

Name \_\_\_\_\_

## Gravitational Potential and Kinetic Energies

➡ “Gravitational potential energy” (GPE) – the energy that is stored in objects because of their position above the earth

➡ “Kinetic energy” (KE) – the energy of movement

### Demonstration: Table Drop

Watch or do the demonstration and answer questions raised by the teacher.

### Experiment 1: Bucket Splash

Do the experiment and record your data in tables below.

Single object (varying heights)	Height of splash
Height 1 lowest	
Height 2	
Height 3 highest	

Objects of various mass (all from same height)	Height of splash
Mass 1 lowest	
Mass 2	
Mass 3 highest	

Just for fun, drop the object with the most mass from the highest position! It should make a big splash!

#### Hypothesis:

Based on the initial “table drop” demonstration and what the teacher explained about GPE and KE, complete the hypothesis:

**IF**...the object is dropped from a higher elevation into a bucket,

**THEN**...\_\_\_\_\_

**BECAUSE**...\_\_\_\_\_

## Experiment 2: Apple Swing

After completing or watching the experiment, **answer the following questions:**

At what point in the swing did the apple have the *most* GPE? \_\_\_\_\_

At what point in the swing did the apple have the *most* KE? \_\_\_\_\_

Does the GPE turn into KE? Explain your answer. \_\_\_\_\_

\_\_\_\_\_

Why did the apple not return to its exact starting position? \_\_\_\_\_

### Review:

- ✓ What is Gravitational Potential Energy?
- ✓ What is Kinetic Energy?
- ✓ What two factors are important in GPE?
- ✓ When does an object have the *most* KE?
- ✓ Explain conservation of energy?

# Gravitational Potential and Kinetic Energies

## Teacher Notes

“Gravitational potential energy” (GPE) – the energy that is stored in objects because of their position above the earth

“Kinetic energy” (KE) – the energy of movement

### **Demonstration: Table Drop**

Throw objects to a few students. Ask the students if the object is moving when it is in the air. They will say “yes.” If it’s moving, then it has “kinetic energy” (KE). It’s as simple as that. Next, drop an object onto the table from different heights and have the students decide which height produced the greatest amount of sound. Now drop different objects with different masses from the same height and have the students again decide which object produced the greatest amount of sound.

### **Teach**

If you drop an object on a table from different heights, the object will make more noise when it hits the table the higher it was dropped. This is because the object, before it was dropped contained “gravitational potential energy” (GPE). As the object hit the table, the energy was transferred first into kinetic (as the object fell), then into mechanical and sound energy when it hit the table. The higher the object, the more “potential” energy it receives *from gravity*. As it turns out, there are two factors that determine an object’s GPE: height, as we have just seen, but also mass. The more mass an object has, then the more GPE it has as well, even though it is dropped from the same height.

From the first experiment, you will want to explain GPE, and how height and mass can affect how much GPE an object has. You will also want to explain that energy can be transferred into other states. So, as the object is held in the hand, it has GPE, but when the object is dropped that GPE is transferred into the energy of movement, or KE. When it hits the table, the KE is transferred into mechanical, heat, and sound energy. In the next experiment, the *effects* of this potential energy will become more evident.

## **Experiment 1: Bucket Splash!**

### **Hypothesis:**

Based on the initial “table drop” demonstration, and what the teacher explained about GPE and KE, complete the hypothesis:

- **IF... the object is dropped from a higher elevation into a bucket**
- **THEN...** *(the splash will be greater and travel higher)*
- **BECAUSE...** *(the object’s height gives it more GPE)*

Using a large bucket, drop objects of differing masses and at differing heights into the bucket and measure the height of the splash on a meter stick. Make sure to use a round object as unusual shapes produce strange splashes! (I found this out empirically!). Record your data in the tables below.

Single object (varying heights)	Height of splash
Height 1 lowest	
Height 2	
Height 3 highest	

Objects of various mass (all from same height)	Height of splash
Mass 1 lowest	
Mass 2	
Mass 3 highest	

Just for fun, drop the object with the most mass from the highest position! It should make a big splash!

### Teach

Have the students tell you what kind of energy is in the object, first, as you are holding it in the air, second, as it is dropping, and third, as it hits the water. They should tell you that the object has GPE as it is sitting in your hand, KE as it is in the air, and mechanical and sound energy when it hits the water.

## Experiment 2: Apple Swing

Take apples and “drill” holes through the core. I used a large metal straw and just pushed it through the apples, thus capturing most of the core, but a drill will work! Then loop a long string through the apple and tie it off on one end. Next attach the other end to a high ceiling for best effect. Have the student stand against a wall, move the apple back to the face of the student, and then let it go. The object will go through a pendulum swing, then return back to the face of the student, but will not quite get back to its original position (WARNING: make sure student does not move or push the apple!). Best for the teacher to try this first!

### Teach

When you place the apple to the face of the student, it has GPE. That is because it has mass and it is sitting above the ground (even though it is attached to the string). When the apple is released, the GPE turns into KE, yet just after the half-way point, the apple will begin to slow down as it travels to a higher position (on the other side of the room). This means the KE is turning back into GPE. At the exact spot the apple stops (opposite to the position where it was let go), then it no longer has KE but only GPE. As the apple returns, the same thing happens. As the apple approaches the student’s face again, it will not come back to its

original position, but will typically be a few inches short of that, because of friction due to air resistance. This swapping back and forth is a fantastic example of the “conservation of energy” principle. Make sure the students understand it.

Take a video of the experiment, then play it back and have the students tell you when it has KE and when it has GPE. You can challenge them a little bit by asking when does it have the *most* KE and when does it have the *most* GPE.

**At what point in the swing did the apple have the *most* GPE?** (*At the top of the swing, just as it stops mid-air*)

**At what point in the swing did the apple have the *most* KE?** (*At the bottom of the swing – because it is going faster than at any other time in the swing*)

**Does the GPE turn into KE? Explain your answer.** (*Yes, because energy can't be created or destroyed*)

**Why did the apple not return to its exact starting position?** (*Because of air resistance or friction*)

### Review:

- ✓ What is GPE?
- ✓ What is KE?
- ✓ What two factors are important in GPE?
- ✓ When does an object have the *most* KE?