

## KEY UNDERSTANDING 5

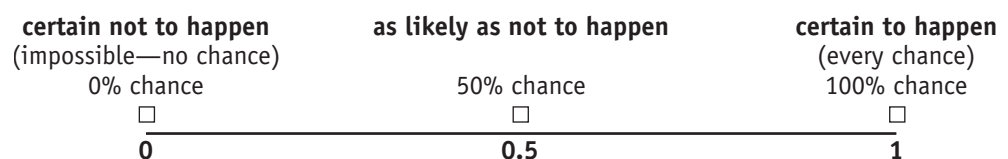
*We can use numbers to describe how likely something is to happen.*

Just as area is a measure of how big a region is and time is a measure of how long something takes, probability is a measure of chance, or of how likely something is to happen.

We can compare and order objects, spaces and events without reference to numbers, but when we want to say, for example, ‘how big’ or ‘how much bigger’ an area is, we use numbers. (See *First Steps in Mathematics: Measurement*, Understand Units, Key Understanding 3.) Similarly, we use numbers when we want to say ‘how likely’ or ‘how much more likely’ an event is. In each case, we use a unit as the basis for quantifying our comparisons.

Events that *cannot* happen all have the same chance of happening, that is, *no* chance, so it makes intuitive sense to say they have a probability of 0. Events that *must* happen are also all equally likely and so it makes sense that they all have the same probability. We have decided to give all events that *must* happen a probability of 1 (or 100%). We then use this certainty of happening as our unit and compare all other events to it in order to quantify how likely they are to occur.

Events that ‘might happen’ are more likely than events that ‘cannot happen’ and less likely than events that ‘must happen’, so we would expect events that ‘might happen’ to have a probability somewhere between 0 (no chance) and 1 (every chance). It is also reasonably intuitive to think of events that are just as likely to happen as not, as having a probability halfway between ‘can’t happen’ and ‘must happen’. In effect, we have developed a numerical scale like this:



Initially, students should informally and intuitively place events, such as the chance of it getting dark tonight, swimming to Jupiter, doing maths tomorrow, and getting a tail when a coin is tossed, on the scale from 0 (cannot possibly happen) to 1 (must happen). They could compare their placements and debate them, perhaps coming to compromise or 'average' positions. Only *after* they understand the idea of more, less and equally likely (see Key Understandings 3 and 4) should they begin to quantify chance.

Without actually working out probabilities for themselves (but see Key Understanding 6), students in the later primary years should interpret simple probability statements in everyday use. For example, they might say that a 90% chance of rain means rain is very likely and therefore decide to cancel the picnic, but a 10% chance of rain means there is little likelihood of rain and so they are prepared to take the small risk of rain and won't cancel. Given a 50% probability of rain, they might find it difficult to decide. Thus, they should come to understand that events are at their least predictable in the centre of this scale and become more predictable as you move towards either end.

Students who have attained Level 4 can use the scale from 0 to 1 in an informal way, placing everyday expressions of chance such as 'impossible', 'poor chance', 'even chance' 'good chance' and 'certain' on the scale. They have an intuitive sense of the meaning of probability statements such as those associated with weather predictions. At Level 5, they understand that probability is the way we measure chance, that is, probability statements give a measure of how likely something is to happen. They understand the 0 to 1 scale and can interpret expressions of probability in general usage such as 'the probability of rain tomorrow is 30%' and 'there's a 50-50 chance'.

## SAMPLE LEARNING ACTIVITIES

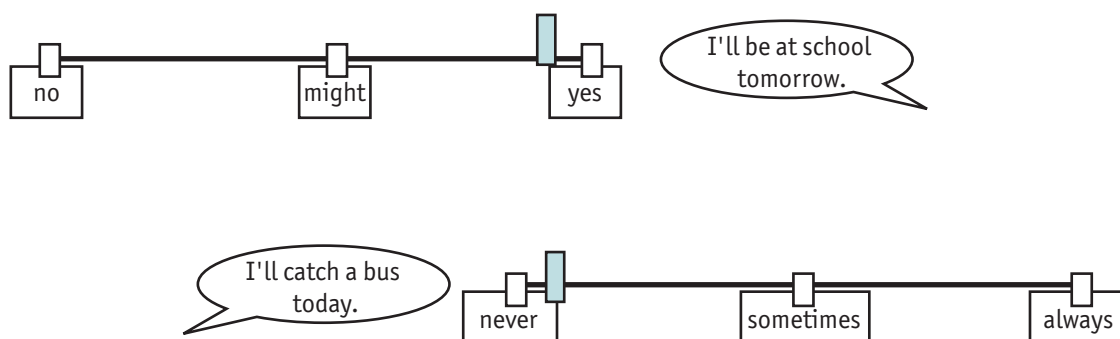
### Beginning ✓

#### What Will Happen?

Make two labels: 'can't happen' and 'must happen'. Place the labels wide apart. Prepare a set of cards showing various classroom activities, such as using a calculator, playing cards, reading a book and playing with play dough. Invite students to order the cards from most to least likely to happen tomorrow, and place their cards somewhere between the labels. Ask them to say why they put the cards closer to one of the labels, or towards the middle. (See Key Understandings 2, 3 and 4.)

#### String Line

Ask students to pin labels such as 'yes', 'might', 'no', or 'always', 'sometimes', 'never' (indicating the likelihood of things happening) in order along a string across the room. They then take turns choosing where events such as 'I'll be at school tomorrow' or 'I'll catch a bus today' should go, by moving a marker along the string line.



#### Fifty-Fifty

In incidental discussion of chance events, such as rain, use the term '50-50 chance' to describe events that have an equal chance of happening. Explain it as having an even chance of happening—'maybe it will, maybe it won't'. Draw out that 50 is half of 100.

#### Paper Scale

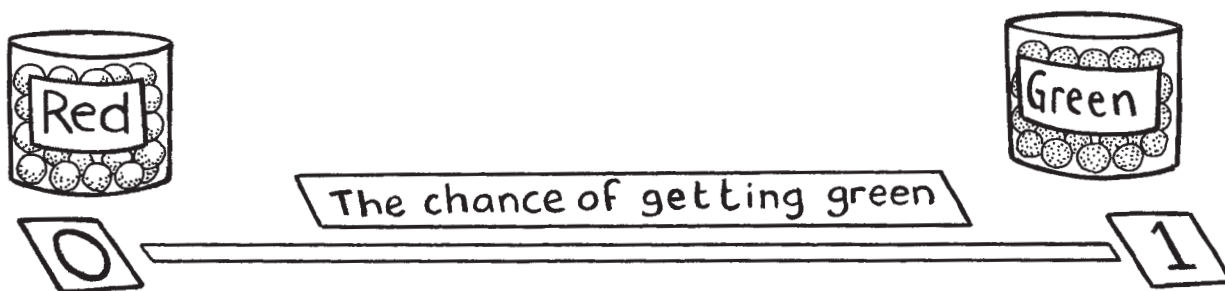
Have students cut a long strip of paper and label one end 'can't happen' and the other end 'must happen'. Ask them to draw pictures of things that could happen after school that day, including unusual as well as routine events. They then place their pictures on the strip of paper, where they think they would be on the scale, and say why.

## SAMPLE LEARNING ACTIVITIES

### Middle ✓✓

#### Coloured Balls

Place a tape across the front of the room, marked with 0 at one end and 1 at the other. Label it 'the chance of getting green'. Show students two jars, one containing only, say, red balls, the other containing only green. Point to the jar containing red and ask: If you drew one ball from this jar, what chance is there of getting green? (None) If we gave that a number, what should it be? Place the jar at the appropriate place (0) on the tape. Repeat for the jar containing green balls, asking: What is the chance of getting green? Place that jar at the other end of the tape (1). Make up another jar containing mostly red and one or two green balls. Ask students where on the tape would show how likely you are to get a green ball. Discuss why. Repeat for various combinations using an intuitive sense of whether you should be closer to the red (0) or green (1) end. Repeat with a jar containing equal numbers of red and green.



#### What Will Happen?

After students play 'What Will Happen?' (page 54), introduce the idea of a numerical scale. Link this to measuring other things such as length and time, e.g. if no time has passed we would say there are zero seconds or zero minutes. Ask: If we used the number 0 to show that something is certain not to happen, what number could be used to show that an event is certain to happen? What kinds of numbers might we expect to see on the things that might happen?

#### Fifty-Fifty

After students identify a situation where there is a 50-50 chance (link to Key Understanding 3), ask them to identify where this would be on the number scale. Find other situations that would be similarly placed in the centre, e.g. 50% chance of rain, one in two chance of throwing a head, or odds or evens on a six-sided die.

## Middle ✓✓

### Combined Possibilities

Invite students to identify all the possibilities in a simple 'chance' situation. Draw out that one of these must happen or is certain to happen. For example: Show students a jar containing Jaffas™ and Kool Mints™ and ask them to list the possible outcomes if you were to draw out one ball (*a Jaffa™ or a Kool Mint™*). Ask: How likely am I to get either a Jaffa™ or a Kool Mint™? (*certain to, a sure thing*) So, if we were to give the chance of getting a Jaffa™ or a Kool Mint™ a number, what would it be? (*100%, 1*) What is the chance of pulling out a jelly bean? (*no chance, Buckley's, impossible*) So if we were to give that a number, what would be the sensible number? (*0*)

### More Possibilities

Extend the previous activity to include halfway points. Ask: How could we fill this jar so that you had an equal chance of getting a Jaffa™ or a Kool Mint™? (*equal numbers of both*) What chance would there be of getting a Jaffa™ if you drew out one sweet? Would the chance be more than 0? More than 1? Less than 1? Where between 0 and 1 would it be?

### Rating the Chances

Have students use a 0 to 1 chance scale to estimate the chance of a range of events, such as 'I'll drink some water some time tomorrow' and 'I'm going shopping after school today'. Ask: Why did you decide to put that one close to the 0 and that one close to the 1?

### Prize Box

Encourage students to use numbers informally to rate their chances of events occurring. For example: Ask them what prize they hope to draw out from an enclosed box containing six Cherry Ripes™, three Crunchies™ and one Snickers™. Students informally predict their chance of getting what they want and then indicate where this sits on a scale, with 0 being 'impossible' and 1 being 'certain'. Those who choose the same prize can compare and justify the positions they chose. (See Key Understanding 5, 'Later'.)

## SAMPLE LEARNING ACTIVITIES

### Later ✓✓✓

#### Rating the Chances

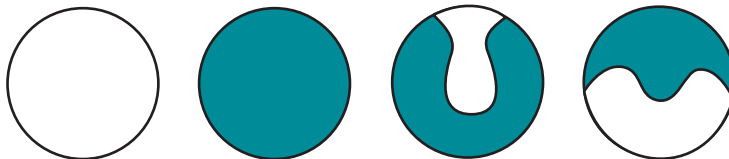
Ask students to use newspapers to help generate a list of national or international events that might happen. Using a number line between 0 and 1, have students informally rate the chances of the events occurring, and explain their reasoning.

#### Word Sort

Have students sort chance words such as 'nearly', 'may', 'Buckley's', 'possible', 'doubtful', 'highly probable' and 'fifty-fifty', and place them on a 0 to 1 probability scale according to their description of whether an event will, might or will not happen. Ask them to justify their positioning of words. (See Key Understanding 2.)

#### Ordering Spinners

Show students the spinners below. Ask them to put the spinners in order according to which they would rather have, if they needed to spin white to win. Ask: Why did you put them in that order? Have students use a number line between 0 and 1 to informally rate the chances of spinning white, and explain their reasoning for ordering each of the four spinners. (See Key Understanding 3.)



#### Pigs Might Fly

Extend 'Pigs Might Fly' (page 39) to have students place the unlikely events they have already ordered, on a scale from 0 to 1. Ask them to justify their order and say why all the events are close to 0.

#### Rulak

Have students interpret probability statements as an aid to making decisions. For example: Present monthly probability information about the weather in their home town and an imaginary location (Rulak) in the Northern Hemisphere for each month in the year. Ask students to imagine a friend from Rulak will be coming to visit. Have them write to their friend, suggesting suitable clothes to bring and comparing the local weather to their friend's home, justifying their decisions.

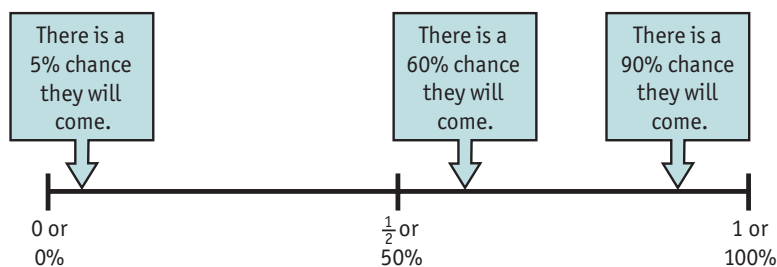
## Later ✓✓✓

### Percentages

After working with percentages as a part of a whole, have students place percentage estimates of probability on the 0 to 1 scale. Reinterpret percentage estimates as approximate fractions. For example: Collect percentage estimates from newspapers, magazines or news programs. Ask: Where on the number line would you place the statement 'The chance of rain tomorrow is 30%'? What does that mean? If the percentages are closer to 0 or to 1, how does that affect our prediction? (*The closer it is to 0 or 1, the surer we are that it will not, or that it will rain; the closer it is to 50%, the less sure we are about rain or no rain.*) (Link to Key Understanding 3.)

### Sorting Percentages

Extend the previous activity and have students sort everyday probability statements in terms of those that make it easy to make a decision and those that do not make it easy. For example: The school sports day is tomorrow. Consider the following probability statements: there is a 90% chance of rain; there is a 10% chance of rain; there is a 50% chance of rain. Which probability statements help you make a decision about whether or not to cancel? Which statement does not help you make a decision? Or: The school canteen manager is deciding whether or not to order more drinks based on whether visitors from a neighbouring school are coming or not. Consider the following probability statements: there is a 90% chance they will come; there is a 60% chance they will come; there is a 5% chance they will come. Which probabilities help you make a decision? Which statement does not help you make a decision? Draw out that events are more predictable at either end of the scale and less predictable in the centre of the scale.



### Prize Box (1)

Have students use numbers informally to rate their chances of events occurring. Invite them to examine a prize box containing six Cherry Ripes™, three Crunchies™ and one Snickers™ bar. The prizes are drawn from the covered box so they cannot see what they are choosing. Have them informally predict their chance of drawing out each of the bars and then indicate where this chance sits on a scale with '0' being certain not to happen and '1' being certain to happen. Students compare and justify their positions they chose for each type of bar.

**Prize Box (2)**

Extend the previous activity by asking students to remove one bar from the box. Invite students to again predict their chance of drawing out each of the bars and then indicate where this chance sits on a new scale. Ask: Are your predictions the same as before or have they changed after one bar has been removed? How have your predictions changed? Remove a second bar and then invite students to use another scale to again predict the chance of drawing out each of the bars. Continue drawing out bars and ask: When might you get a 0% chance of drawing out a particular bar? When might you get a 100% chance of drawing out a particular bar? Would the chances change if we replaced the drawn prize after each turn? Why? Why not?

**Predict and Test**

Ask students to predict and test the outcome of chance events with and without replacement. For example: Put all the students' names in a hat and have them consider their chances of having their names drawn out to win prizes. After establishing that they have one chance out of the number of names in the hat, invite them to approximate this on a 0 to 1 chance scale. Ask: What is your chance of having your name drawn out? Where would that chance appear on the scale? Draw out a name for first prize, and then ask if and how students' chances have changed for winning second prize. Repeat for third and fourth prize. Ask: What is the chance of the first prize-winner also winning second prize? What affects whether their chance is 0% or the same chance as everyone else? (*It's whether or not the name is replaced after it is drawn out.*) If we continue drawing prize-winners without putting the names back and you end up the very last to be drawn out, what happens to your position on the 0 to 1 chance scale each time? (*The chance moves from near the 0 end at the first draw to 1 before the last draw, when their name will be certain to be drawn out next.*) (See Key Understanding 1.)

**Chance of Red**

Have students examine the contents of a box of Smarties™. Ask: If you were to shake them and take one out without looking, what would your chances be of getting a red one? Ask students to estimate this by plotting a point on a number line between 0 and 1. Take one Smartie™ out and eat it. Ask: What is your chance of getting a red now? Has it gone up, stayed the same, or gone down? Where do you think the new point is now? How do you know? Continue until all the Smarties™ have gone, focusing students' attention on the fact that the whole (what 1 represents) changes with each Smartie™ eaten, because the whole chance is the total number of Smarties™ left in the box before each draw. The chance of getting a red each time will depend on the relationship between the number of red Smarties™ not yet eaten and the total number of Smarties™ still left in the box.