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Baggage forces

Activities for pupils at Key Stage 2

Baggage forces

SESSION FOR PUPILS AT KEY STAGE 2

In this activity, pupils will investigate the amount of effort needed to move baggage around the airport. The activities cover the science curriculum topics of:

- Working scientifically - planning, controlling variables, taking reliable measurements, interpreting data, making predictions and communicating findings.
- Forces, gravity and friction.

The activity offers an opportunity to those working with baggage to talk about their work and how the baggage is moved around the airport.

MOVING TAKES EFFORT

Around 20 minutes

This activity gives an opportunity for pupils to get settled and introduces them to the idea that moving things around takes some sort of effort. It relates to the bags that the baggage handlers need to process.

This activity allows students to experience the effort needed to raise a weight. It focuses onto relatively weak muscles in the forearm but these will fatigue and pupils will feel the work being done.

Safety note

A full risk assessment should be performed before any practical activity. In this case, the use of weights provides an obvious hazard. A good way of making weights without sharp or hard edges is to fill empty milk containers with water. These also have a convenient handle for suspending from string. 500cm^3 of water is a 500g mass, 1litre of water is 1kg mass.

Do not have pupils standing on a raised platform or chair to raise the weight. Have pupils stop if they feel pain or discomfort in their arms.

Materials

- 1kg mass (e.g. water in a plastic container)
- 50cm piece of broom handle with strong string wrapped around
- Stop watch
- Bag or rucksack (not too heavy)
- Scales to weigh the bag
- If available, a short video clip of bags moving around the airport.

Activity

Introduce pupils to the idea that baggage needs to be moved around the airport; from the check-in to the aircraft's hold. This is done behind the scenes but takes a lot of effort.

How much effort does it take to move something?

Have a 1kg mass suspended on a strong piece of string. The string is attached around a piece of broom handle. Pupils hold the dowel in front of them, with both hands palms facing down. They can wind the weight up by twisting the dowel. Demonstrate the technique.

Mark a height of 1m from the weight on the string. Pupils time how quickly they can wind the mass up the 1m height. This allows them to work out the power they have generated.

Try this with a few volunteers to see how long it takes to raise just a 1kg mass.

Summarise by reinforcing the idea that moving things around takes some effort.

Effort can be thought of as the force needed to move an object, along with the distance the object needs to be moved.

Conclude by having a piece of typical luggage that people bring to the airport. Use a set of scales to see how heavy the bag is. If possible, have a rucksack so that a volunteer can try it on (not too heavy).

- How much effort would this take?
- How are the pushes and pulls generated to move them?
- Some is done by people but how are large numbers of bags transported? This can lead in to the ideas of electric motors, conveyor belts and vehicles that are used to move bags around.

If available, conclude this introduction with a short video clip of bags moving around the airport. Alternatively see the images in the presentation.

Note on weight and mass:

Scales generally read in grams, whilst the Newton meters read a force given in Newtons. The latter is the correct measurement for the weight of an object, even though we normally say something 'weighs' a certain amount of grams or kilograms.

Discuss the difference in the two units and have pupils understand that weight is a measure of the force on the object due to gravity and is measured in Newtons. Gram is a measure of mass (the amount of the material).

USING THE SMALLEST AMOUNT OF EFFORT.

Around 70 minutes

Pupils investigate the forces needed to move plastic containers with weights inside them (to represent the baggage) along a surface. This represents the conveyor belts and trackways that are used in the baggage handling areas. Remind pupils that friction is the force that is making it harder to move the bag.

This activity is an investigation which allows groups to explore several factors. Groups should be encouraged to choose the one that they will investigate. A planning sheet is included so that their thoughts can be gathered prior to starting the practical activity.

Time should be spent on this first phase as planning a good investigation will allow time for reflection on the process.

Safety note

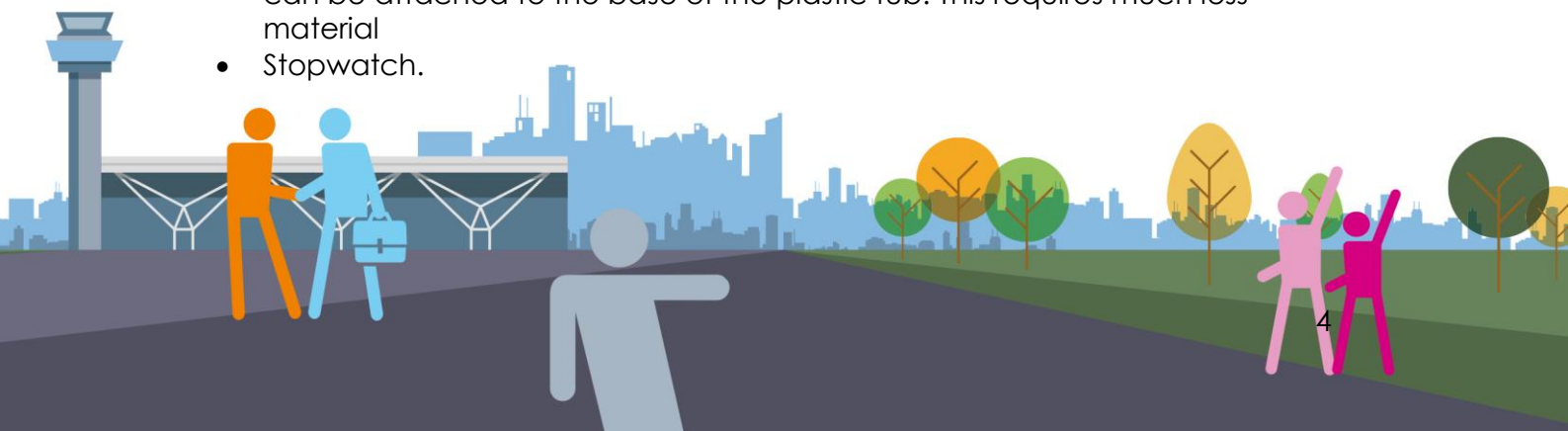
A full risk assessment should be performed, to take into account the local conditions, ability of the group and any other relevant factors. In this investigation, moving weights and the use of ramps are an obvious hazard. Ensure safe weights are used and that these are not raised to a height where, should they be dropped, they could cause injury. Ramps may also be a hazard in which fingers or feet could be trapped.

Pupils should be made aware of all the necessary precautions needed.

Materials

Pupils should work in groups of four. By the nature of the investigations, a range of materials may be called on depending on how pupils investigate the problem. Typically access to the following would enable a range of investigations to take place:

- A range of safe weights (for example, plasticine, water-filled containers)
- Force meters (scale will depend on the weights used but typically 0-10N and 0-50N)
- Rigid ramp (for example, 30cm x 120cm - mark at 100cm interval to give a repeatable distance for pulls)
- Plastic tub or tray to hold weights
- String and sticky tape to attach loop to plastic tub
- Range of materials to modify the ramp surface (fabrics, paper, plastic films, rough papers)
  It is best to add the material to the ramp, but as an alternative, the material can be attached to the base of the plastic tub. This requires much less material
- Stopwatch.



Activity

The activity is an investigation but the planning part should not be rushed.

Slides in the accompanying presentation may also be used.

Begin by showing the pupils the materials that are available and setting out the problem. Have each group talk about how the investigation could be performed. After a few minutes have them feedback their ideas. At this stage the ideas may need refining and there may be a variety of suggestions. Attempt to steer groups with clearly unworkable ideas to a more achievable approach.

Remind pupils that we will see how much force is needed to move the bag a certain distance; the greater the force, the greater the effort.

Give time for groups to consider the questions on the planning sheet.

<u>What question are we going to try and answer?</u>

Have each group use the planning sheet to define what they are going to test. This also offers an opportunity to go around each group and check what they are planning to do.

Some investigations could be:

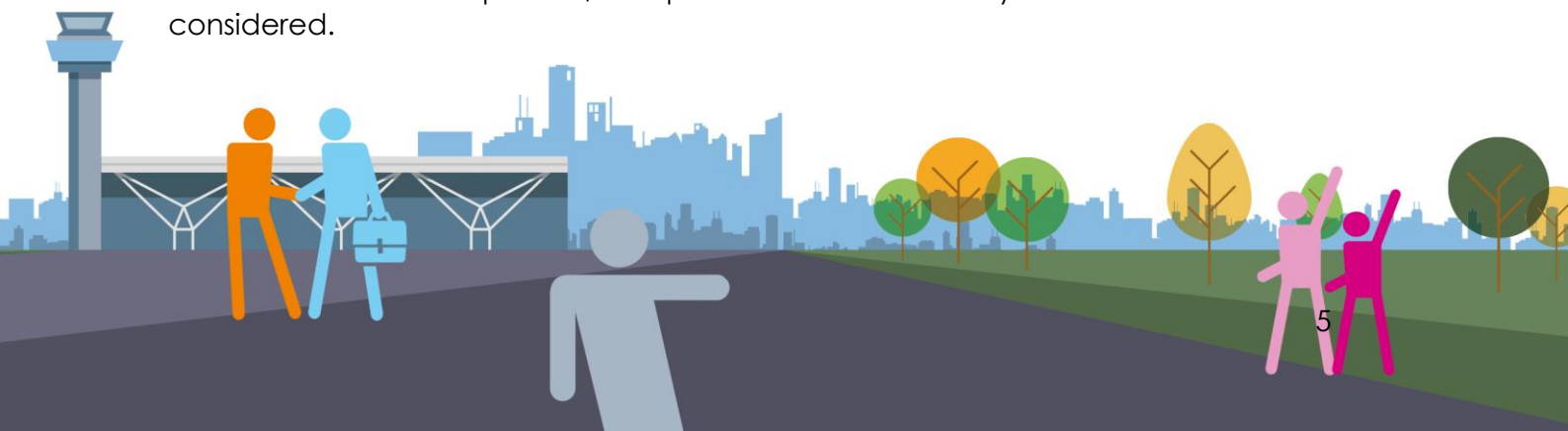
- How does the surface that the bag is moved over affect the amount of effort?
- How does the weight of the bag influence the amount of effort required?
- How much effort does it take to raise a bag and then slide it down a ramp?
- What angle does the ramp need to be?
- What materials need to be on the surface of a ramp to help it slide down the ramp?
- How much effort does it take to slide a bag up a ramp? How does the angle of the ramp influence the effort needed? For example when loading into the aircraft?
- Is there a difference in effort when a bag is slided up a ramp or lifted vertically to the same height?
- How quickly will bags move with different forces?

<u>What one thing will we change?</u>

Using the planning sheet, have pupils specify the one thing they are going to change (variable).

<u>What are we going to keep the same?</u>

Groups complete this section by defining what will be controlled. Remind groups that for a reliable comparison, the speed of movement may need to be considered.



What are we going to measure?

The 'ideal' answer here is to measure the force and distance moved over a set amount of time.

Attaching the force meters to the bag and moving it steadily but slowly is the trick here. A movement that speeds up and slows down will give a variable reading of force. Steady and slow is best. Even so, it can be tricky to measure the force accurately. This allows for discussions on reliability, repeatability, averages and data processing.

Whilst pupils should be encouraged to think about their experiment before they start the practical aspect, allow pupils to make improvements to their design as they go along. This is part of the investigative process.

Reporting findings

Remind pupils that they will need to record, analyse and present their results. Have them consider how they will do this before they start gathering the data.

Draw a line under the planning phase by demonstrating how the pupils can use the force meters to measure the force needed to slide the bags.

This demonstration also allows the group to be pulled together and reminded of safety before starting the practical element of the investigation.

Once the investigation has been completed, have pupils present their findings to the class. Is there a consensus as to the best way to move the bags? How do their findings tie-in with the way they have seen bags moved around the airport in earlier sessions?

MOVING BAGS

The final activities depend on the time available.

If possible, go to the viewing area to see the aircraft taking off. Have pupils consider the weight of the baggage in the aircraft, and the energy and effort that is needed to lift these off the ground. Where does this energy come from? Where does the force for the movement come from? Why is there a baggage weight limit for each passenger? What would happen if there was no weight limit?

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Moving bags

What questions could we investigate?

What one question will we try to answer?

What one thing will we change?

What are we going to keep the same?

What are we going to measure?

How will we record and report what we find?