Name _____
Clark
Science Period _____
Date _____

LAB/PROJ11

Due 9/24

NO FIX

Playing Around on Mars

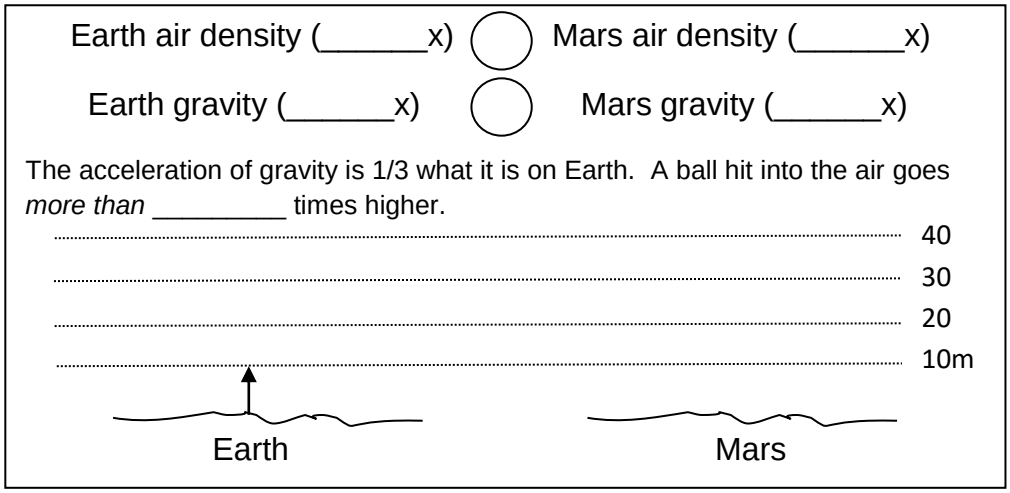
TSWBAT: understand and explain gravity and air density.

Scientific Question (problem):

How does the thin air and lower gravity of Mars affect how things move on Mars?

Background Research Notes:

- The air on Earth is 100 times denser than the air on Mars. So objects that fly through the air produce 100 times less lift on Mars than they do on Earth.
- The gravity on Mars is about 1/3 the gravity at the surface of Earth. Because of this, things fall with about a 1/3 the acceleration they do on earth. (Acceleration is the change in speed of an object.)
- Do the following to complete the research:
  - ✓ Complete the picture below using the facts above: (*how many x)* and < *or* >
  - ✓ *Draw an arrow for height of ball thrown up on Mars*



Activities:

1. **Basketball and Volleyball *(Show your work!)***

You can jump _____ times higher on Mars.
How high can you jump? _____cm. How high would you be able to jump on Mars? _____cm.

2. **Weight on Mars *(Set this up as a ratio. Show your work!)***

Since Mars has less gravity than Earth, you would weigh 62% less than you do here on our home planet. Every 10 pounds on Earth only equals 4 pounds on the Red Planet. How much would you weigh on Mars? (Show your work!) _____lbs.

3. **Baseball**

Since the acceleration of gravity is 1/3 what it is on Earth, a ball hit into the air stays in the air for *more than* 3 times longer. It goes *more than* _____ times higher. You can hit a ball *more than* _____ times further. It is "more than" _____ times because the air drag is so much less on Mars.
Since baseballs can be hit _____ times farther, fields will have to be _____ times longer and _____ times wider. Fielders will have to cover 9 times the area. Luckily they have a longer time to do it. Unluckily their top speed on Mars is reduced. They may even have to use the kangaroo hop that astronauts on the moon found to be a good way to cover distance.

Pitchers cannot throw curve balls on Mars. Usually the threads on the spinning ball throw air to the side and make the ball curve by what is known as the Magnus effect. The air on Mars is _____ times less dense than the air on earth so the spinning ball gets little thrust from the little air it deflects (turns aside).

4. **Cheering for your favorite team *(Remember CAPS including restating the questions in your answer.)***

In order for sound to travel, there has to be something with molecules, like air or water, for it to travel through. On Earth, sound travels to your ears by vibrating air molecules. In deep space, the large empty areas between stars and planets, there are no molecules to vibrate. There is no sound there.
On Mars, the air is 100 times less dense than the air on Earth. You would need to cheer louder on Mars for your favorite team to hear you.
Why would noises be quieter on Mars than on Earth and why? (*Hint: density*) _____
_____
_____

5. **Frisbee *(Simple math)***

A Frisbee on Mars has 100 times less lift than on earth but there is only _____ of the gravity. So a Frisbee on Mars has an effective lift of 30 times (100/3 = _____ %) less than on earth. To understand what this feels like, imagine trying to throw a Frisbee that is 30 times heavier. (It would be like throwing a hub cap.)

6. **Falling**

It's not a sport, but it can happen while playing many sports! To drop to the ground from a given height only takes 1.7 times as long on Mars.

7. **Golf**

Mars is one big sand trap. At least there are no water hazards, but there are no greens either.
Hooks and slices will be 100 times smaller per second of flight time for the ball due to the 100 times thinner atmosphere. The drives will be in the air _____ times longer and go _____ times further.

8. **Impossible Leap *(Remember CAPS including restating the questions in your answer.)***

Try this gravity exercise: stand up and bend over, touching your toes. Bend your knees slightly and try to jump forward without moving your hands from your toes.
What happens? _____
Here's why: Because jumping causes a shift in your center of gravity toward the direction you are jumping, you have to maintain balance by also moving your support base. In order to jump forward, you would need your toes, but since your fingers are in the way it will not work. However, you will see that you can jump backwards or even side to side, because your heels are free to use for balance.

9. **Paper Airplanes *(Simple math)***

Paper planes would not fly well on Mars; there is _____ times less lift in the thin air of Mars but also _____of the gravity.
You can model the flight of paper planes on Mars here on earth by folding a paper plane from _____ sheets of paper, giving it the same lift as a normal paper plane but _____ times the mass.

10. **Skateboarding**

You get _____ times the hang time on Mars, you can Ollie _____ times higher, but you'll need to practice the timing. You can Ollie _____ times further.

11. **Swimming**

Even with 1/3 the gravity, you would still float exactly the same on Mars. The gravity pull on you is 1/3 what it is on earth, and the gravity pull on the water is too.
The speed of a swimmer is limited by the speed of the water wave they push along with them, thus swimming speeds on Mars would be 0.6 times what they would be on earth.

Adapted from: http://www.exo.net/~pauld/Mars/6play/playingonmars.html