Intro Physics

The Physics Playground

Week 1

Kinematics - Motion

Week 2

Dynamics - Forces

Week 3

Energy Conservation

Week 2 Homework Review

Week 2: Forces and Free-Body Diagrams
Physics Playground Worksheet

Instructions:

- Draw a free body diagram for each of the situations by drawing a small circle to represent the item in question, and arrow for each of the forces acting on it.
- Make sure to consider length and direction of the arrows. Longer arrows for larger forces.

Example Problem:

A block is resting on a table on earth. Draw a free body diagram for the block.

note: the F_g arrow indicates the gravitational force pulling the block down, from being on earth in its gravitational field. The F_N arrow indicated the Normal Force from the table pushing up on the block. Since the block is stationary, the net force must be zero. This is shown by the two arrows being the same length.

Week 2 Homework Review

Practice Problems:

1. A ball is free-falling towards the ground on earth. Ignore air resistance. Draw a free body diagram for the ball.

2. A block is hanging from a spring on earth, and is not moving. Draw a free body diagram for the block.

3. A rocket is taking off from earth, and is accelerating up from the force of its engine. Draw a free body diagram for the body of the rocket.

Conservation Laws

Cube Conservation example - Isolated/Closed Systems

Conservation of Energy, Momentum and Charge

Conservation of Energy

Kinetic - Energy of Motion

fast vs. slow

high mass vs. low mass

Potential Energy - Stored Energy

based on position

Conservation - Pendulum Example (high k, low g)

Kinetic Energy

Energy of Motion

Fast vs. Slow, Massive vs. Not

Kinetic Energy = $\frac{1}{2} * m * v^2$

Example of block at constant velocity, solve for KE

Energy Plot Hands-on

Potential Energy

Energy stored due to position

Gravitational

Gravitational Potential Energy = $m * g * h$

Spring

Spring Potential Energy = $\frac{1}{2} * k * x^2$

Energy Plot Hands-on

Internal Energy

System vs. Object

Drop cube on table, where does energy go?

Two cubes attached with spring, define as system, compress and release

Energy Plot Hands-on

Energy Examples - drawing Energy bars at times

Block falling and hitting anchors on way down

Mass hanging from spring

Sling shot

Week 4

Review and Projects

Overview

Kinematics - Motion

Dynamics - Forces

Energy - Conserved Quantity

Kinematics

Displacement - how far

Speed - how fast

Velocity - how fast and in what direction

$$v = \Delta d / \Delta t$$

Acceleration - change in velocity

$$a = \Delta v / \Delta t$$

Dynamics

Newton's Laws of Motion

1st: Objects in motion stay in motion at a constant velocity, objects at rest stay at rest, unless acted on by a net force

2nd: $\Sigma F = m * a$ or $a = \Sigma F / m$

Gravity Force: $F_g = m * g$

Spring Force: $F_s = k * x$

Normal Force: F_N = reactive force

Friction Force: $F_f \leq \mu * F_N$

Energy

Conservation Laws - define the boundaries of the system

Kinetic Energy - energy of motion

$$KE = \frac{1}{2} * m * v^2$$

Gravitational Potential Energy - energy from position in gravitational field

$$PE_g = m * g * h$$

Spring Potential Energy - energy in spring from being stretched or compressed

$$PE_s = \frac{1}{2} * k * x^2$$

Internal Energy - energy inside of a system (includes Thermal energy)

Practice talking about Physics

Build your own simulation, and then describe the physics of it to the rest of the class in terms of:

- Kinematics
- Dynamics
- Energy