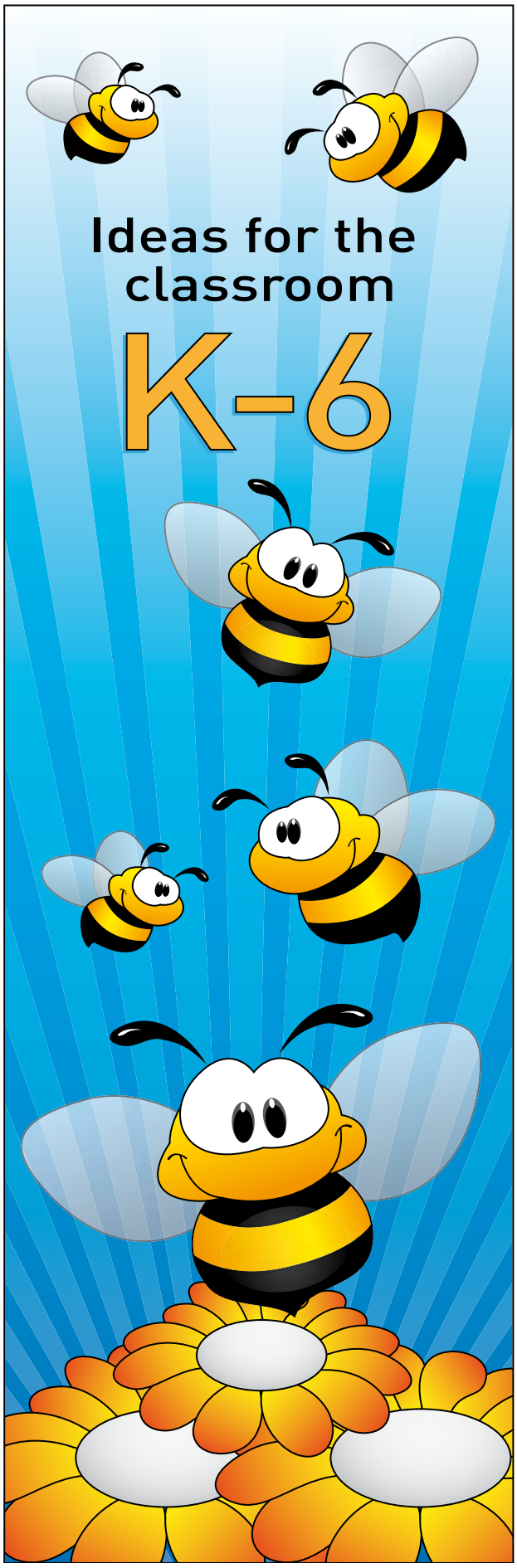

What if Science was a Game that everyone could Win? Part II

By Marti Ellen

When we are small and begin to learn Maths, we count and learn 1+1. When we learn to read, we start with the ABCs and put them together into words. But where does learning science begin?

The game of science

In Part 1 we went back to the basics of energy, mass and forces to build our foundation of science as a game. We built this foundation to achieve real understanding, and to create a platform of experience on which to build further. We showed that understanding these keystones of energy, mass, and forces validates that we can win at the game, and that the game is fun.

We featured the methods of investigation and experimentation to get winning results. When students do an activity and can see the answer, they remember it. When they do several such activities in a row, they develop a certainty and an understanding about the rules of the physical world, and a certainty about themselves as being capable. It works.

In this article, I will show you how to take this strategy further. We will carry out a series of steps that lead students to build and see answers for themselves. We will move forward along a straight line in very small increments. That is the key to winning the game. Make your steps very small and change only one thing at a time. The result is a deep understanding of the topic and a sound, certain platform.

I have chosen as our investigation topic a question about a common misunderstanding:

"What is the difference between mass and weight?"

To answer this question:

- break it down into smaller questions
- have an activity ready to demonstrate the answer to each one.

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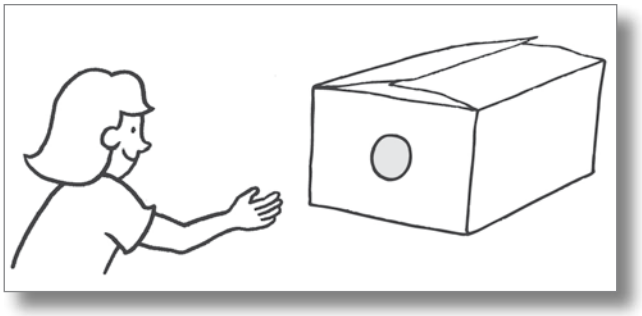
For example:

Question 1: "What is mass and what are its properties?"

Activity 1: Have a look at the physical objects around you: balls, shoes, books, etc. It's the stuff in the physical world. Pick up a bit of mass. Observe its properties (shape, texture, size, colour). Compare its similarities and differences to a second bit of mass.

To make this a game and more fun for your students, get them to pull the objects out of a cardboard box one by one.



Have students observe other properties of mass, e.g. it takes up space, has volume, has a centre upon which it balances, has a density. Note: Look up "What if science was a game that everyone could win?" part 1, in the previous edition of SEN. In it are numerous exercises to use to observe the properties of mass together with the corresponding Australian Curriculum reference codes.

We use our understanding of Mass to ask the next question.

Question 2: "What happens when you let go of a bit of mass?"

Activity 2: Ask students to pick up one bit of mass, e.g. a marble. Hold it up above the floor and let it go. Repeat several times.

Throughout your life experience, you will have seen this happen many times. You know what will happen. It will fall to the floor.

What we are creating is a process to follow. We show students that to investigate any question, they must repeat the activity to give a fair test. It doesn't matter if the answer is obvious. We are introducing a method, the scientific method.

By repeatedly letting go of our bit of mass, we observe that it falls every time. Whether we like it or not, a thing will drop if we let it go. We call the force causing this effect **gravity**.

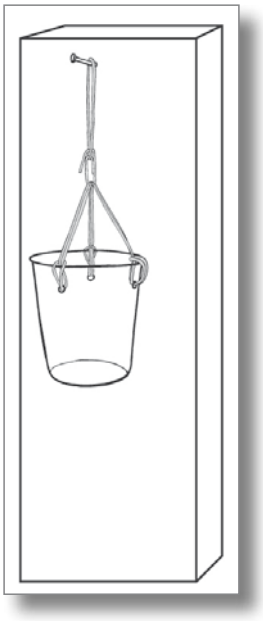
Gravity is the falling force and it acts on mass.

By repeatedly dropping the marble and consistently creating the effect, we create confidence for our students. No one thinks it is hard. Everyone understands. Everyone knows that the marble will fall when we let it go.

We use this knowledge about gravity to build our next step.

Question 3: "Can I measure how much the force of gravity pulls on a mass?"

Activity 3: Build a gravity device by using a long nail with a head on it, a hammer, a wooden board, four #14 rubber bands, a plastic or paper cup with three equally spaced holes punched in it, and a paper clip.



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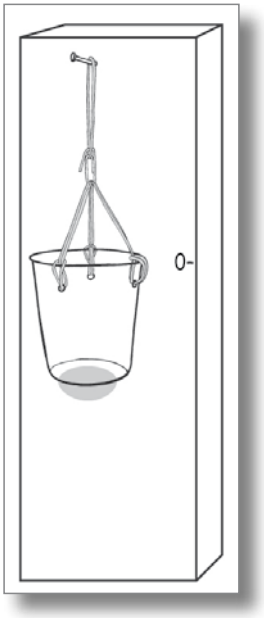
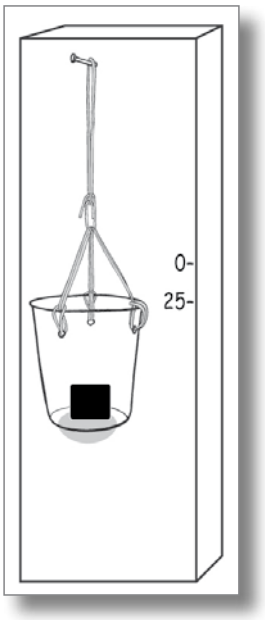
Next, we will calibrate the device. But before we do so, it is important to make sure the rubber bands are taut. You can do this by sticking a 2cm ball of plasticine on the outside bottom of the cup. Then, make a mark with a pencil to show where the rim of the cup is. Label that mark '0'.

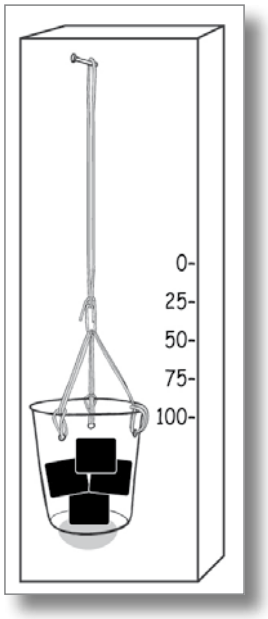


We will calibrate the device by putting objects of different, known masses into the cup. As we put each mass into the cup, the mass will be pulled down by gravity, taking the cup with it.

Use objects of known mass, or create your own out of marbles, e.g.: 25 g, 50 g, 75 g, and 100 g masses can be made by filling small plastic bags with the appropriate amount of marbles. (Small marbles are generally 5 g each.) Note: *If you make your own masses, prepare them prior to doing the activity with students*. Check the mass of each bag on a kitchen scale, and label it with a sticker.



One by one, place each known mass into the cup and make a pencil mark on the board next to the rim. Write the mass value next to the mark.



The principle here is that the greater an object's mass, the greater the effect gravity has on it. Each object is pulled down the board a distance that is directly related to the amount of its mass.

What if Science was a Game that everyone could Win? Part II (continued)

The amount that gravity pulls on an object is what we call weight.

Your students have just demonstrated the phenomenon of 'weight'. It is the measurement of how much the force of gravity is pulling on a bit of mass, and we can clearly see and measure that the distance the cup moves down the board depends on the mass it is carrying.

In discussion, Stage 1 students could report that the numbers got bigger as they went down the piece of wood. They can share their experiences and say whether the result is the same as what they knew at the start, and if not, after reflection say why not.

Students in Stages 2 and 3 could be asked to measure the distance in millimetres from the "0" mark that each object moved along the board. This data could be graphed and analysed, e.g. is the distance from 0 to 25 grams the same as the distance from 25 to 50 grams? 50 to 75 grams? 75 to 100 grams? (It should be, but if not, why not?)

In Stages 2 and 3, students can be asked to collect data that requires careful measurement. If some students find that their measurements lack accuracy, get them to explain their findings. An explanation could be that more care needed to be taken when carrying out the initial calibrating procedure, that rubber bands are not high precision equipment, or that the rubber bands were not taut in the initial calibration. Ask them to communicate and reflect on what they could do to improve their results. Ask what they think was the purpose of the ball of plasticine.

Students can use their calibrated gravity device to measure the weight of other objects by using the calibrations, e.g. a golf ball, an egg, or a rock from the garden.

Everyone can win at the science game. It becomes easy when we break down a big question and focus on demonstrating and experiencing the little questions that make it up. Step by step we use this key to the science game and create many winners.

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