

U of T Lab Practical 1

Physics, Forces, Motion

Jason Harlow



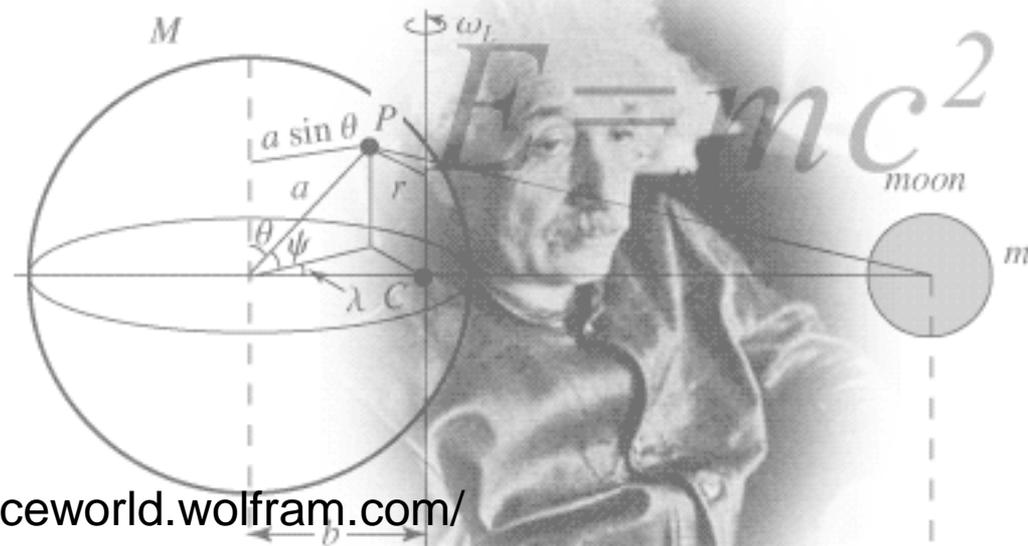
*University of Toronto,
Department of Physics,
St. George Campus*

What is Physics?

- According to wikipedia:

“Physics is a natural science that involves the study of matter and its motion through spacetime, as well as all related concepts, including energy and force. More broadly, it is the general analysis of nature, conducted in order to understand how the universe behaves.”

- Physicists try to understand nature by observing nature and looking for patterns and principles which explain things.





Physics UNIVERSITY OF TORONTO

<http://www.physics.utoronto.ca/>



- 55 Researching Faculty
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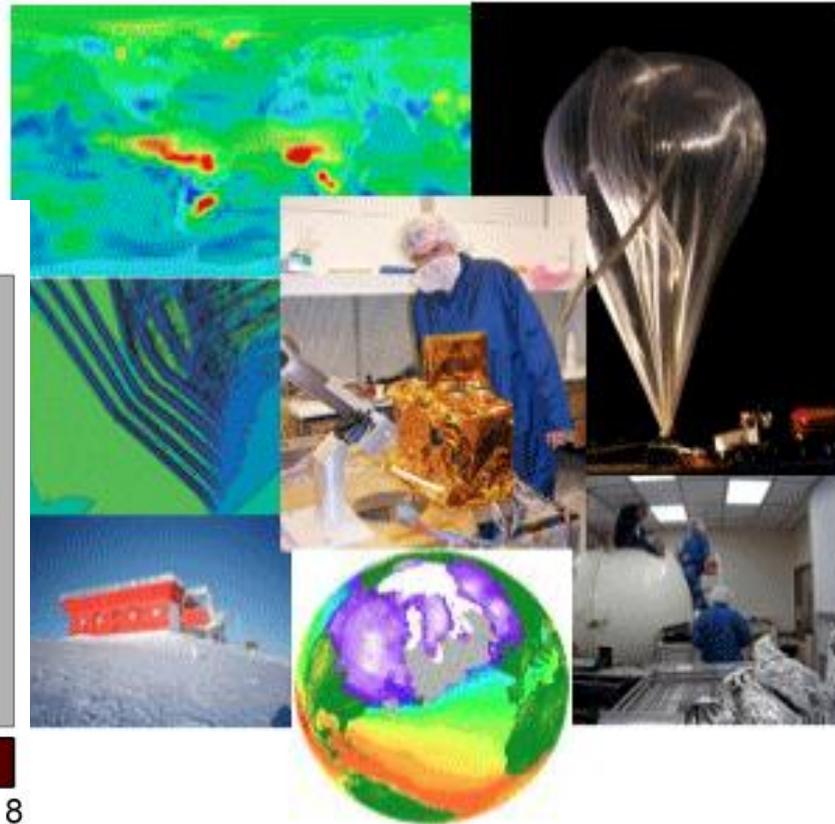
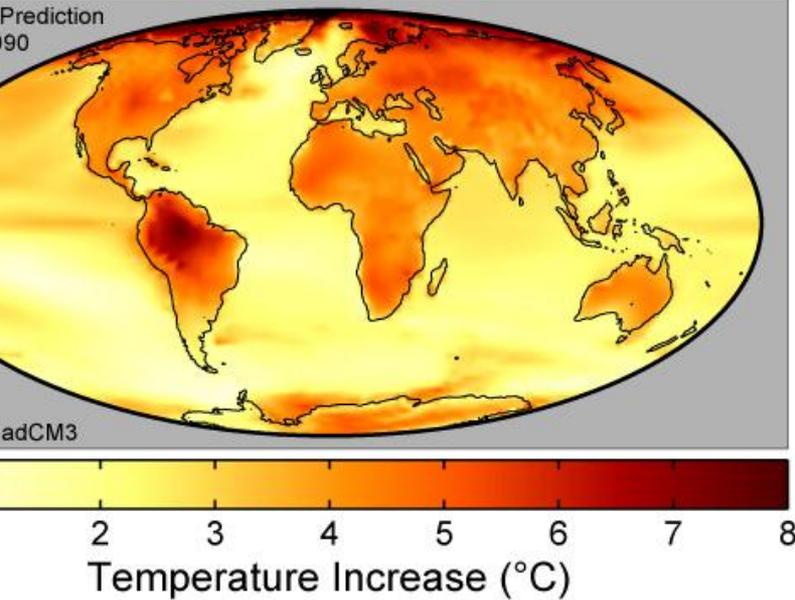


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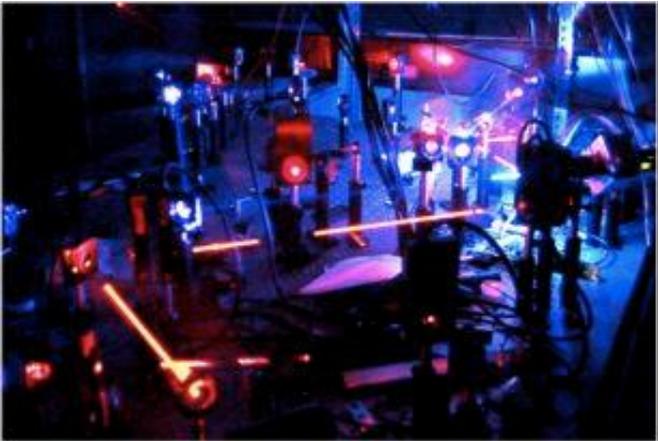
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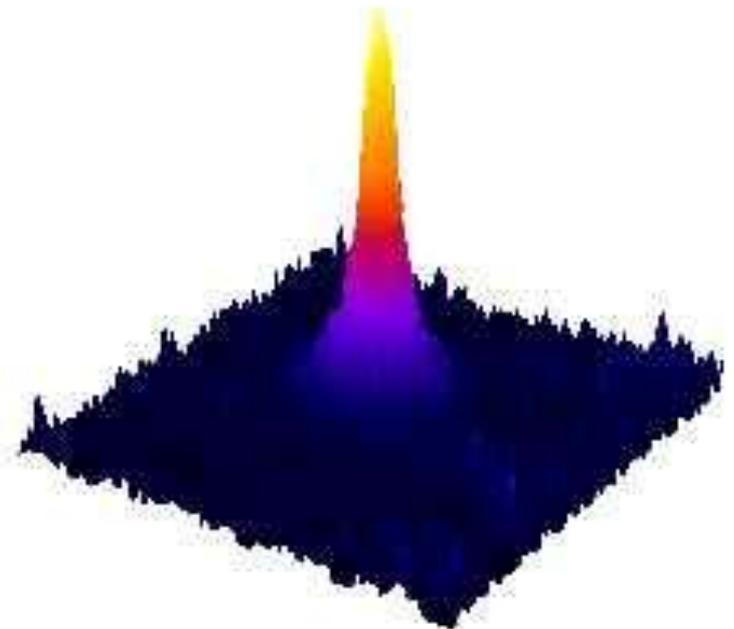
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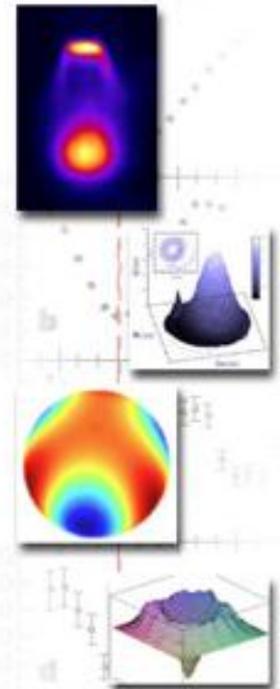


RESEARCH

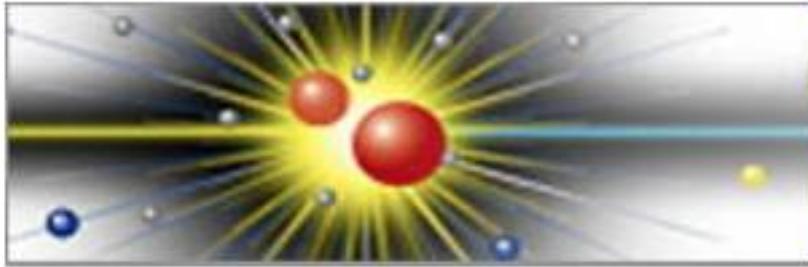
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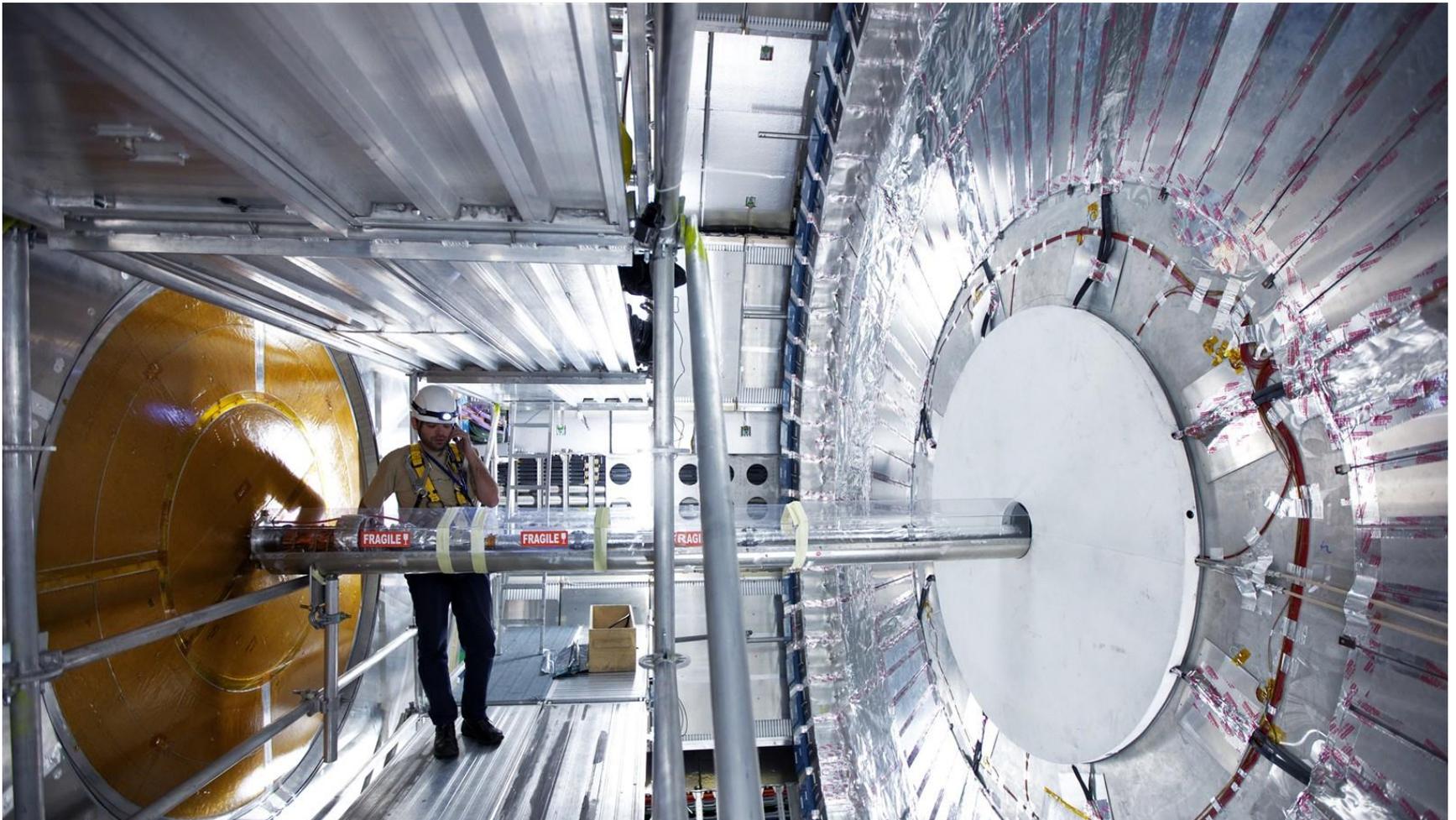
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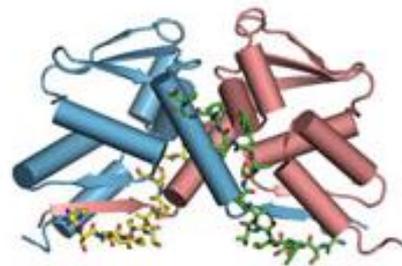
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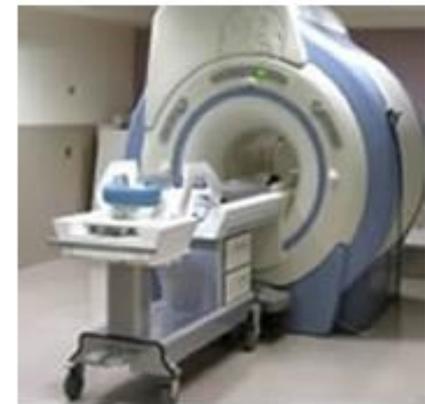
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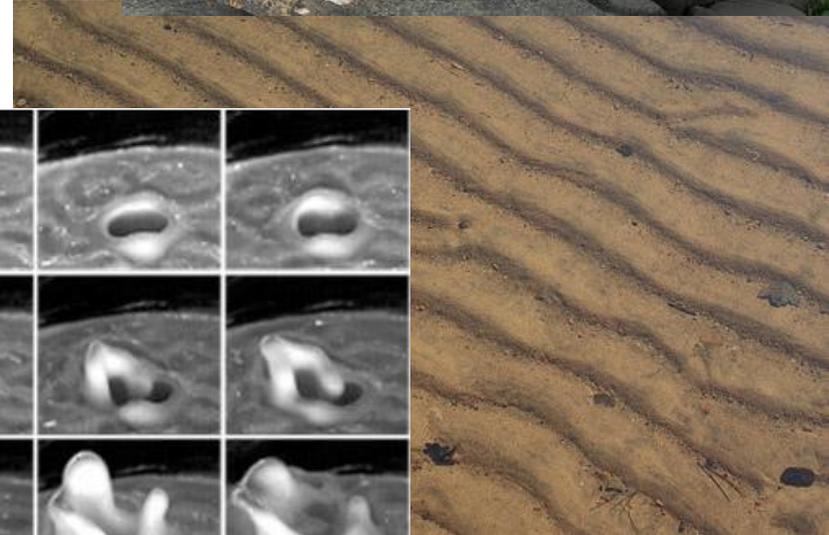
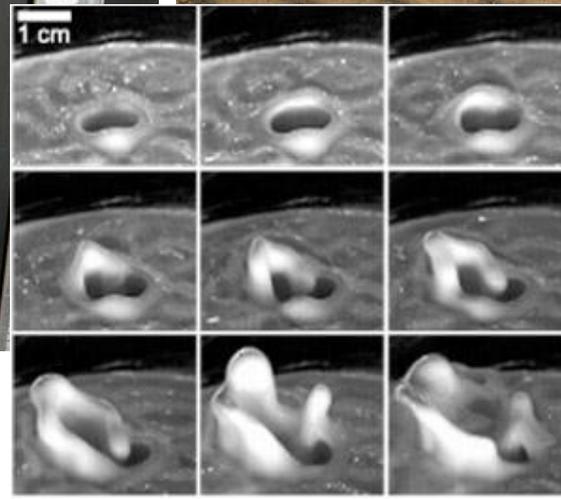
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Starch and water scene of TBBT.

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Today's Workshop

let's begin...



- Form groups of 3 or 4
- Introduce yourselves – write your name on your worksheet, and the names of all your team-mates
- Have a look at your equipment – the fan accessory will need 4 AA-batteries

Motion

Chapter 1: Sections 1.1 to 1.3





Translational Motion



Circular Motion



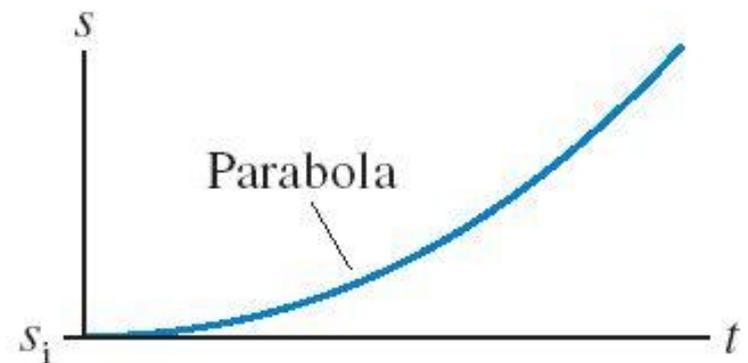
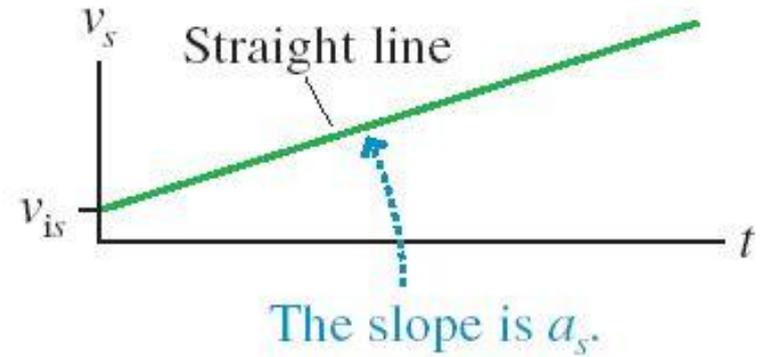
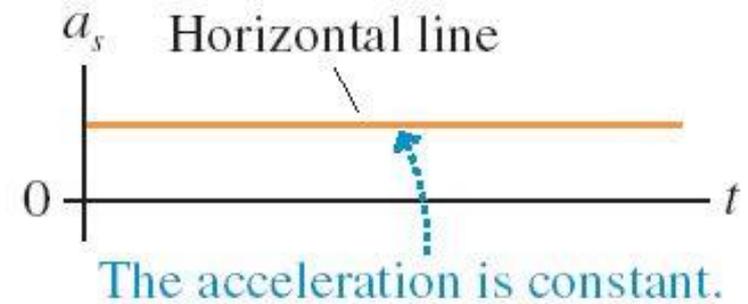
Projectile Motion



Rotational Motion

- The rate of change of velocity over time is called **acceleration**.
- The rate of change of position over time is called **velocity**.
- Position, or distance. Your ***motion sensor*** actually measures this, using echolocation.

(b) Motion at constant acceleration



Mechanics Module 2, Activity 10: Introduction to the Motion Sensor

- Try it out on the cart as you move it toward and away from the sensor.
- Stack 3 quick graphs of x vs t , v vs t and a vs t .
- Comment on the “smoothness” of the position, velocity and acceleration graphs.



(about 15 minutes)

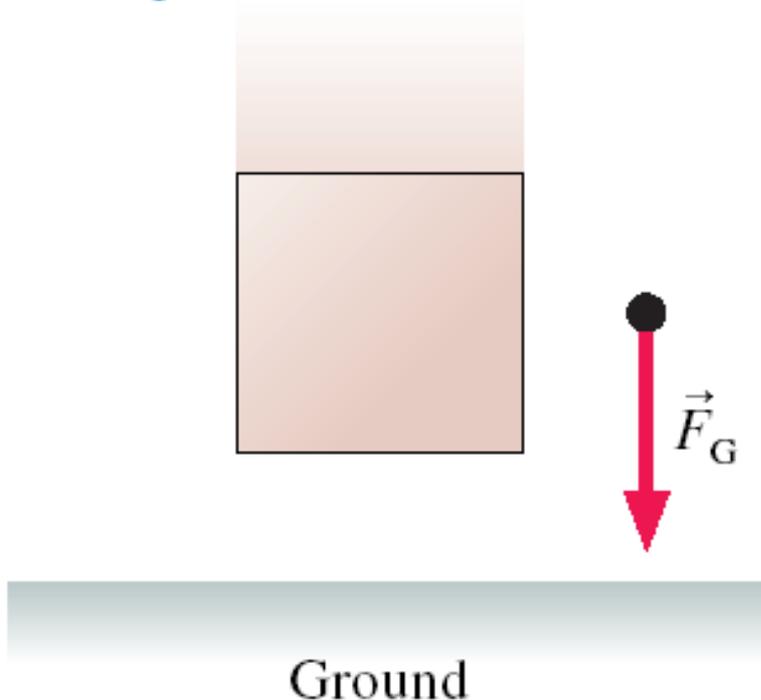
What is a force?

- A force is a push or a pull on an object.
- A force is a vector. It has both a magnitude and a direction.
- The magnitude of a force can be measured in the S.I. unit of “Newtons”. (But you can come up with your own unit!)
- The force of gravity on 1 kg = 9.8 Newtons.
- 100 pounds = 445 Newtons
- A force always requires two objects: an agent and a recipient. Something does the pushing or pulling, and something else gets pushed or pulled.

A Short Catalog of Forces

FIGURE 5.3 Gravity.

The gravitational force pulls the box down.

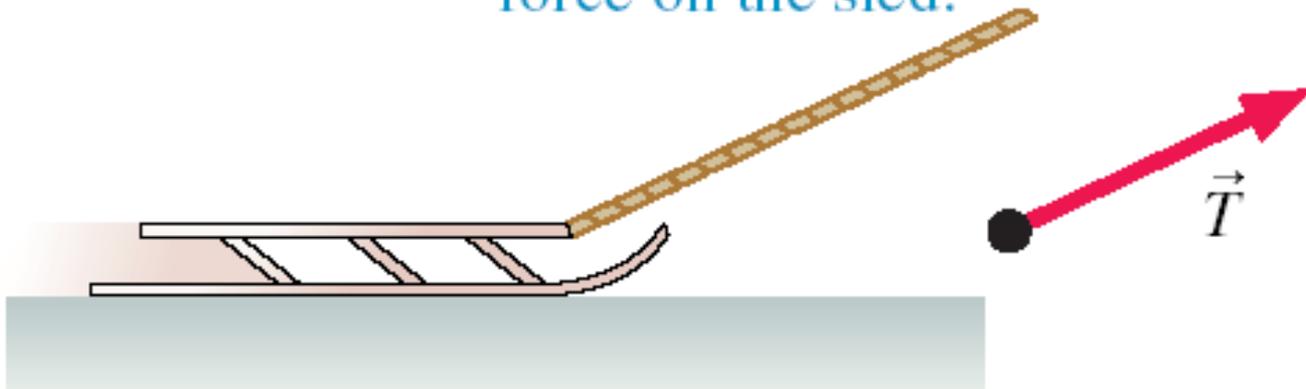


$\vec{F}_G = m\vec{g}$ when the object is close to the surface of the Earth. vector- g is 9.8 m/s^2 , toward the centre of the Earth (down).

A Short Catalog of Forces

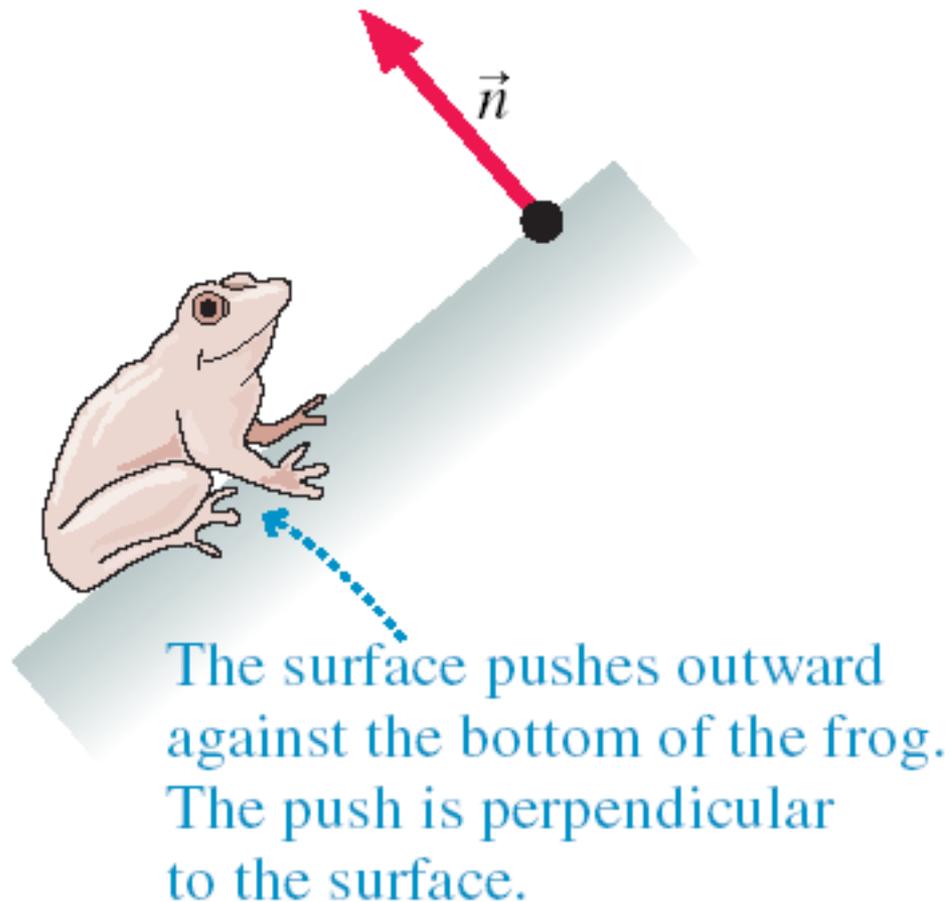
FIGURE 5.5 Tension.

The rope exerts a tension force on the sled.



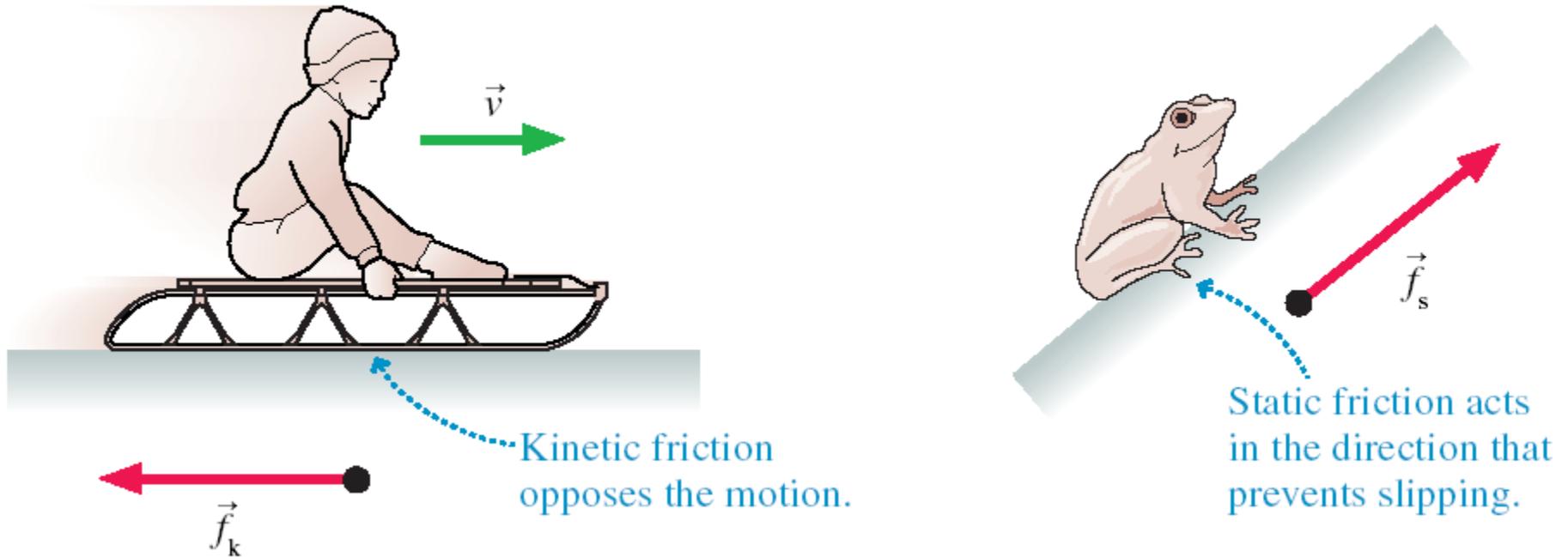
A Short Catalog of Forces

FIGURE 5.9 The normal force.



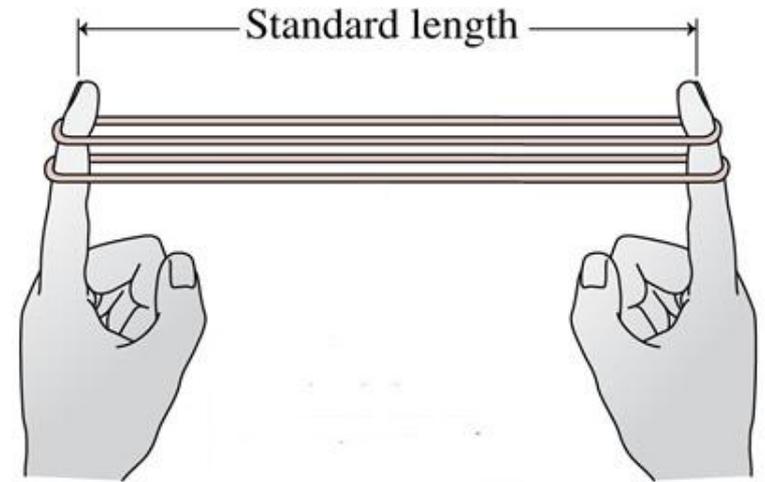
A Short Catalog of Forces

FIGURE 5.10 Kinetic and static friction.



Mechanics Module 2, Activities 12, 13: *What does “force” feel like?*

- Come up with your own unit for force – your team should choose a name.
- Compare your intuition about forces and adding forces to a measurement.



(about 10 minutes
each, 20 minutes total)

1

Newton's First Law

The natural state of an object with no net external force on it is to either remain at rest or continue to move in a straight line with a constant velocity.



2

Newton's Second Law

The acceleration of an object is directly proportional to the net force acting on it, and inversely proportional to its mass.

$$a = \frac{F_{\text{net}}}{m}$$



Mechanics Module 2, Activity 14: Kinematics of Constant Acceleration

- Combine a measurement of acceleration with a measurement of force to test Newton's 2nd Law:

$$a = F/m$$

(about 20 minutes)



Proper units:
 F in Newtons
 m in kilograms
 a in meters / sec²

Clean-up Time!

- Please carefully remove the batteries from the fan accessories (the small yellow screwdriver may help!)
- Place the 4 batteries back in the little bag.
- The cart stays on the track. Place all other loose items back in the bins.

Thanks!

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Department of Physics*