Forces all around us

Science context
Forces
Forces acting upon an object can make it move, increase speed and make it stop. For example, a flower blowing in the wind displays numerous forces acting upon it.

HSW
Using scientific ideas and models to explain phenomena. Critically analysing and evaluating evidence from observations.

Mathematics
Transformations; Identify and classify patterns

Where?
In and around the school grounds

Time
70-85 mins

Lesson summary
In this activity, students will show and develop their understanding of balanced and unbalanced forces by looking for, and recording, examples of forces in action within their school playground.

Cognitive potential
Forces have size and direction. They can push and pull. They can make things move, change direction, change speed and stop. Everywhere around us, there is evidence of forces in actions. The challenge for many students is that some of this evidence seems invisible (i.e. a stationary object). In the classroom, the concept of forces is often introduced using pictures and diagrams. This activity enables students to apply these classroom experiences to the real world around them and focuses on encouraging students to begin to see the relevance of school science within the context of their more complex, everyday environment.

Central theme and skills
Forces
Making observations and applying scientific understanding

Key resources
Each group will need a copy of the photograph of the bench in the playground and a 'forces' pack that includes:

- Key words: e.g. gravity, reaction force, air resistance, friction, balanced, unbalanced
- Arrows: a number that vary in length to encourage students to think about the direction and size of forces.
- Blank cards and a pen

Digital camera
Blu-tac
Note books and pencils

Setting the scene (5mins)
Divide the class up into their newly established groups of threes or fours. **Think back to the last time you worked as a group. What worked well? What didn't? What kinds of things do you need to do to work well together, as a team? How is working outside the classroom different?** Give the class some 'thinking time' to reflect on this individually and then get them to share their thoughts with each other, either in their group or in pairs. Use their ideas as a basis for re-establishing some common ground rules for group work and working outside the classroom.

(10-15mins)
Give each group the photograph of the bench in playground and their pack of words and arrows**. Decided as a group what you need from the pack to help explain all the forces that you think are present in this photograph. Think about where you would place the words and arrows. You will need to give reasons for your decisions.** Give the groups about five minutes to work on this before gathering them back as a whole class. Have the photograph up on the IWB. Invite different students to come up and talk about and demonstrate one word or arrow that their group decided to use**.** At the end of this discussion ask them: **Are the forces in this example balanced or unbalanced? Why?** (This activity could be completed outside).

	Observations outside (10mins) Give each group some paper and one pen. Ask the students to explore, in their groups, the playground and look for and record up to five examples of something they all agree shows forces in action in the playground. **You need to find at least one example of unbalanced forces and one of balanced forces.** Encourage them to make annotated sketches as they will be referring back to these later. ***Sharing ideas and provoking conflict I (15-20mins)*** Collect groups back to a central space in the playground and give each group the forces pack that they were using back in the classroom. The groups now need to decide on two of their earlier identified examples that they could go back to; one example of balanced forces and another of unbalanced forces. Their challenge is to think about which words and arrows in their pack could be applied to their chosen example. **Remember what we did back in the classroom? I want you now to do the same thing. Decide as a group what you would need from the pack to help explain all the forces that you think are present.** Send the groups off to go to their examples and give them about 10 minutes to work on this, using Blu-tac to attach words and arrows to show the forces in action in their example. They may use their own bodies to stick words/arrows on to illustrate invisible forces. E.g. if the students want to label the forces acting on a bush, one student could stand alongside the bush and words and arrows could be positioned on them corresponding to the position on the bush. If possible, try and get some digital photographs of these examples for possible later classroom work. ***Sharing ideas and provoking conflict II (15mins)*** Collect the groups back and either pair up groups so that they can show and explain their examples to each other or keep them as a whole group and move to a few selected examples, getting particular groups to present their ideas and the others to evaluate. **Is this the only way? What else would you suggest? Why?** ***Linking ideas together (15-20mins)*** Gather the whole class back to reflect on the learning. They could think about these questions individually, in pairs or in their groups before a whole class discussion. You can also ask them to write down their responses to these questions. **As a group, what did you talk about that helped you to decide that something you could see around you was an example of forces in action?** **What were some of the problems with using the pack to explain your examples?** This could be set as a homework task: **How many different examples of forces can you spot around you on your journey between home and school?**

	Mathematical plug-ins: **"Transformations" all around us** This should work in a similar way to forces all around us with a couple of substitutions: In the pack: Key words: Rotation, Reflection, Translation, Enlargement Provide a picture of the London Skyline with the same one on the IWB. Ask pupils to find as many examples as possible in the picture of transformations (e.g. Reflection: The river, shiny glass, rotation: the London Eye, wheels in general, the hands of Big Ben, translation: a boat along the river, going up in a lift, pacing a capsule of the London Eye, Enlargement: the photo in itself) **How did you know it was a transformation? Does everybody agree? What defines each transformation?** (mirror line, centre of rotation, direction and angle of rotation, centre of enlargement and scale factor, a vector for translation) Provide students with: A metre stick, a large protractor, red tape (mark mirror lines and centre of rotations) Ask them to find examples of each of the four transformations in the school grounds and also an example of a composite transformation. Take a photo of each example suitably labelled with tape, and take the necessary measurements to draw the example on paper. See sharing ideas and linking ideas together in the "forces all around us" activity to complete this lesson.