FLEET ARC CENTRE OF EXCELLENCE IN FUTURE LOW-ENERGY ELECTRONICS TECHNOLOGIES

FLEET Schools. Activity 6: Double bounce

Learning intentions

This is where we introduce the concept of transfer of energy. Students can visualize potential (gravitational) energy and kinetic energy and how one form is transferred to the other to affect change.

Materials

- Basketball
- Tennis ball
- Optional (ping pong or squash ball)
- Tape measure
- Outdoor space (unless you have high ceilings such as in a gym)
- Optional – for a bit of messy fun – raw eggs or water balloons

Teacher Notes	Student activities
Forms of energy Remember there are two main forms of energy: potential and kinetic and each have different types. See Activities 4 and 5 for an exploration of potential and kinetic energy. A brief description of each is below. **Potential energy**: This is the energy associated with either the position of an object and the forces being exerted on it (e.g., a skateboarder stationary at the top of a ramp) or its structure (e.g., the chemical bonds in different molecules). The many types of potential energy include gravitational, chemical and elastic. Each can be defined in different ways. Collectively, however, potential energy represents the potential that something has to do work. **Kinetic energy:** Kinetic energy is movement, or the energy of a moving object. To get an object to move we must apply a force. The amount of kinetic energy something has is dependent on its mass and velocity (how fast it is moving). The greater the mass and velocity, the greater the kinetic energy. If something is not moving then it has no kinetic energy (but it will have potential energy).	Students could just drop the balls one at a time then one on top of the other and observe, but let's add a bit of scientific rigour to this activity to help us understand what is happening. **Method** 1. Use a metre ruler and drop the basketball from the one metre mark. Record the height it reaches on the rebound off the ground. 2. Repeat this with a tennis ball. 3. Hold the tennis ball on top of the basketball and drop them together from the same height (1 metre mark). 4. If possible measure the height the tennis ball reached (you might have to repeat this a few times before you get the tennis ball to fly reasonably straight upwards. Doing this next to a high wall with marked height points and filming it can help with the measurement. 5. Try this with the third ball. It is tricky to get all three balls to balance well enough to make this work. But small dobs of silicon or similar (maybe blutack?) on the balls to make a resting spot for the smaller ball to nest in can help.

Questions

The stationary basketball does have energy. It has potential gravitational energy. That is, there is the force of gravity acting on the ball pulling it toward the Earth. The basketball has the potential to do work. Once dropped it converts that potential gravitational energy into kinetic energy (movement).

When the balls are dropped by themselves they lose some energy when they hit the ground. Energy is lost from heat caused by friction as it hits the ground. As the ball travels up on the rebound, there is also the force of gravity pulling the ball back toward the ground and friction from the air (more heat loss). Therefore, the energy in the balls is less than the energy they had when they were dropped from the 1 metre height, which means their rebound height is lower than 1 metre.

When the balls are dropped together, the tennis ball bounces extremely high because it gains energy from the basketball. Because the basketball transfers most of its remaining energy to the tennis ball, it barely bounces at all.

Get students to consider what happened to the tennis ball. It flew higher – why? What does the tennis ball need to make it go higher (to do more work)? It needs energy. Where did it get the energy from? Students can typically then make the intuitive leap that it must have got the energy from the basketball.

And if the basketball is on top of the tennis ball when dropped…Mass is important. The lower mass of the tennis ball means it has less kinetic energy as it falls and when it hits the ground. The basketball having a greater mass has greater kinetic energy when falling. The tennis ball is unable to transfer sufficient energy to the basketball to enable its

6. Optional (and just for laughs) Replace the tennis ball with the egg or water balloon and place students around just like slips fielders in cricket. They need to try to catch the egg/water balloon as they fly off at the unexpected angles (best done outdoors).

Questions

Does the basketball have any energy when held in the hand at the one metre height and not moving (ie you have not dropped it yet)? Discuss.

Does it have any energy when it is falling? Discuss.

Why do the basketball and tennis ball not rebound back to the one metre mark once dropped?

When the tennis ball on top of the basketball are dropped together, how high does the tennis ball go compared to when it was dropped by itself? It might be difficult to get an accurate measurement and it might have to be an estimate, e.g., it flew 4, 5 or ten times higher than when it was dropped by itself.

How high goes the basketball go compared to when it was dropped by itself?

Can you explain your observations?

What happens if you place the basketball on top of the tennis ball and drop them? Can you explain your observations?

greater mass to rebound more than a few centimetres off the ground. **Extension** If you want to make this more quantitative get students to work out the following. (Note: your measurements will be different and the many variables make the following approximate): The tennis ball gains about 16 times more energy when it bounces off the basketball and it gets this energy from the basketball as it rebounds off the floor. That is, if we assume the average return height for the tennis ball rebounding off the floor is 0.55 metres and the tennis ball rebounds off the basketball to a height of 9 metres then 9/0.55 = 16 (or close enough).	