ScienceCube

Law of Conservation of Mechanical Energy

1. **Compare and explain the changes in potential energy and kinetic energy of a freely falling object.**
2. **Understand the process of mechanical energy conversion during the free fall of an object and explain the law of conservation of mechanical energy.**

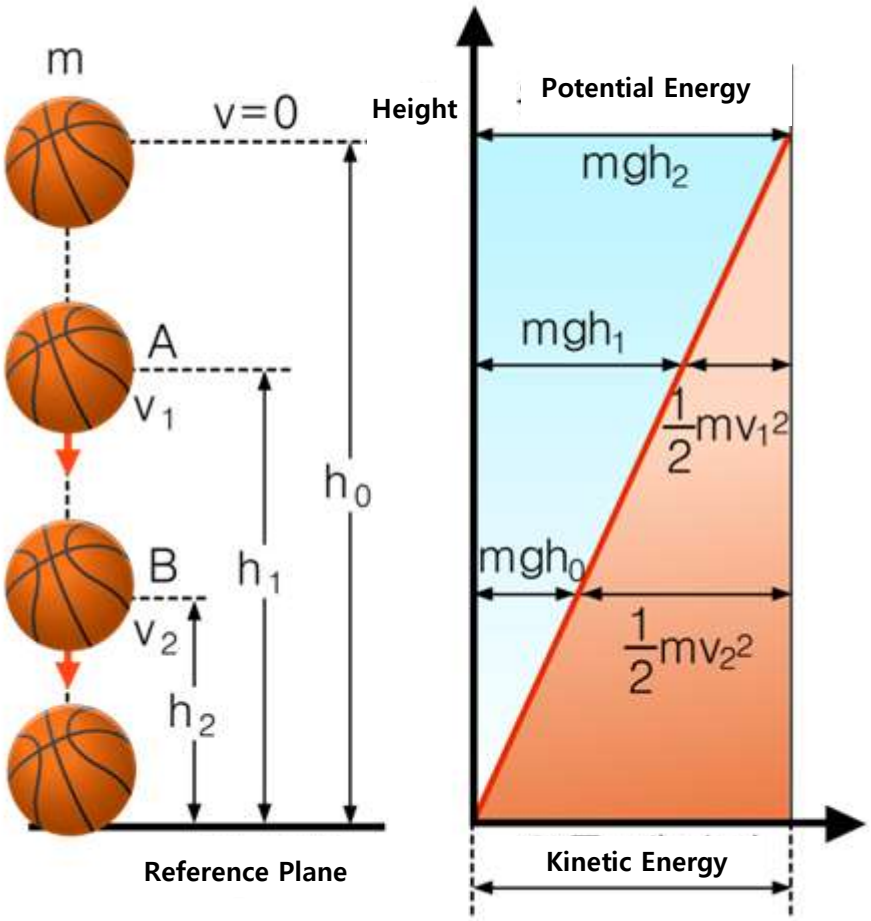
Fundamental Concept

Law of Conservation of Mechanical Energy

: The amount of mechanical energy remains constant even if it is converted from one form to another.

$$\text{Mechanical Energy} = \text{Kinetic Energy } \frac{1}{2}mv^2 + \text{Potential Energy } (mgh) = \text{constant}$$

(provided there is no friction or resistance)



A Point	B Point
Potential Energy due to Gravity = $9.8mh_1$ Kinetic Energy = $\frac{1}{2}mv_1^2$	Potential Energy due to Gravity = $9.8mh_2$ Kinetic Energy = $\frac{1}{2}mv_2^2$

⇒ Since mechanical energy is conserved

$$9.8mh_1 + \frac{1}{2}mv_1^2 = 9.8mh_2 + \frac{1}{2}mv_2^2$$

(Initial Potential Energy + Initial Kinetic Energy = Final Potential Energy + Final Kinetic Energy)

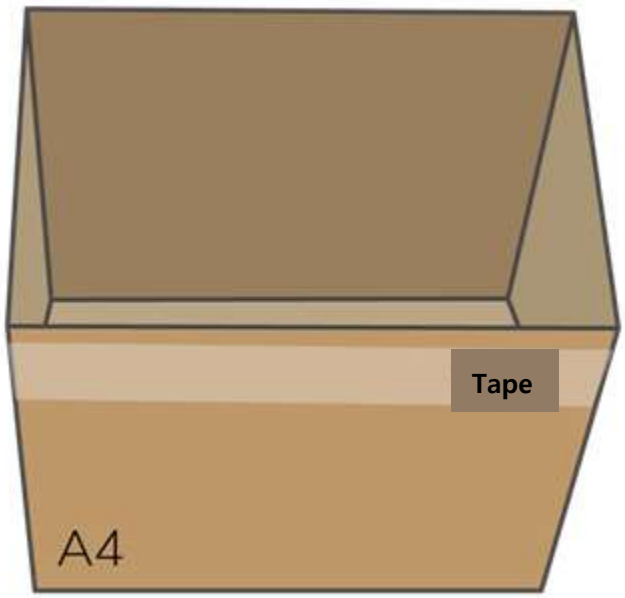
Experiment

Materials Needed

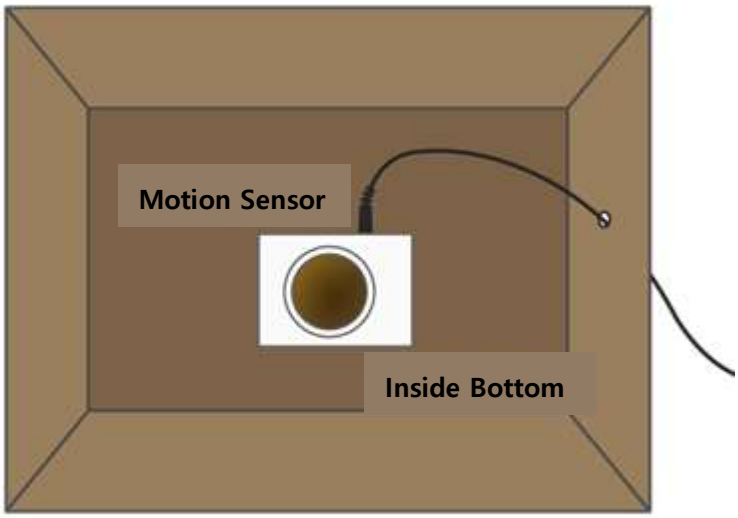
Interface, Science# program, Motion sensor, Basketball, Scale, Copy paper (A4), Empty box, Adhesive tape, Scissors, Awl

Experimental Setup

1. Use adhesive tape to secure the top of the copy paper (A4) box to make it sturdy.
2. Use an awl to make a hole in the side of the box, large enough to insert a cable.
3. Use adhesive tape to secure the motion sensor to the bottom of the box and connect the cable inside the box to the motion sensor.




Side

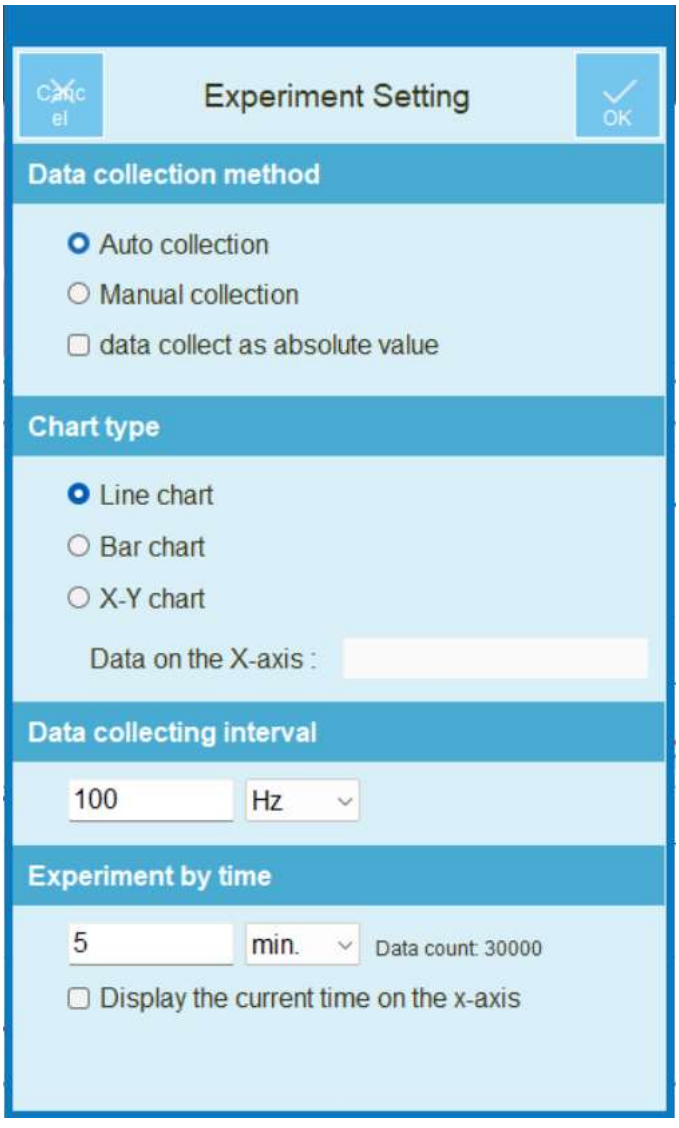

Motion Sensor
Inside Bottom

Interface Setup

1.  Run Science#.

2. Connect the motion sensor to the interface.

3. Press the button  to set up the experimental environment as shown below or press the button  for automatic setup.



 Automatic setup

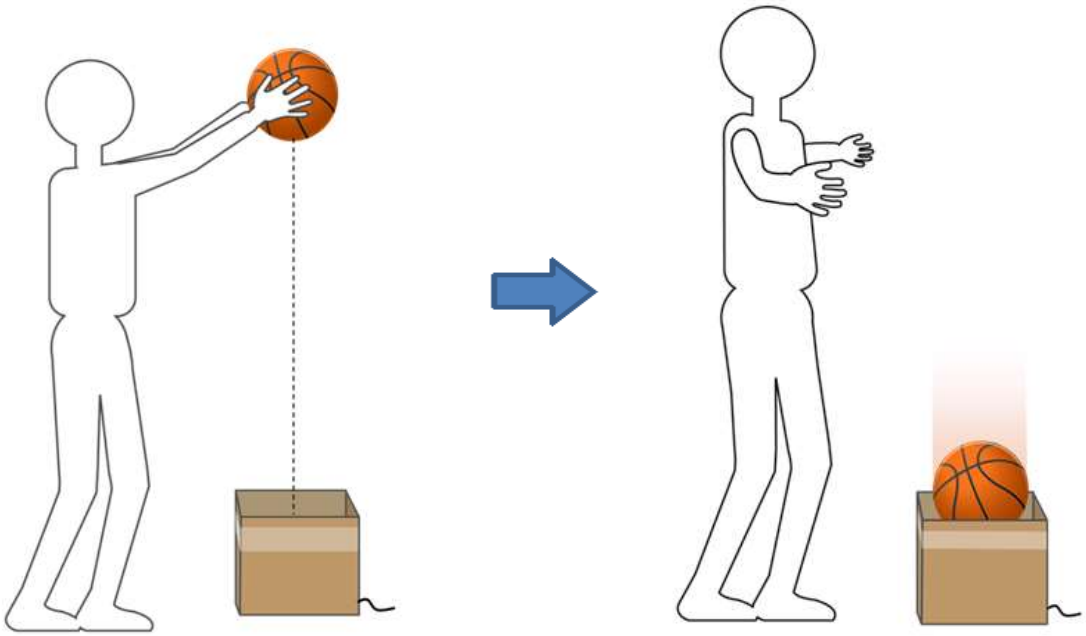
Data Collection

1. Measure the mass of the basketball using the scale.

2. Stand 1 meter away from the motion sensor and position the basketball at that height.

3. Press the button  to start data collection.

4. Carefully release the basketball to let it fall freely. Ensure that your hands are not detected by the motion sensor by keeping them open or behind your back.



5. Navigate to Menu-  - Energy Conservation Law. (Press the button  to delete unnecessary data if needed.)

6. Enter the mass of the basketball - select <Potential Energy> - confirm - block setting - OK to generate the potential energy graph.

7. Generate the kinetic energy and mechanical energy graphs using the same process.

Data Analysis

Recording Data

1. Record the mass of the basketball.

2. Draw a <time-distance> graph measured while the basketball was freely falling.

3. Record and analyze the graphs showing how potential energy, kinetic energy, and mechanical energy change as the ball falls freely.

4. Express the relationship between potential energy, kinetic energy, and mechanical energy during free fall in a formula.

5. List mechanical energy conserved in the experiment? If not, explain the reason.

Data Application and Extended Activities

1. How would a muffin cup, which is much lighter than a basketball, move if dropped from the same height? Compare its motion to that of the basketball.

2. Is mechanical energy conserved when experimenting with a muffin cup? If not, explain why.

3. Discuss how to improve the experimental setup or method to minimize errors and ensure the conservation of mechanical energy during the experiment.


Report
(For Teachers)
Report
(For Students)