Notes of Interest for Science of Tubing Lab Zones:

Zone 1: MASS

Use the electric scale inside the lodge. Weigh yourself. Weigh yourself carrying the tube. Record this for use with other zone data.

Zone 2: FRICTION

Use the spring scale and pull a loaded tube for 10 meters on a flat surface. Record the force used to pull the tube.

Correlate with data from the mass zone. You need to know mass of the object pulled.

Zone 3: AVERAGE SPEED

Use lanes one and two. Use three stopwatches for each tuber. Record and average the times. Use the flag to start the tuber and the stopwatches. Time the tuber for the entire length of the slope.

Zone 4: ACCELERATION AND INSTANT SPEED

Use a minimum of 10 (max of 18) timers, each standing on one of the red arks on the slope. (These markers are 10 meters apart). When the flag drops, the tuber starts and ALL stop watches start. Each timer should stop their watch when the tuber passes them. They should record their time and their position. This can be used to calculate the interval time between points and the rates of acceleration.

Zone 5: DECLERATION AND FINAL VELOCITY

You will need two stopwatches doing two separate functions. First watch times how long it takes to travel the last 10 meters of the run (before the run-out). These are red marks on lane eight. Start the watch as the tuber passes the first red mark...stop the watch as it passes the second red mark. Second watch times the total deceleration times. Start the watch when the tuber passes the first red mark and stop the watch when the tuber comes to a complete stop at the end. Calculate the speed (final velocity) using the time for the past 10 meters. This is really the start speed for the deceleration calculation. The ending speed is zero.

Zone 6: WORK AND POTENTIAL ENERGY, POWER

Using a spring scale pull a tuber (with the mass known from Zone 1) up a Slope similar to the lift line. Record the force needed to pull the tuber for 10 meters. Calculate the work done to pull a tuber the 500 – foot slope. How many tubers are on the lift at one time? Time how long it takes from the lift to pull one tuber to the top. Calculate the power needed.

Student Packet

SCIENCE OF TUBING PHYSICS ADVENTURE

The Rock Snow Park| 7900B W Crystal Ridge Dr |Franklin, WI |www.rocksnowpark.com|groups@rocksnowpark.com

Tubing at The Rock

All measurements and calculations will be done with the metric system.

Measurements are to be made at The Rock; the calculations, however, are best made in your classroom or at home. Check with your instructor, which is best for you.

PRINCIPLES YOU WILL STUDY AT THE ROCK:

WORK * POWER * FORCE * KINEMATICS * FRICTION * ACCELERATION * PRINCIPLES OF GRAPHING * RIGHT TRIANGLE TRIG

CONSERATION OF ENERGY
POTENTIAL ENERGY ~ KINETIC ENERGY

SPEED
AVERAGE ~ INSTANTAEOUS

Measurement at The Rock.

ZONE 1 - MASS

A. Determining the mass of you and your tube. Use the weight scale.
Measure weight of tube ____________ lbs. Tube mass _________kg. Measure your weight ___________ lbs. Your mass _________ kg. Tube + rider weight ___________ lbs.

Tube + rider mass _______kg.

1.0 kg = 2.202 lbs

B. MEASURE THE HEIGHT OF THE TUBING HILL

Using a 300 foot tape, measure the length of the hill from the top (starting point)to the bottom of the hill (as close to the bottom of the slope as possible.) See diagram below.

Record the angle. M ∠θ of hill = _____________ degrees.

From the data and right-angle trig calculate the height of the hill.
h = __________m

ZONE 2 - FRICTION

C. DETERMINE THE FRICTIONAL FORE BETWEEN THE TUBE AND THE SNOW.

Find a level section of ground covered with snow. Using a spring scale supplied by The Rock, apply a force that slowly moves the tube and its rider along the snow. While you concentrate on pulling the tube, a partner should position him or herself so that they can accurately read the spring scale. Repeat this procedure until you get consistent results. As your instructor suggests, you could repeat this procedure with other partners riding their tube and pulling the spring scale. Record this value of the force below. This force is the FRICTIONAL FORCE.

Frictional Force = ___________ pounds
Frictional Force = ___________ newton's

1 pound = 4.45 newton's

1. Calculate the coefficient of friction (u) between the tube and the snow.

$$u = \frac{F(f)\ (\text{newton's})}{\text{Weight of the tube and ride (newton's)}}$$

u = _______________

You may repeat this activity by placing a piece of material between the tube and the snow. The Rock will have the material available.

I. What difference do you notice when the material is used? Why?

What difference do you notice when the material is used? Why?

ZONE 3 – AVERAGE SPEED

D. MEASURING THE AVERAGE SPEED OF THE TUBE ON THE HILL

Have a student placed at the starting point with a flag, which they will wave when the tuber starts down the hill. Position three timers at the bottom of the hill and they will start their timers when the starter waves their flag. Stop your timers when the tuber passes your position. Using the length of the hill previously measured and the average time needed for a tuber to travel to travel from the marked starting point to the bottom of the hill, calculate the average speed of the tube.

Time 1__________ sec, Time 2___________sec, Time 3_________sec;
Average time _________sec.

V (ave) = ___________________m/s

ZONE 4 – ACCELERATION AND INSTANT SPEED

E. ANALYZING INSTANTANEOUS SPEED (CLASS ACTIVITY)

To more thoroughly study the motion of the tuber on the hill, times measured at different positions are needed. Pull the 300 ft tape to its full length. Position students with a time at 32.8 ft, 65.6 ft, and so on. (This is 10m) One student with a colored flag is positioned at the starting position. When the flag is waved, the tuber starts down the hill and all timers start their timers. As the tuber slides down the hill, timers stop their watch as the tuber passes by. Record the time and your position below. Circle your assigned position.

Position 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m

Record your measure time t = ___________sec

When you return to your classroom share your data with your classmates. Your teacher will guide you through the analysis of the motion. Plotting a graph of distance traveled by the tube versus elapsed time will help you discover the kind of motion the tuber underwent. Determining the slopes of the graph intervals will aid in determining the instantaneous speeds and also if the tube was accelerating. If so, at what rate?

ZONE 5 – DECELERATION AND FINAL VELOCITY

F. MEASURING OF FINAL VELOCITY

From the previous measurements of the height of the tubing hill and the mass of you and the tube, calculate the Potential Energy of the rider and the tube.

PE = ____________________Joules

Calculate the Kinetic Energy of the tuber near the bottom of the hill. To find the speed of the tuber near the bottom of the hill, place a partner with a colored flag 3.28 ft uphill from the bottom of the hill. Position three partners at the bottom of the hill with timers. When the tuber who started their slide at the top of the hill passes the flag person, the flag is dropped and at the same time the timers start their watches. They stop their watches when the tuber passes them. (1) Record the times.

timer 1_____ sec timer 2_____sec timer 3_______sec ave time _____sec

(2) Calculate the average speed for this 10 - meter interval.

V (ave) = __________________m/s

This speed is an instantaneous speed at the bottom of the hill. (3) Using this speed and the mass of you and the tube complete your calculation of KINETIC ENERGY. (4) Compare the PE at the top of the hill with the KE at the bottom of the hill. (5) Which is larger? Why?

G. USING THE COEFFICIENT OF FRICTION

Using the equation, a = ug, (1) calculate the negative acceleration as you coast to rest when reaching the bottom of the hill.

A = ___________________m/s^2

$$X = \frac{Vf - Vo}{a}$$

(3) Measure the actual distance and compare the values. (4) Why are they not the same? (5) Which is greater? Why?

ZONE 6 – WORK, POWER, AND POTENTIAL ENERGY

H. WORK

How much work is done to pull you up the hill by the tow machine? Calculate the work done as you are pulled up to the top of the hill.

W = _________________Joules

1. Does the shape of the hill affect your results? Why or why not?
2. How does this value for WORK compare with your value of POTENTIAL ENERGY

I. POWER

How many horsepower does the tow motor develop when it pulls you up the hill? For this calculation, use the previous calculation for work and time how long it takes to pull a tuber to the top of the hill from the bottom.

W = ____________________ Joules

t = __________________ sec

P = ___________________watts

P = __________________horsepower

746 watts equals 1 horsepower

Ask a Rock staff member the rated horsepower of the tow motor. Compare your value to the rented value.

1. How do they compare?
2. Why are the two values not close?