Take Home Quiz:

(Use the story and your textbook to answer these questions)

Describe the difference between mass and force?

Identify a tool which measures mass:

Identify a tool which measures force:

If Neil Armstrong shot an arrow on the moon, what two forces would act on the arrow?

Would either of these forces change, if he shot the same bow and arrow on Earth?

Which one?

Neil Armstrong Shoots a Bow and Arrow on the Moon

Imagine that you are Neil Armstrong, the first person to set foot on the moon. You have brought a bow and arrow with you to the moon. You really had to be sneaky, because no one really knows what will happen if you shoot an arrow from a bow on the moon. Before you, no one has even been to the moon, they only dreamed about it! While you are waiting for your partner, Ed "Buzz" Aldrin, (the second person to set foot on the moon) to exit the landing module, you decide to do a couple experiments of your own. You take out your bow and arrow, your balance scale, and your grams/newtons pull spring scale, and begin to investigate a few things.

You can feel that there is less gravity on the moon. When the scientists back on Earth stood you on the Super Balance Scale wearing your space suit and gear, the scale showed 159 kilograms (350 pounds)! On the moon there is one-sixth the gravity. It is a strange sensation! You bounce around for a few minutes -- laughing. It is a good thing you turned down the micro-phone volume on your communicator.

You put the Super Balance Scale down in the moon dust. When you step on the balance scale, you should have one-sixth the mass as on Earth. You step up on the balance scale, and … what? You still have the same mass, 159 kilograms (350 pounds)! Oh, wait! You remember! You still have the same mass on the moon as you do on Earth. You still have the same amount of matter making up your body.

You take out your bow, and set it on the Super Balance Scale. On Earth, when you set the bow on the balance scale, the scale measured 1.4 kilograms, or 1400 grams (3 pounds). You set the bow on the balance scale, and sure enough, the scale still measures the bow at 1.4 kilograms, or 1400 grams. The bow has the same mass.

Now you decide to do some tests with the spring scale. You hold up the spring scale, and pull the hook at the bottom with your finger to test it out. It still works! You hang the bow by the middle of the string on the spring scale.

On the moon, there is one-sixth the force of gravity pulling on the object. You hang the bow by its string on the scale, and it is only being pulled by one-sixth of the gravitational force of what it is pulled by on Earth. It only weighs 233.3 grams (0.5 pounds).

Force is measured in newtons. The force of gravity pulling on the bow on the moon is 2.2 newtons of force. Now, you are going to see how far you can shoot the arrow! You look around to make sure "Buzz" isn't out of the lander yet. First, you are going to test the force of the bow. You hold the bow up, as if you are going to fire an arrow, but instead of nocking an arrow, you put the hook of the hanging scale around the middle of the string. When you did this on Earth, you pulled the string back 25 centimeters (approximately 10 inches) from the grip, and the scale measured 5 kilograms, or 5000 grams (11 pounds). You pull

the string back 25 centimeters (~10 inches) from the grip, and, sure enough, the spring scale measures 5 kilograms, or 5000 grams (11 pounds). On the spring scale, 5000 grams is 49 newtons of force.

The elastic force of the bow is 49 newtons when it is pulled to 25 centimeters. The elastic force of the bow is the same on Earth as it is on the moon. Knowing this, do you think the arrow you shoot on the moon will travel a longer distance or shorter distance than the arrow you shoot with the same bow on the Earth?