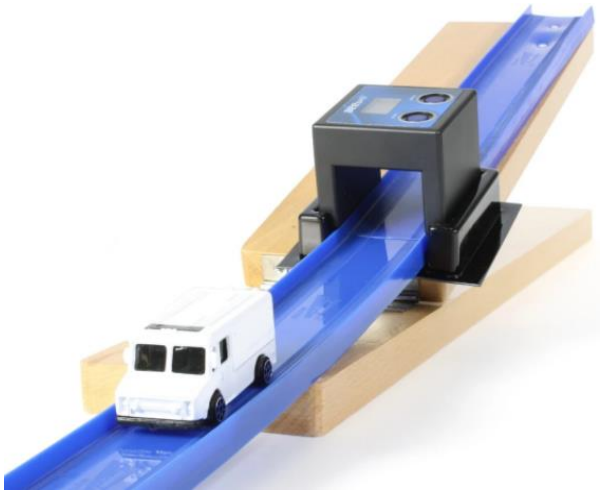
Energy on Wheels

Introduction:

This experimental set up demonstrates how potential energy becomes partly transformed to kinetic energy. You perform work when you lift an object, because you are working against the force of gravity. The work (W) done by a constant force (F), is equal to the force multiplied by the distance over which the force is applied (x)

$$W = Fx$$



As the object is raised, the energy from the work done is stored as additional potential energy: (ΔE_p)

$$\Delta E_p = W$$

The average lifting force equals the weight of the object, (mg)

$$F = mg$$

When lifting an object, the distance, x, equals the height, h, so, combining these equations, we have that the change in potential energy is

$$\Delta E_p = mgh$$

When the car rolls down the track, potential energy is converted to kinetic energy. A greater starting height means that the car has more potential energy, so when the car gets to the bottom of the track, more energy has been transformed to kinetic energy. Therefore, increasing the starting height will increase the final speed of the car.

In reality, not all of the potential energy gets converted into kinetic energy. Some of the energy is lost due to friction, air resistance, sound, and heat. However, these losses are fairly small and, since the length of the track doesn't change, these losses are approximately constant as the starting height is changed. The resultant kinetic energy is equal to the potential energy

$$mgh = \tfrac{1}{2}mv^2$$

From this, the lifting height can be related to the final velocity:

$$h = v^2/2g$$

Background Research.

1. Define all variables used in the mathematical relationships (equations) above.
   - ✓ W
   - ✓ F
   - ✓ x
   - ✓ Δ
   - ✓ E_p
   - ✓ m
   - ✓ g
   - ✓ h
   - ✓ v

Height	$V_{(f)}$

Scientific Inquiry:

- ➔ Set up the car track so that you can adjust the inclination.
- ➔ Place the speedometer and photogate at the end of the track.
- ➔ Measure the height from which the car starts.
- ➔ Measure the speed of the car with the photogate.
- ➔ Write down the values of the height (h) & the final velocity (v)
  - Initial velocity = 0 m/s
- ➔ Repeat the test but change the car's starting height.

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Reflection/Conclusion

2. Does the car's starting height affect its final speed? Explain….
3. Draw a graph showing the final speed as a function of starting height. $F(h) = v_f$
4. Calculate the square of the final speed values (v^2), and draw a graph of the final speed as a function of starting height using the following equation $f(h) = v^2/2g$

Communicating Results:

5. Create a loom video recreating the experiment. In this video you should discuss the physics of Kinetic Energy as a function of Potential Energy. Discuss how energy can be lost from the system. Discuss how a change in height affects final velocity, assuming the length of the track stays the same. Video length should be a maximum of 4 minutes.