

Unit 3 – Falling and Spinning



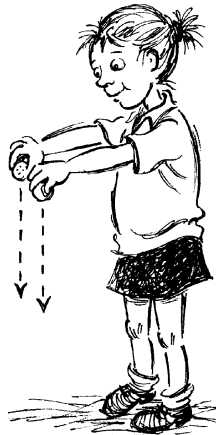
Gravity

Gravity is a force that pulls everything down towards the Earth. You can feel it on a swing – you push yourself up, but gravity pulls you back down every time. Gravity pulls all objects towards Earth. The scientist Galileo (1564–1642) was the first to prove this. Falling objects should be pulled downwards with a single force – so he reasoned that they should reach the ground at the same time. It doesn't matter if they are different sizes or weights.

Galileo's theory only works where there are no other forces acting on a falling object. In reality, air resistance will make some objects fall more slowly – air resistance makes a feather float rather than fall directly down.

Activity – Galileo's Experiment

You can test Galileo's theory by dropping two different balls. Hold a golf ball and a ping-pong ball at the same height. Drop them at the same time. Do they hit the ground at the same time?



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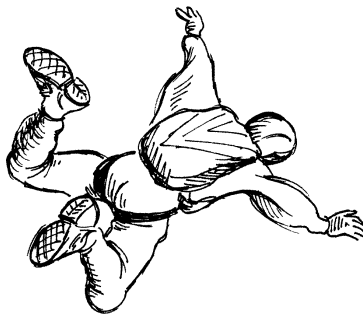
Skydiving

When a skydiver falls from a plane, gravity pulls him or her down. The skydiver falls faster and faster (accelerates). But air resistance is also at work. The upward push of the air will steadily increase as the skydiver's speed increases until it becomes equal to the downward pull of gravity. Now the skydiver can fall no faster. The speed now stays the same – it's called **terminal velocity** (about 200 km/h).

Opening a parachute creates more surface area, therefore more air resistance, which slows the fall. A World War II pilot survived a fall from 3 000 metres – without a parachute! He fell through trees into deep snow, which reduced the impact by providing more time for his momentum to be transferred to the ground.

Activity – Terminal Velocity

Draw arrows to show the push and pull (of air and gravity) at terminal velocity on the skydiver:



Motion is Energy



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Things that move have energy – it's called **kinetic** energy. You can't see kinetic energy while an object's moving. But when an object stops, the energy has to go somewhere. The energy can go into another object.

When you hammer a nail into wood, the hammer has kinetic energy as it moves towards the nail. The hammer stops when it hits the nail and the energy is transferred into the nail. If you've hit the nail hard enough, the nail is pushed into the wood. The nail also becomes warm, because some of the kinetic energy has been converted into heat energy.

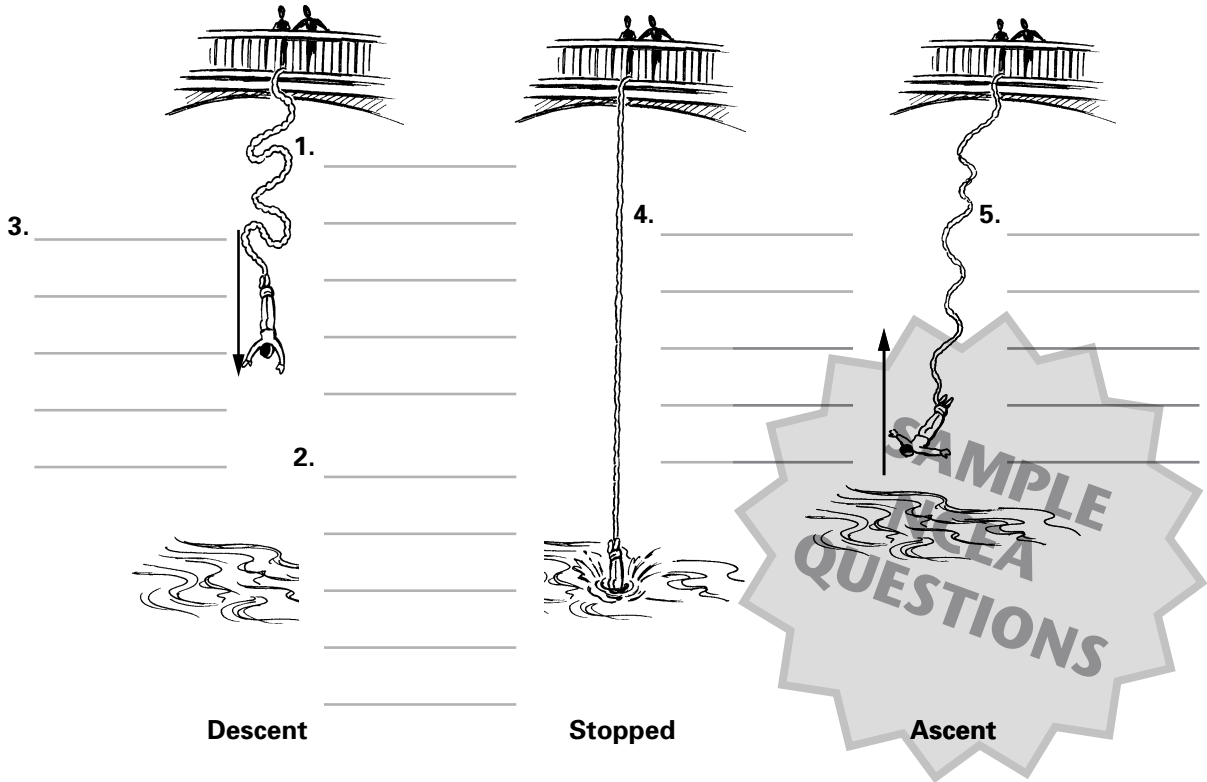
Bungee Jumping

There's energy transfer involved in a bungee jump. A person is tied to a stretchy cord and dives off a platform.

- The force of gravity makes the person fall.
- As they fall, they gain kinetic energy.
- As the bungee cord stretches, some of the kinetic energy is being transferred to the cord.
- When the person stops falling, all the energy is now in the cord.
- The cord then transfers the energy back to the person and jerks them up again.

Activity – Bungee Energy

Illustrate this diagram to show the energy transfer involved in a bungee jump using the previous bullet points about *Bungee Jumping*:



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Terminal Velocity



Bungee Energy

1. The force of gravity makes them fall.
2. As they fall, they gain kinetic energy.
3. As the bungee cord stretches, some of the kinetic energy is being transferred to the cord.
4. When the person stops falling, all the energy is now in the cord.
5. The cord then transfers the energy back to the person and jerks them up again.

Roller-coasters

It's a similar feeling of weightlessness that people get as they jump off a diving board or that astronauts get in space.

