611-0082 (40-377) Friction Cube

Description: Show how different frictional characteristics affect the force required to move a stationary body. The friction cube includes 4 different surfaces on a two inch wood cube. The friction cube comes with a hook on one side for towing against inclined planes or other surfaces.

Warranty and Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

How to Teach with Friction Cube:
Concepts Taught: Friction; inclined plane; work; mathematical calculations (e.g., unit cancellation and algebra).
Curriculum Fit: Physical Science and Friction. **Grades 6-8 and up.**

Additional Materials Needed:

- 611-0035 Inclined Plane
- 611-0000 Spring Scale, 1 N/0.10 kg

Theory:

What is friction? It can be defined as: *a force that opposes, or resists, the motion when one body moves over another.*
What is force? It can be defined as: *a push or a pull, typically measured in Newton's (N).*
What is work? It can be defined as: *the product of the force exerted on a body and the distance that the body moves in the direction of the force.*

Experiment 1: Work and Efficiency on an Inclined Plane

General Idea: Using an inclined plane, measure work and efficiency. The student will pull the varying friction block surfaces up the incline (set at varying angles) and measure the force needed to pull the block the entire distance of the plane. Students will calculate the total work in each instance.

Procedure:

1. Students should set up the inclined plane on a flat surface and adjust the angle to 30°. To secure the angle, raise the support rod to meet the incline. Secure the rod to the incline with the thumb screw.
2. Attach the hook of the spring scale to the friction block with the sandpaper side facing down on the inclined plane. Measure and record in Table 1 below the force (N) required to pull the friction block up the entire distance of the inclined plane at 30°. Make sure that the force applied to the block is parallel with the inclined plane.

Table 1 – Average Force (N) to move Friction Block

	Force (N)
Sandpaper	
Vinyl	
Paper	
Wood	

Repeat step 3 with the vinyl, paper, and wood surfaces. Record the force (N) in Table 1 above.

3. Calculate the work done in pulling the friction block the entire length up the inclined plane.

Work (N•m) = Force (N) x Distance (m)

1 m = 100 cm
1 N•m = 1 Joule

Record the values in Table 2 on page 3.

Table 2 – Work (N•m) to move Friction Block

	Work (N•m)
Sandpaper	
Vinyl	
Paper	
Wood	

4. Students should repeat steps 1 – 5 at 10°, 20° and 40°. Data should be recorded in Table 3 below.

Table 3 – Force and Work at Varying Angles

		Force (N)	Work (N•m)
Sandpaper	10°		
Vinyl	10°		
Paper	10°		
Wood	10°		
Sandpaper	20°		
Vinyl	20°		
Paper	20°		
Wood	20°		
Sandpaper	40°		
Vinyl	40°		
Paper	40°		
Wood	40°		

5. Students should record their observations about how force changes based on the angle used.

_____

_____

6. Optional – Calculate the coefficient of friction.

   a. Weigh the friction cube on a top loading balance. Record weight below.

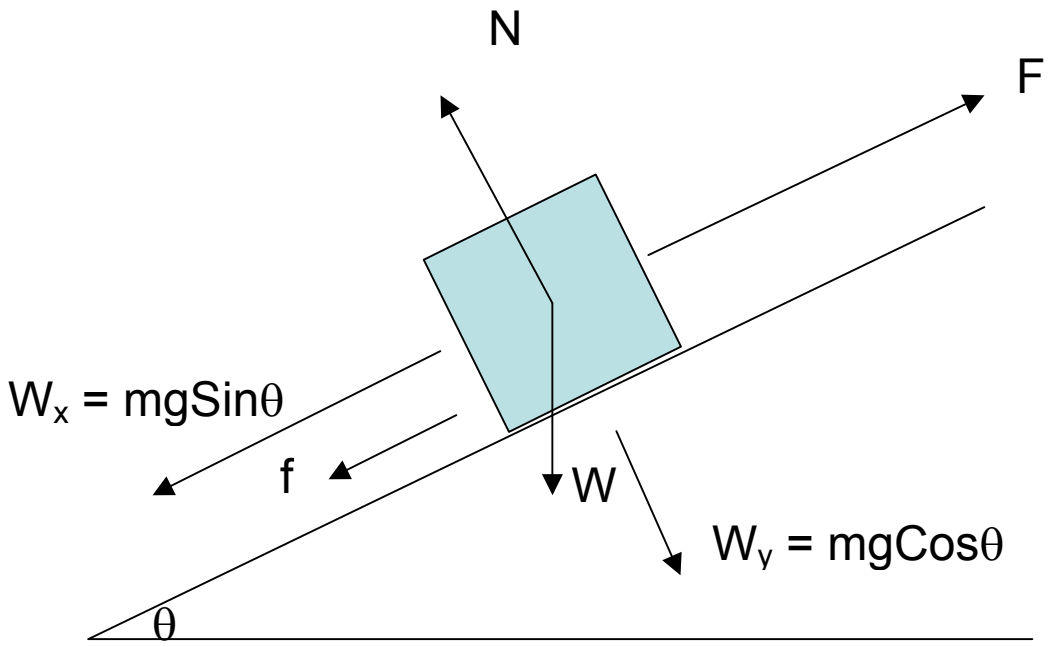
      Friction cube mass = _____ (g)

   b. Using the force (N) values from Table 1 for each side of the friction block, calculate the coefficient of friction for each surface as follows:

      Coefficient of friction (F) = f_d + mgsinθ
      Where,

      f_d = F - mgsinθ

m = mass (g)
g = gravity (9.8 m/s^2)



Record values below.

Coefficient of friction sandpaper = _____
Coefficient of friction vinyl = _____
Coefficient of friction paper = _____
Coefficient of friction wood = _____

c. Make observations about the values above by speculating on how a smooth plastic surface of a friction cube would compare to the materials above versus a rougher piece of felt. Also, discuss how the static friction is different for each surface (sandpaper, vinyl, paper, and wood). Why is this the case?

_____
_____
_____
_____
_____
_____

Theory behind static and dynamic friction:

Static friction is defined as the force between two objects that are not moving relative to each other. The coefficient of static friction is denoted, μ_x. For example, static friction can help to prevent an object from sliding down a slope. A real world example is the force that prevents a car wheel from slipping as it rolls on the ground. The point of the tire in contact with the ground is stationary relative to the ground.

Kinetic (dynamic) friction is defined as two objects moving relative to each other and rubbing together, like a sled being pulled along a flat surface. The coefficient of dynamic friction is denoted, μ_k. Dynamic friction is usually negative work and it works to slow an object down.

In general, the static friction value is greater than the dynamic friction value.

BENCHMARKS AND STANDARDS

Benchmarks for Science Literacy	National Science Education Standards
Motion Grade 6-8 4F/M3a	**Physical Science 6.2b Grade 5-8: Motions and Forces**
An unbalanced force acting on an object changes its speed or direction of motion, or both.	**Motions and Forces: If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.**

Related Products:

Science First® *is a designer and manufacturer of hands-on science labs. Our products are available from most science education distributors. For more information contact us.*

615-3015 Friction Rod Kit - Learn about static energy the way the ancients did - create electric charges and experiment with them. Contains 3 rods, 3/16 x 8" long - glass, acrylic and hard rubber; and 3 pads - cotton (12 x 12"), faux fur (fabric pad) and silk (12 x 12"). Instructions include experiments. Meets many curriculum requirements!