THE SCIENCE OF SNOW TUBING

Presented by:

WILD CHUTES SNOW TUBING AREA at

Wild Mountain
SKI /SNOWBOARD AREA & SNOW TUBING

TEACHER EDITION

The Better Way To Discover:

WORK, POWER, FORCE, KINEMATICS, SPEED, ACCELERATION AND MORE…

All while making time for some exciting snow tubing down our 500' hill.

Contact us today!
(651) 465-6365 / (800) 447-4958

Reserve your discovery trip today before your date is sold out!

Your three-hour discovery trip includes tube rentals, effortless conveyor rides up the hill, and all the equipment needed to conquer your experiments and enjoy all the fun.

Available Weekdays (Non-Holiday)
Advanced Reservations Required
Minimum of 50 students
One complimentary chaperone per 20 students.

This lab is set up so that all measurements and calculations will be metric.

CALCULATIONS: (are provided to aid you with the completion of each necessary calculation)
Reminder: These lab activities can be done qualitatively as well as quantitively, depending on the math skills of your class.

A. CONVERTING FROM MPH TO m/s:

$$\frac{20 \text{ miles}}{} \times \frac{1\text{hr}}{} \times \frac{1609\text{m}}{}$$

1 hour 3600 sec 1 mile

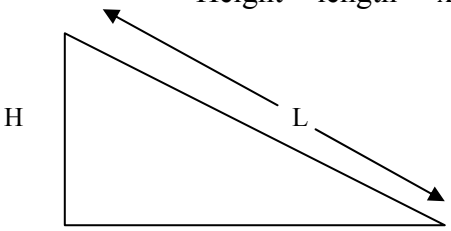
your weight in pounds x $\frac{1kg}{2.2\ lbs.}$ x $\frac{9.8 newtons}{1kg}$

B. WEIGHT IN POUNDS TO MASS IN KILOGRAMS:

Total weight in pounds x $\frac{1kg}{2.2\ lbs.}$

C. HEIGHT OF THE HILL:

Height = length x Sin Θ



D. COEFFICIENT OF FRICTION:

$U = \frac{\text{Force of Friction}}{\text{total weight}}$

total weight (pounds) x 1kg x 9.8 (Newtons)

$V\ (ave) = \frac{\text{change in distance}}{\text{change in time}}$

E. INSTANTANEOUS SPEED:

$V\ (inst) = \frac{\text{change in distance}}{\text{change in time}}$ (small time interval)

F. POTENTIAL ENERGY:

$PE = mgh\ \ (g = 9.8\ \frac{newtons}{Kg})$

G. HOW FAR WILL A TUBE SLIDE BEFORE COMING TO REST AT THE HILL'S BOTTOM?

A = ug (u is coefficient of friction)
(g is 9.8 m/s^2)

H. WORK:

W = mgh

I. POWER:

$P = \frac{mgh}{T}$ (power will be in watts)

Conversion: 1Hp = 746 watts

LEARNING GOALS

A. GOAL: Upon the completion of the activities, the student will have an enhanced understanding of the following concepts of physics on the macroscopic scale:

WORK * POWER * KINEMATICS * FRICTION * ACCELERATION * PRINCIPLE OF GRAPHING *
RIGHT TRIANGLE TRIG

CONSERVATION OF ENERGY:
POTENTIAL ENERGY and KINETIC ENERGY

SPEED: AVERAGE and INSTANTANEOUS

The student will:

1. Calculate the power required to haul a tuber up the hill.
2. Apply the principles of conservation of energy to determine the speed and acceleration of an object, while traveling down the hill.
3. Calculate the work needed to pull a tuber up the hill.
4. Calculate the work done by friction.
5. Use right triangle trig to calculate the height of the hill.
6. Apply Newton's Laws of Motion to explain the effect of forces on passengers.
7. Calculate the coefficient of friction.
8. Calculate the effect of friction bringing the tube to rest at the bottom of the hill.
9. Calculate potential and kinetic energy.

ATTITUDES

A. GOAL: Upon completion of the activities, the student will develop a positive attitude toward the physical sciences.

The student will:

1. Be motivated to study physics by being challenged with a meaningful task that allows them to predict personal experience.
2. Gain an appreciation of the physics involved on a tubing hill.

B. GOAL: Upon completion of the activities, the students will bridge the gap between schoolwork and life education by seeing them as not isolated from one another.

The student will:

1. Gain an appreciation of physical principles and how they are applicable, studied in the classroom to large-scale phenomena.
2. Be encouraged to work as a member of a team, in order to attain common goals.

What educational advantage is there for the student to travel significant distances and slide down a hill on a tube? This ideal laboratory allows students an opportunity to not only witness the laws of physics in operation, but also feel them. Tubing down the hill at Wild Chutes is fun, but also allows students to feel physics first hand and study what is happening.

Students may quantify their results or you may have them simply describe what they experienced with your guidance. To quantify their experiences, only simple equipment is needed. Wild Chutes Snow Tubing and Wild Mountain will provide all of the equipment you'll need. Using this equipment to gather the necessary data will allow the calculation of the following:

Average speed, instantaneous speed, force of friction, coefficient of friction, potential energy, kinetic energy, work and power.

Unlike textbooks, little data is given - data must be collected by students.

Pre-trip Preparation:

1. Instruct students to dress warmly and appropriately for several hours of outside activity in the snow and cold. Hats, gloves / mittens, snow pants, boots w/ good traction are some items to encourage.
2. Assign students to lab groups of four or more, which gives each group enough help to get the job done.

3. Remind students to follow all safety instructions. There will be an official from Wild Chutes to discuss these instructions with you. No restricted areas or safety zones are to be entered to obtain data. All data can be obtained from general public areas.

Organizational Suggestions:

1. Tell students exactly where and when to meet the bus.
2. A day or so prior to the trip to Wild Chutes, spend time with your class and go through the student section of this packet. Students will have a sense of how to use the pages most efficiently and familiarity will make the exercises less intimidating.
3. ON THE BUS there is a set of activities that you can have the students do. The bus trip will go faster and the time will be more educational.
4. Completing the entire set of exercises may be in your plans or you can pick and choose which sections you want the students to do. You could also assign different parts to different groups and then share the data back in the classroom.
5. When checking student answers, please remember that human reaction times vary and the results of the calculations depend on the accuracy of measurements made.
6. Considering the weather conditions and the number of calculations that your students may do, it is best to collect data at the hill and complete calculations later in the classroom or at home.

EQUIPMENT NEEDED

At Wild Chutes Snow Tubing, we'll supply just about everything you need to accomplish your successful Discovery Trip!

Wild Chutes Snow Tubing will provide the following equipment:

- Stopwatches
- Measuring tape
- Brightly colored flags
- Clipboards
- Dye (marking distance)
- Snow Tubes
- Sheet(s) of Material (coefficient of friction)
- Angel Finder
- Weighing Scale
- One Gallon or Larger Zip Lock Bag

Your class will have to provide:

- Your own staff at each zone to assist with the student's activities. (Wild Chutes does not provide a teaching staff at any zone.)
- Pencils, not pens.
- Extra note pads, if desired
- Bag lunches*

***CATERING OPTIONS:**
Add to your Discovery Trip by having a fun, economical, and tasty meal prepared and served by Wild Mt. Reservations and deposit are needed for food orders.

- Soup & Sandwich, pickle, chips, cookie & soda $7.50
- Sloppy Joes, chips, cookie & soda $5.50
- Homemade Chili, chips, cookie & soda $6.50

Our complete catering menu and value pricing is available online at www.wildmountain.com or upon request. For those who do not prefer catering, the Wild Chutes concession stand will be open, offering a basic snack bar menu.

Notes of Interest for Science of Tubing Lab Zones

ZONE 1: MASS

Use the electric scale kept inside the warming room.
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 mass zone. You need to know mass of the object pulled.

ZONE 3: AVERAGE SPEED

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 (excluding the run-out). Note the slope length is 500 feet. (Convert to meters).

ZONE 4: ACCELERATION AND INSTANT SPEED

Use a minimum of 10 (max. of 18) timers, each standing on one of the red marks 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 rate of acceleration.

ZONE 5: DECELERATION AND FINAL VELOCITY

You will need two stopwatches doing two separate frictions. 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 time. 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

Calculate the power needed to transport one tuber to the top of the 500' conveyor. Then calculate how large of a motor is needed to transport the maximum number of tubers allowed on the conveyor to the top at a rate of one tuber per 6'.

WORKBOOKS:

Record all data in your workbooks or shared worksheets and do all Calculations when you return to the classroom.

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