First Steps in Mathematics

Measurement

Diagnostic Tasks – Student Worksheets

Understand Units
Direct Measure
Indirect Measure

FIRST041 | First steps in Mathematics: Measurement - Diagnostic tasks - Student worksheets

First Steps in Mathematics: Measurement

Diagnostic tasks - Student worksheets

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Introduction

First Steps in Mathematics: Diagnostic tasks - Student worksheets

Task review and planning sessions are a critical component of using First Steps in Mathematics. After completing each First Steps in Mathematics content session, teachers should use some of the diagnostic tasks with their students and then work with a small group of colleagues to review the completed tasks and plan for further learning.

Diagnostic TASK

FOCUS
Direct Measure
- Key Understanding 4
- Did You Know? p. 136

Broken Ruler

Years 3–7

Purpose

To reveal if the student:
- can use the marks on the ruler to measure in centimetres
- understands how the number on the scale relates to the units.

Materials

For small groups or the whole class, use the attached worksheet.

For individual interviews, use a broken piece of ruler and an object to measure.

Producing work samples

It is important that the students use the picture of the broken ruler and **do not** use their own ruler to work out the length of the leaf.

Use this task in an individual interview, or with a small group or whole class.

Individual interview

Provide a broken ruler and ask the student to measure an object that is shorter than the piece of ruler.

Small group or whole class

Read out the problem while the students follow on the sheet. Ask them to write a full explanation of how they worked it out. It may be necessary to do some follow-up interviews to clarify what individual children are thinking.

After the students have found an answer

Ask, *How did you work out the answer?*

Record what the students do and say.

Observe whether they count the spaces or the marks, or use the numbers and any other operation to work out the size of the leaf. Do they count the starting number as zero or as one?

Broken Ruler

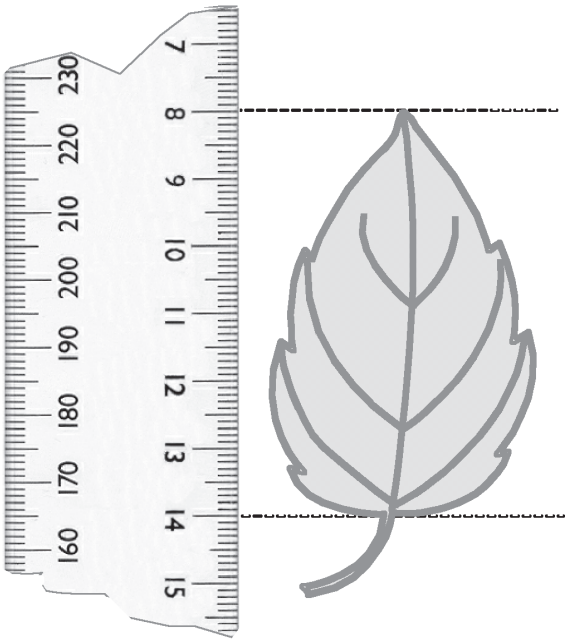
Name _____ Year _____ Date _____

(Do not use another ruler for this.)

Andrea wanted to measure the length of the leaf she had collected for Science.

All she could find was a broken ruler.

She lined up the ruler and the leaf like this.



Can you say how long the leaf is, using the broken ruler?

The leaf is _____ cm long.

Explain how you got this.

Diagnostic TASK

FOCUS

Understanding Units	Direct Measure
• Key Understanding 3	• Key Understanding 2
• Key Understanding 4	• Key Understanding 3

Desk through the Doorway

K–Year 5

Purpose

To reveal if the student:
- counts units of length to say 'how many fit'
- chooses to use units to compare lengths
- chooses appropriate units to compare lengths
- can use units without gaps and overlap
- recognises and uses part units.

Materials

Desk, or table some distance from a doorway

A variety of objects which students can choose to use as units, e.g. felt-tipped pens, pop sticks, matchsticks, paperclips, blocks, marbles, beads etc.

Teacher Recording Sheet

Procedure

Sit with a student at a desk or table that is a similar width to, but a few metres away from, a doorway, and ask:
- *How many pens do you think will fit across the table?* If necessary, prompt by saying, *Could you use the pens to check?*
- *How wide is the table?*

Observe and record what the students say and do:
- Are they careful to avoid gaps and overlaps?
- Do they only fit whole pens, or do they consider part pens as well?

Then ask:
- *If I wanted to push or slide this table out the door, do you think it would fit?*
- *Could you use something on the table to check?* (indicate the pens and the range of other objects)

Observe and record what the students say and do. Do they:
- only consider a direct comparison or non-numerical indirect comparison
- use the pen measurement to say whether the desk will fit through the doorway
- use a different unit for each measurement
- choose a unit that has length
- consider gaps and overlaps
- measure the appropriate part of the doorway
- use fractional numbers for part units.

Desk through the Doorway: Teacher Recording Sheet

Name _____ Year _____ Date _____

1. **How many pens do you think will fit across the table?** If necessary, prompt with, **Could you use the pens to check?**

2. **How wide is the desk?**

3. **If I wanted to push this table out the door, do you think it would fit? How could you check?** If the student's response is direct comparison, ask, *Is there something else we could use to work it out?*

Diagnostic TASK

FOCUS

Understand Units

- Key Understandings 3, 4

Direct Measure

- Key Understanding 3

Snail Trails

Years 1–5

Purpose

To reveal if the student:

- chooses appropriate objects to represent units of length
- counts to say 'how many fit'
- uses objects that have uniform lengths and lines up without gaps or overlaps
- chooses the same sized unit for each line
- is not distracted by the number (where there are more small units on one line and fewer larger units on the other line)

Materials

A copy of the Snail Trails sheet

Mixed range of materials, e.g. matches, blocks, counters, unifix cubes, toothpicks, paperclips, marbles etc. (include broken matches and toothpicks)

Teacher Recording Sheet

Procedure

Individual interviews are appropriate for this task.

Give the student the Snail Trails sheet and ask them to say which trail is longer (NB: the first trail is longer).

Prompt the student to use units to measure both lines to say which is longer.

If the student places the same sized unit on both lines, change the units on one line so that the number of units on the **shorter** line is more than the number of units on the **longer** line. For example, remove the units from the shorter trail and replace them with a smaller unit or, if the student has already used the smallest unit, substitute larger units on the longer line.

Ask the student to say how long each line is, using the units now on each line, and then ask the student again to say which is the longer line.

Ask the student to explain their choice by asking, *How do you know?* If the student has changed their mind, ask *Why did you change your mind?*

Record the responses.

Snail Trails: Teacher Recording Sheet

Name _____ Year _____ Date _____

1. We are going to pretend that two snails left trails on the lawn last night. Can you work out which snail left the longer trail? Use these materials to help you.

If necessary, prompt the student with, **Can you use any of these materials to find out how long this trail is?** (point to one trail) or **How many of these (cubes) fit along this line?**

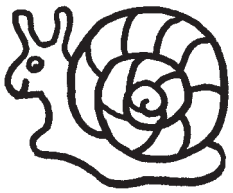
Prompt the student to measure the other trail if they do not do so independently.

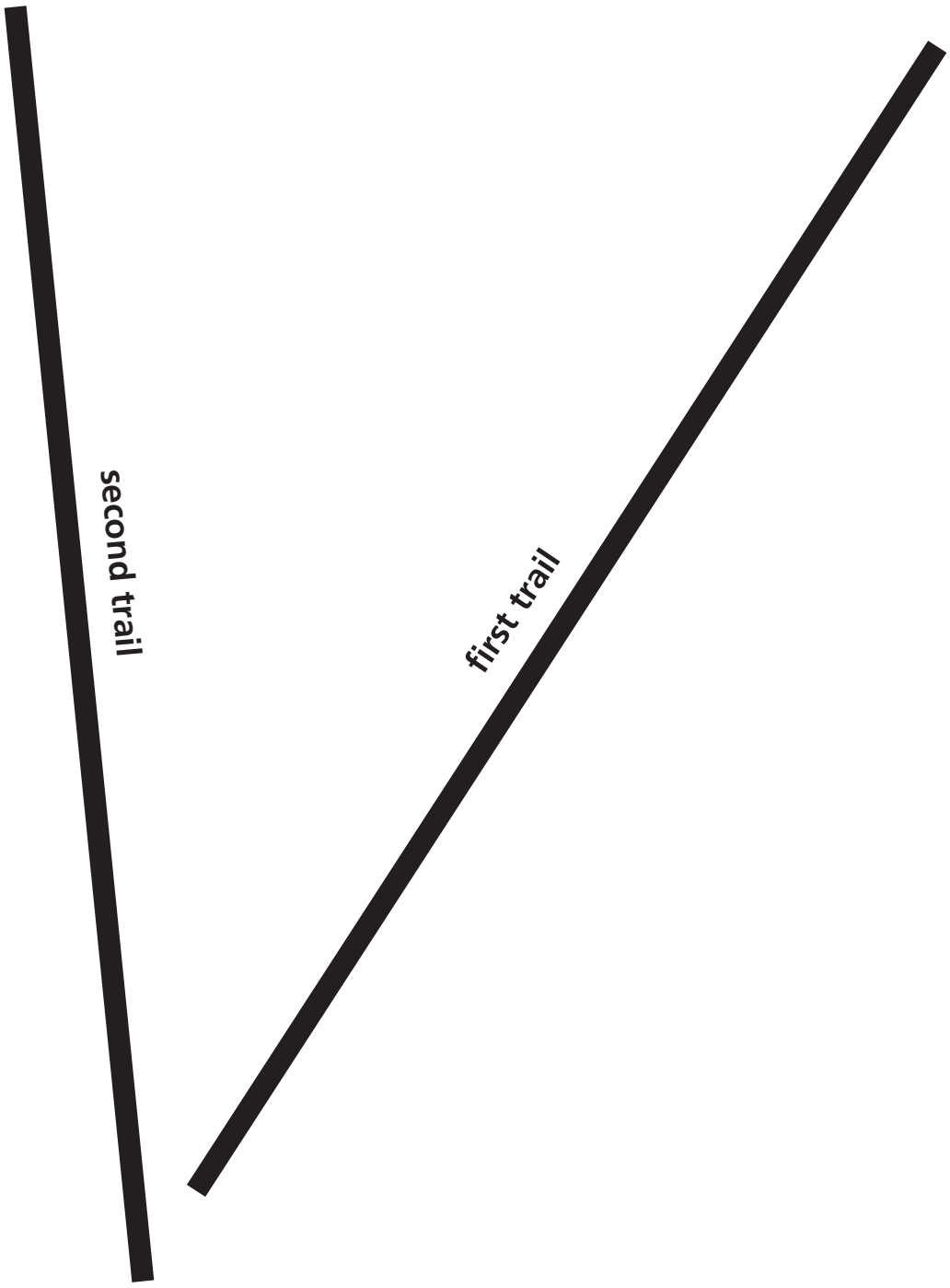
2. If the student does not tell you which trail is longer after placing materials on each line ask, **Now can you tell me which snail has the longer trail? How do you know?**

If the student chooses the same unit for both lines, remove the units from the *shorter* line and replace them with a *smaller* unit. If the student has already used the smallest unit, then substitute *larger* units on the *longer* line.

Ask: **How many counters** (or whatever unit used) **fit along here?** (point to the shorter line) **How many matches** (or whatever unit used) **fit along here?** (point to the longer line)
So which one is the longer? How do you know? If the student changes their mind, ask, **Why did you change your mind?**

Snail Trails





Diagnostic TASK

FOCUS

Understand Units

- Key Understandings 3, 4

Direct Measure

- Key Understanding 3

Which Line Is Longer? Years 4–7

Purpose

This variation of the Snail Trails task should be used to interview upper primary students who are not able to show, in the Broken Ruler task, that they are in the Measuring Phase.

To reveal if the student:

- chooses appropriate objects to represent units of length
- chooses objects that have uniform lengths, and lines up without gaps or overlaps
- chooses the same sized unit for each line
- is not distracted by the numbers (where there are more small units on one line and fewer larger units on the other line
- can explain **why** the line with more units is shorter.

Materials

A copy of the sheet with lines A and B marked

Mixed range of materials, e.g. matches, blocks, counters, unifix cubes, toothpicks, paperclips, marbles etc. (include broken matches and toothpicks)

Teacher Recording Sheet

Procedure

Individual interviews are appropriate for this task.

Give the student the sheet of paper with the two lines and ask them to say which is longer. Say: *Two students were arguing over which line was longer. Jane thought line A was longer than line B. Which do you think is longer? Use these materials to help you.*

Prompt the student to use units to measure both lines.

If the student places the same sized unit on both lines, change the units on one line so that the number of units on the **shorter** line is more than the number of units on the **longer** line. For example, remove the units from the shorter line and replace them with a smaller unit or, if the student has already used the smallest unit, substitute larger units on the longer line (NB: Line A is longer).

Ask the student to say how long each line is, using the units now on each line, and then ask the student again to say which is the longer line.

Ask the student to explain their choice by asking *How do you know?* If the student has changed their mind, ask, *Why did you change your mind?*

Record the responses.

Which Line Is Longer? Teacher Recording Sheet

Name _____ Year _____ Date _____

1. Two students were arguing over which line was longer. Jane thought line A was longer than line B. Which do you think is longer? Use these materials to help you.

If necessary, prompt with, **Can you use any of these materials to find out how long this line is?** (point to one line) or **How many of these** (cubes) **fit along this line?**

Prompt the student to measure the other line if they do not do so independently.

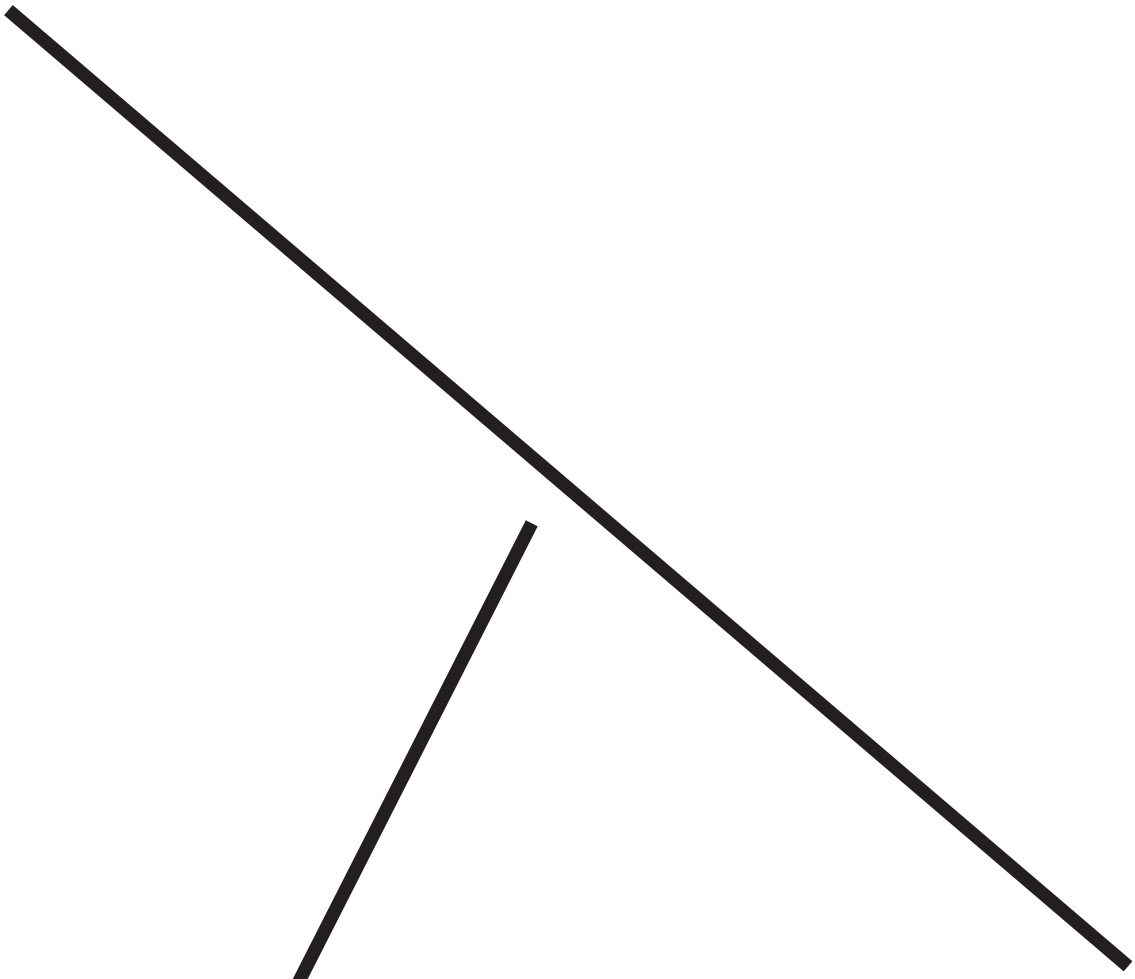
2. If the student does not tell you which line is longer after placing materials on each line ask, **Now can you tell me which line is longer? How do you know?**

If the student chooses the same unit for both lines, remove the units from the *shorter* line and replace them with a *smaller* unit. If the student has already used the smallest unit, then substitute *larger* units on the *longer* line.

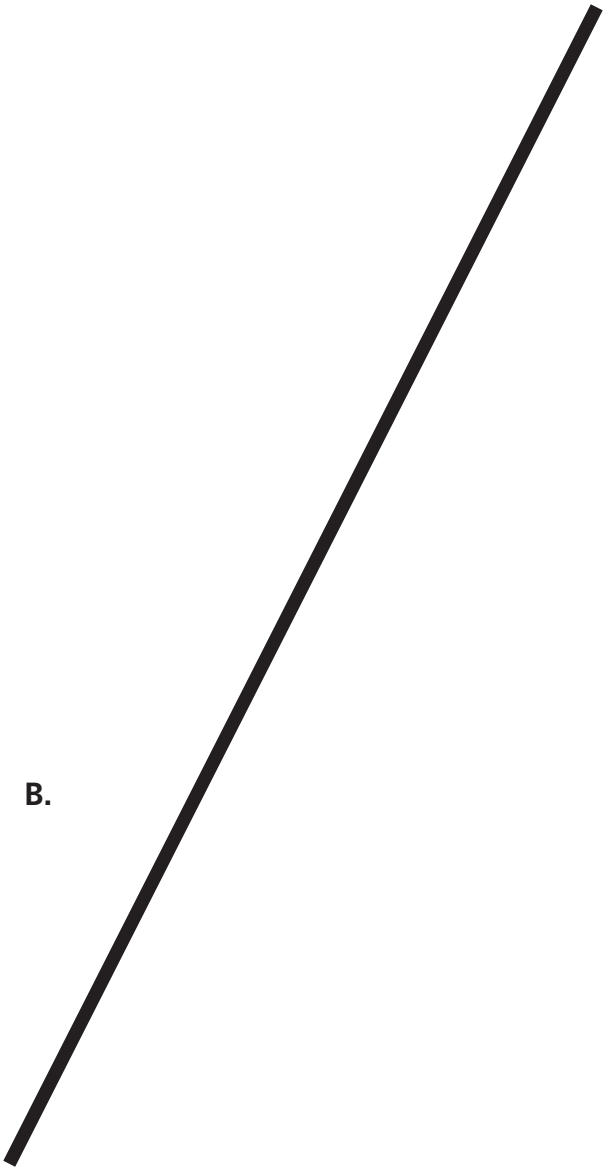
Ask: **How many counters** (or whatever unit used) **fit along here?** (point to the shorter line) **How many matches** (or whatever unit used) **fit along here?** (point to the longer line)
So which one is longer? How do you know? If the student changes their mind, ask, **Why did you change your mind?**

Which Line Segment Is Longer?

A.



B.



Diagnostic TASK

FOCUS

Understand Units

- Key Understandings 1, 2

Direct Measure

- Key Understanding 1

Which Tin?

K–Year 3

Purpose

To reveal if the student:

- focuses on and describes 2–3 attributes of one object
- compares things with respect to a particular physical attribute
- is able to use comparative language of measurement attributes.

Materials

Five tins displaying a range of attributes, i.e. short, thin, wide, tall, heavy, light
Storage box or bag for tins
Coin or similar small object to hide under a tin
Teacher Recording Sheet

Procedure

1. Begin by asking the student to take the tins out of the bag/box and put them on the table, giving them the opportunity to feel and comment on the mass. If they do not make comments about the weight of the tins, ask questions such as: *How is that tin different to the other tin?* (point to the heaviest tin). Record the exact words the student uses to compare the tins, e.g. big, not big, heavy, light, not heavy.
2. Tell the student you are going to play a game. Say: *I'm going to hide a coin under one of the tins and then give you some clues to find it. Hide your eyes. OK, Open your eyes. I have put the coin under the tall, heavy, thin tin. Can you find it?*

   Record which tin the student points to first, which attributes they focus on, and how many attributes they were able to focus on.
3. Exchange roles and ask the student to hide the coin. Say: *Now it is my turn to guess where you hide the coin. You have to give me some clues so I can guess.*

   If necessary, prompt with, *I want you to tell me as much as you can about the tin to make it easy for me to find it. Don't point to it. Keep your hands under the table, because I have to work it out from what you tell me.*

   Record which attributes the student uses and the terms they use.

   It may be necessary to prompt the student into using three clues. Say, for example, *I can see two tall, heavy tins. How will I know which one the coin is under?*

Which Tin? Teacher Recording Sheet

Name _____ Year _____ Date _____

1. How is that tin different to the other tins? (point to the heaviest tin)

2. I'm going to hide a coin under one of the tins and then give you some clues to find it. Hide your eyes. OK, open your eyes. I have put the coin under the tall, heavy, thin tin. Can you find it?

3. Exchange roles.

Now it is my turn to guess where you hide the coin. You have to give me some clues so I can guess (remind the child not to point).

After the child places the coin, prompt if necessary with, **I want you to tell me as much as you can about the tin to make it easy for me to find it. I can see two tall, heavy tins. How will I know which one the coin is under?**

Diagnostic TASK

FOCUS

Understand Units

- Key Understandings 1, 2

Direct Measure

- Key Understanding 1

Ordering Tins

K–Year 3

Purpose

To reveal if the student:

- knows that ordering objects by different attributes may result in different orders
- can use comparative words to describe order.

Materials

Five tins displaying a range of attributes, i.e. short, thin, wide, tall, heavy, light
Teacher Recording Sheet

Procedure

1. Use the tins from the Which Tins? task.

   Ask the student to put the tins in order. Say: *Please put the tins in order in some way*.

   If the student hesitates for too long, a prompt may help, e.g. *Put them in a line from biggest to smallest.*

   Record the attribute they used to order the tins.

2. Ask the students to describe the order. Say: *Tell me the idea you have used to order them. Tell me about each tin.*
   Record the words the student uses to describe their order?

3. Ask students to put the tins into a different order. Say: *Could the tins be ordered in a different way?*

   If the student hesitates for too long, prompt, e.g. *Last time you ordered by (how tall they were). This time can you use something else about the tins?*

   After they have reordered the tins, ask, *What have you used to order the tins this time?*

   Record the language the student uses.

   Consider and record:

   - Is the child able to reorder the tins?
   - Which attribute does the child use?
   - What words do they use to describe their order?

Ordering Tins: Teacher Recording Sheet

Name _____ Year _____ Date _____

1. Use tins from the Which Tin? task and ask the student to put them in order. Which attribute does the child use to order the tins?

2. Ask the student to describe the order. Say: **Tell me the idea you have used to order them.** If necessary ask, **Tell me about each tin.** If the student hesitates for too long, prompt with, **Put them in a line from biggest to smallest.** If necessary, say: **Start with the biggest one and put it over here.** What words do they use to describe their order?

3. Ask students to then put the tins into a different order. Say: **Could the tins be ordered in a different way?** If the student hesitates for too long, prompt with: **Last time you ordered by** (*how tall they were*). **This time can you use something else about the tins?** Ask, **What have you used to order the tins this time?**

Is the child able to reorder the tins?

Which attribute does the child use?

What words do they use to describe their order?

Diagnostic TASK

FOCUS

Understanding Units

- Key Understandings 1, 2

Direct Measure

- Key Understanding 1

Which Frog Is Heaviest?

K–Year 4

Purpose

To reveal if the student:

- focuses on general bigness and smallness rather than mass
- hefts to directly compare mass
- understands heavier/heaviest and lighter/lightest.

Materials

Three toy frogs (or other familiar objects). Ensure that the frogs (or other toys) conform to the following:

- Frog 1: heaviest but smallest
- Frog 2: lightest but largest
- Frog 3: middle sized and mid weight

A representation of a pond and 3 lily pads

Teacher Recording Sheet

Producing work samples

Set out the 3 frogs (or familiar objects) next to the representation of the pond and lily pad on the table.

1. Say: *Which of these frogs is the biggest?* Then ask, *Which of these frogs is the heaviest?* Record what the student does.
2. If the student picks up only one frog, prompt them to consider all three. Say: *Check to see if you are right.*
3. Say: *Put the heaviest frog on one lily pad.*
4. Then say: *Now put the lightest frog on another lily pad.*
5. To give the student the opportunity to use the language, say: *Tell me about which frog you have put on each of the lily pads.*

Which Frog Is Heaviest? Teacher Recording Sheet

Name _____ Year _____ Date _____

1. Which of these frogs is biggest? Which of these frogs is the heaviest?

2. Check to see if you are right.

3. Put the heaviest frog on the lily pad.

4. Now put the lightest frog on another lily pad.

5. Tell me about what you have on the lily pads.

Comments

Which Frog Is Heaviest?

Video of Jordan, 4 years, 8 months.

What does Jordan know about mass?

Which phase does this suggest for Jordan? Why?

Planning for Learning

What mathematics does Jordan need to learn?

Key Understandings

Sample Learning Activities

Diagnostic TASK

FOCUS

Understanding Units

- Key Understandings 3, 4, 5

Direct Measure

- Key Understandings 2, 3, 5

How Heavy Is this Frog/Tin? Years 5–7

Purpose

To reveal if the student:

- uses balance scales accurately to match the mass of an object
- counts how many whole uniform units match the mass of an object
- knows to use the same size objects to compare two quantities
- lets the number of units override their perceptual judgment
- understands and uses the notion of part units when describing the size of an object.

Materials

A fabric, weighted frog or Tin One (heavier but smaller); a second frog or Tin Two (lighter but bigger)

Balance scales

Set of washers

Assorted marbles, wooden and plastic blocks and other objects

Set of weights (e.g. Invicta blue 20 g, 10 g, 5 g)

Teacher Recording Sheet (use as worksheet for small or whole class assessment or observation sheet for individual interview)

Procedure

1. Say: *Which of these two frogs (tins) is heavier? How do you know?*
   (To check if the notion of heaviness is dominated by visual perception and give students the opportunity to self correct after lifting the tins.)

2. Point to one of the frogs (tins) on the desk. Say: *How heavy do you think this frog (tin) is?* Wait for an answer, then say: *Is there any way we could find out for sure?*
   Prompt students to use balance scales if necessary and provide various objects.
   Say: *Let's use some of these materials to find out how heavy your frog (tin) is.*

3. After the student has weighed the frog (tin) ask, *So how heavy is this frog (tin)?* After the student answers, say: *Is that exactly how much it weighs?* (To see if students will use smaller units to become more accurate.)

4. If the child is able to use units to weigh one frog (tin), then ask them to use a different unit to measure the other frog. Say: *Can you weigh this frog (tin) with* _____ (name of different unit)? Suggest lighter objects to weigh the lighter frog or heavier objects to weigh the heavier frog.

5. After the child has weighed the second frog (tin), say: *How heavy is this frog (tin)? Which frog (tin) is heavier? How do you know?* Then say: *How much heavier is this frog (tin) than the other?*

How Heavy Is this Frog/Tin? Teacher Recording Sheet

Name _____ Class _____ Date _____

Which of these two frogs/tins is heavier?

How do you know?

Choose one frog/tin. How heavy do you think this tin is?

Use the balance scales to weigh this frog/tin.
How heavy is it exactly?

How did you work it out?

Weigh the second frog/tin using _____ How heavy is this one?

So which one is the heavier?

How do you know?

How much heavier is this tin than the other tin?

How did you work it out?

Diagnostic TASK

FOCUS
Direct Measure
- Key Understanding 4

Kitchen Scales

Years 5–7

Purpose

To reveal if the student:

- understands that the graduations on a kitchen scale mark the end points of gram and kilogram units.

Materials

A copy of the worksheets pages 84-87

Producing work samples

Small group or whole class

Provide every student with their own copy of the work sheets.
Read through the sheet for the students and ensure that they understand the task.

Individual interviews

These may be needed as a follow-up to clarify how some students found their answers.

Kitchen Scales: Student Work Sheet

Name _____ Year Level_____ Date _____

How much does the jar of coffee weigh? _____

How did you work it out?

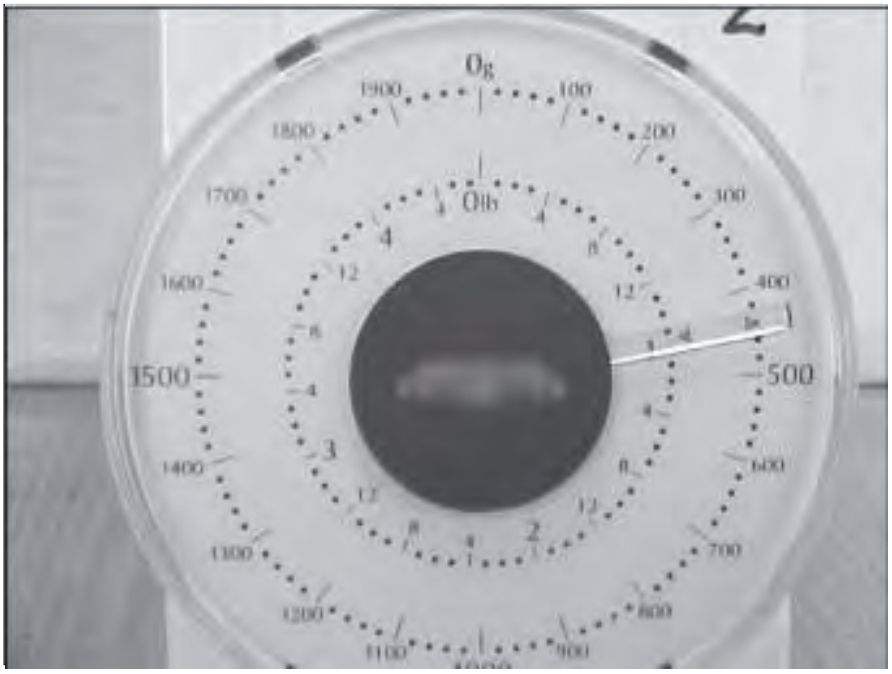
_____

_____

_____

Kitchen Scales: Student Work Sheet

Name _____ Year Level_____ Date _____



How much does the cup weigh? _____

How did you work it out?

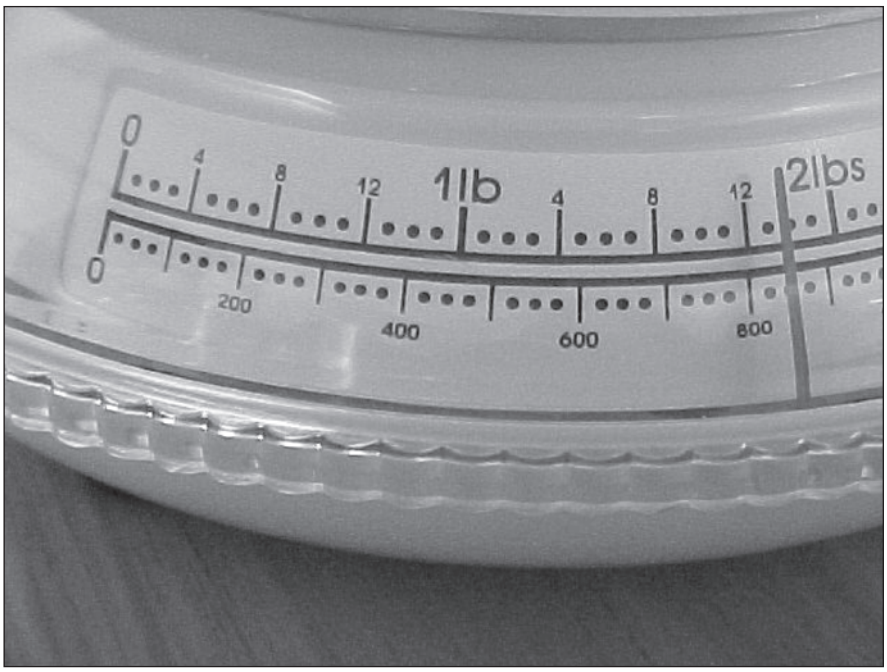
_____

_____

_____

Kitchen Scales: Student Work Sheet

Name _____ Year Level_____ Date _____



How much does the cup weigh? _____

How did you work it out?

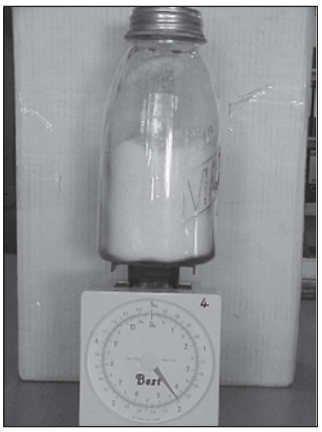
_____

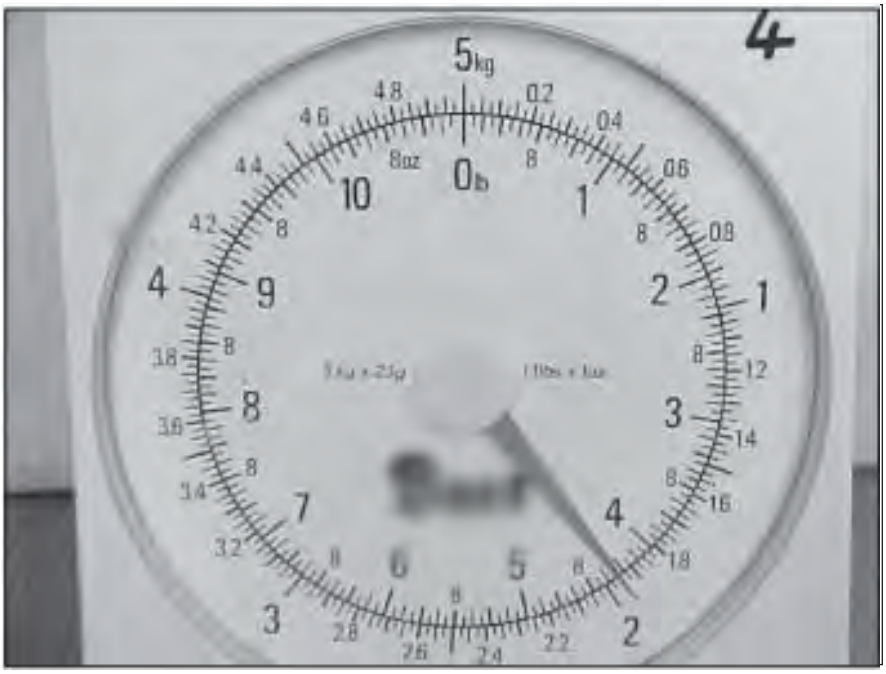
_____

_____

Kitchen Scales: Student Work Sheet

Name _____ Year Level_____ Date _____





How much does the jar of sugar weigh? _____

How did you work it out?

_____

_____

_____

Diagnostic TASK

FOCUS

Understanding Units

- Key Understanding 1

Direct Measure

- Key Understanding 1, 2

Pour to Decide

K–Year 4

Purpose

To reveal if the student:

- responds to and/or uses capacity language
- estimates which of two containers holds more drink
- can compare two containers to find out which one holds more by pouring water from one to the other.

Materials

Two quite differently shaped clear plastic drinking glasses
Cloth for spillage
Bucket of water (rice or sand can be used)
Teacher Recording Sheet

Procedure

Individual interview

Ask, *Which of these two glasses will hold the most drink? How do you know?* Record exactly what the student says.

If the student fills both containers and makes a judgment just by looking, prompt for direct comparison strategies. Ask, *Is there something else you could do to work out which one holds more?*

If the student does not realise that they can use the water to compare the capacities, fill the larger glass and say, *Pour the water into the other glass to see which one holds the most*. Record what the student says and does.

Small group

This task could be conducted as a small group activity. Provide each child with their own set of equipment and observe and record their actions and conversation. Use the suggested questions from above.

Refer to Direct Measure, Key Understanding 1, Did You Know? on page 107 to help interpret why some students do not know to stop pouring when the water begins to overflow.

Pour to Decide: Teacher Recording Sheet

Name _____ Year _____ Date _____

1. Which cup will hold the most drink? How do you know?

2. If the child fills both containers and makes a judgment by just looking, prompt for direct comparison strategies with: **Is there something else you could do to work out which one holds more?**

Further prompt with: **Will filling one container with water, help you to work out which one holds more? Show me.**

Other questions:

Diagnostic TASK

FOCUS
Direct Measure
- Key Understanding 4

Make a Measuring Jug

Years 4–7

Purpose

To find out if the student understands that the calibrated scale on a measuring jug shows the units of capacity.

Materials

Bucket of water
Range of lids, caps, spoons, toy cups and a medicine glass
Permanent fine-tipped pen
Ruler
Container that is wider at the top than the base, e.g. a round, transparent take-away food container or plastic cup
Old towel to mop up afterwards.

Producing work samples

This task could be used as an individual interview, small group or whole class.

Individual interview

Ask the student to make the clear plastic cup or container into a measuring jug to use for small quantities of liquid (e.g. paint in the art lesson).

Provide a range of materials for the student to select from.

Record what the student does and says.

Small group or whole class

Observe all students and take note of whether they choose to use a unit to fill the container and mark the scale on the side accordingly, or whether they use another method. Choose three or four students to talk to in depth, asking them to explain what they are doing and why.

Diagnostic TASK

FOCUS

Understanding Units

- Key Understandings 3, 4

Direct Measure

- Key Understanding 3

Leaf Task

Year 4–7

Purpose

To reveal if the student:

- understands the attribute of area
- can use units to measure the area of the leaf
- considers the gaps and overlaps when using units.

Materials

A copy of the Leaf Task sheet

A variety of materials: small and large blocks, pattern blocks, grid paper, counters, cotton balls, paper clips, buttons, unifix cubes, centicubes, pasta, bread tags, bottle tops, etc.

Procedure

Individual interview

Interviews are appropriate for younger students or for students whom teachers consider may be at risk.

Provide a copy of the Leaf task sheet and a mixture of materials in one container.

Ask the child: *Can you please use the materials to work out the area of the leaf?*

Note whether the child attends to the gaps between the units. Ask all students to explain their thinking: *Does it matter if you have gaps between your units? Why?*

Note whether the child attempts to keep the units within the leaf outline. Ask all students to explain their thinking: *Does it matter if you have some units overlapping the edge of the leaf? Why?*

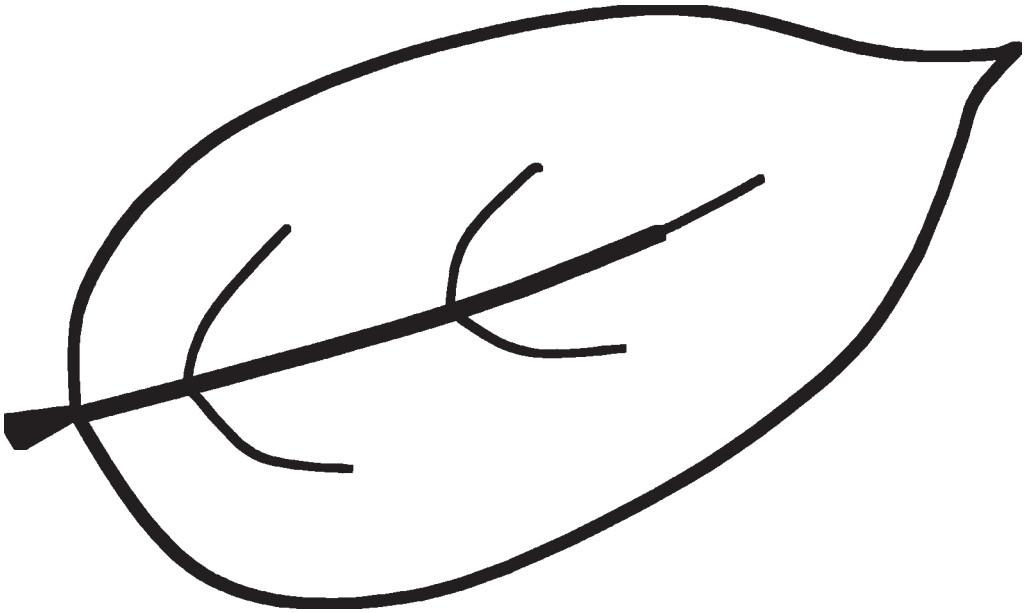
Small group

This task may be conducted with a small group, using the instructions above. Take note of which children attend to the gaps and overlaps and then ask them to explain their thinking.

Leaf Task

Name _____ Year _____ Date _____

Measure the area of the leaf and show or explain how you did it.



Diagnostic TASK

FOCUS

Understand Units

- Key Understandings 1, 2, 3, 4, 5, 6

Direct Measure

- Key Understanding 1, 2, 3, 5

Indirect Measure

- Key Understanding 1, 4

Ice Cream Puddles

K–Year 7

Purpose

To investigate what the child knows about:

- the attribute of area
- directly comparing area
- using units to measure and compare areas
- using rectangular arrays and area formula as a shortcut.

Materials

Cardboard cut-out of the two ice cream puddles

A variety of objects for use as units, e.g. 1 cm and 2 cm cubes, tiles, marbles, pattern blocks, round counters

A collection of measuring equipment that extends beyond that required to measure area, e.g. balance scales, measuring cylinders, string, measuring tape, ruler, pencil, scissors, glue, plain paper, square gird paper; also, a container of sand, rice or water

Teacher Recording Sheet

Producing work samples

Individual interview

Hand the child the cut-out of the two puddles and present this scenario: On a very hot day, two children drop their ice creams on the ground. They melt, making two ice cream puddles.

1. Ask, *Which puddle is bigger? Are you sure? Show me how you know*. Prompt the child to pick up the puddles if they do not choose to superimpose.

2. Point to the puddle they have chosen as the largest and ask, *How big is that puddle?* If necessary prompt the child to use the materials, *Can you use the materials to work it out?*

3. If the child uses materials that are easy to count, ask them to compare the two puddles, *How much bigger is that puddle* (the one they have chosen) *than the other one?* If they choose to draw a grid across the puddle, then do not ask them to compare the two puddles.

4. If the child **does not** use the materials to work out the size of the first puddle, or if they use materials that are not easy to count, such as sand or string, then prompt again by asking, *How much bigger is that puddle (the one chosen) than the other one?*

Ask the child to write/draw what they did to work it out. Record observations on the record sheet provided.

Small group

This task may be administered to a small group of middle and upper primary students using the instructions above. Each student needs a copy of the two puddles and easy access to the materials listed above. Ask them to write and draw what they did to work it out. Note what individual students say and do throughout the activity, using the record sheet.

Ice Cream Puddles: Teacher Recording Sheet

Name _____ Year _____ Date _____

Say: On a very hot day, two children drop their ice creams on the ground. They melt, making two ice cream puddles.

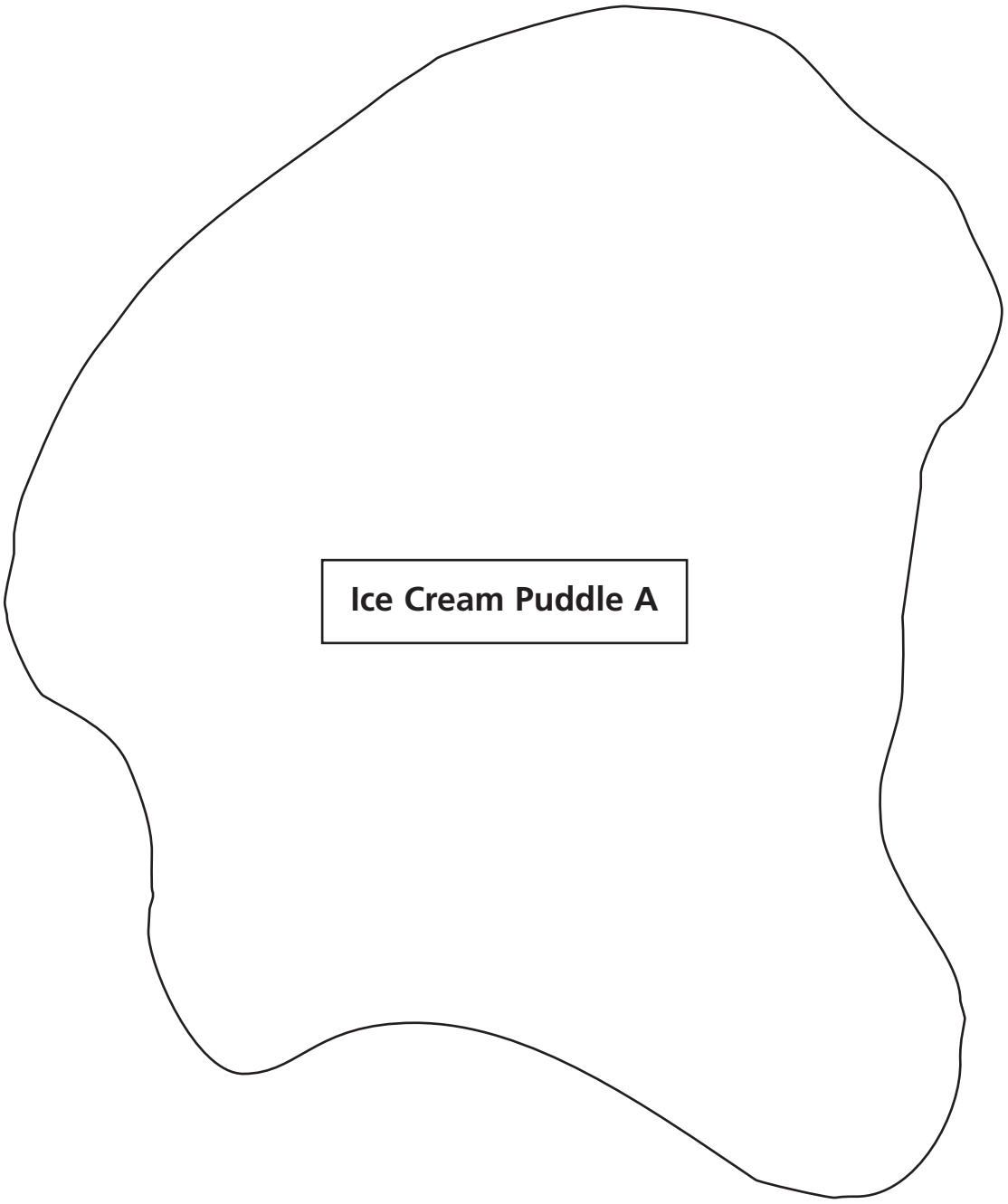
1. Which puddle is bigger? Are you sure? Show me how you know.
If necessary, prompt the child to pick up the puddles.

2. Point to the puddle they have chosen as the largest. **How big is that puddle?**
If necessary, prompt with, **Can you use the materials to work it out?**

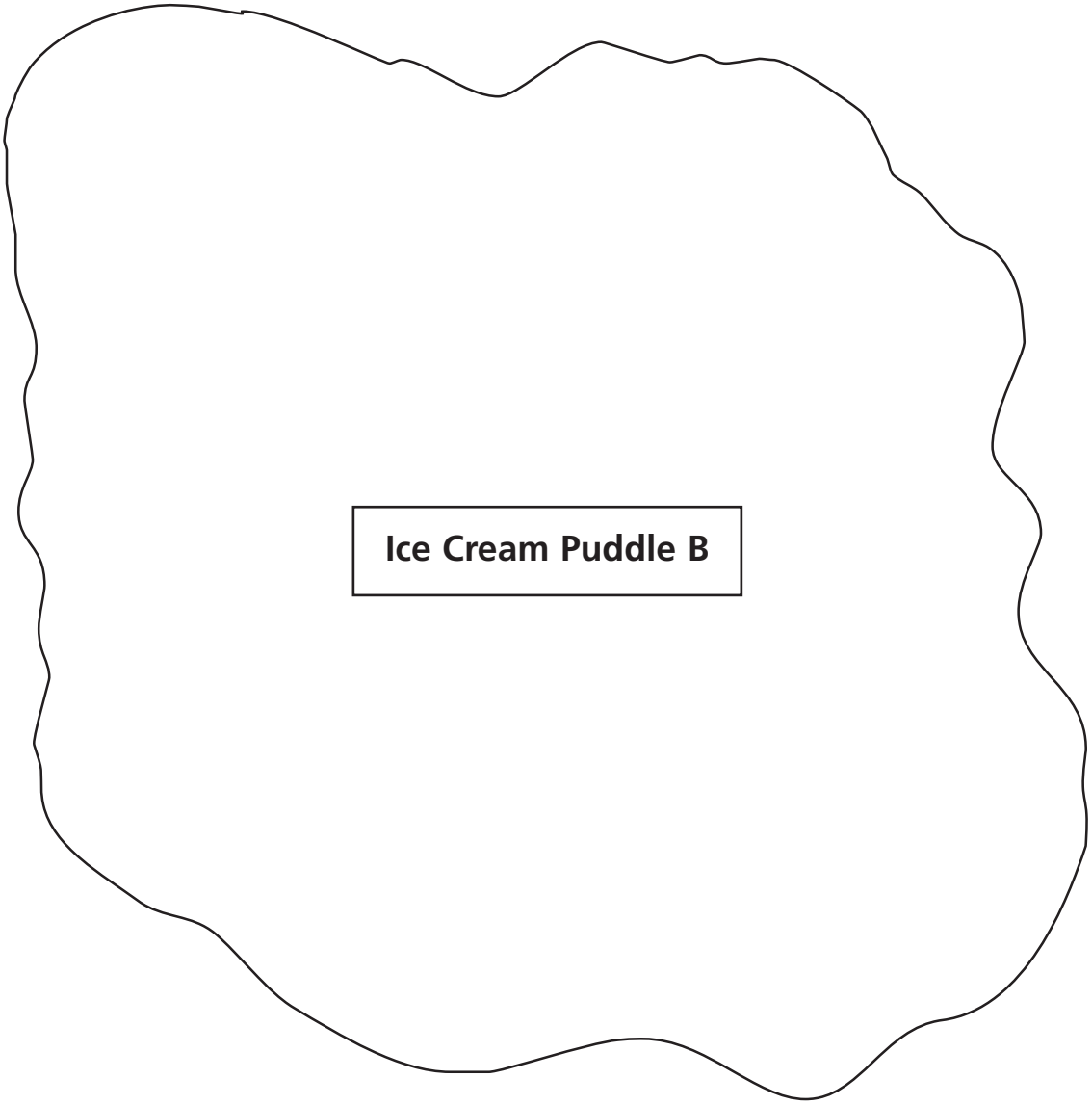
3. If the child uses materials that are easy to count, ask, **How much bigger is that puddle** (the one they have chosen) **than the other one?** If the child chooses to draw a grid across the puddle, then do not ask them to compare the puddles.

4. If the child *does not* use the materials to work out the size of the first puddle, or uses materials that are not easy to count, such as sand or string, prompt with, **How much bigger is that puddle** (the one chosen) **than the other one?**

Ice Cream Puddles



Ice Cream Puddles



Diagnostic TASK

FOCUS

Understand Units

- Key Understandings 1, 3, 7

Direct Measure

- Key Understanding 3

Indirect Measure

- Key Understanding 1

What Is the Area? Year 5–8

Purpose

To investigate what children know about:

- using an array structure as a shortcut to counting squares
- using the area formula.

Materials

Worksheets

A variety of objects that can be used as units, e.g. 1 cm and 2 cm cubes, tiles, marbles, pattern blocks, round counters.

A collection of measuring equipment that extends beyond that required to measure area, e.g. balance scales, measuring cylinders, string, measuring tape, ruler, pencil, scissors glue, plain paper, and square gird paper; also a jug of sand, rice or water.

Producing the work samples

Individual interview

Interviews are appropriate for younger students or for students whom teachers consider may be at risk. Read and familiarise children with the tasks on the sheets. Students carry out the tasks and record how they worked it out. They may need assistance to record this information.

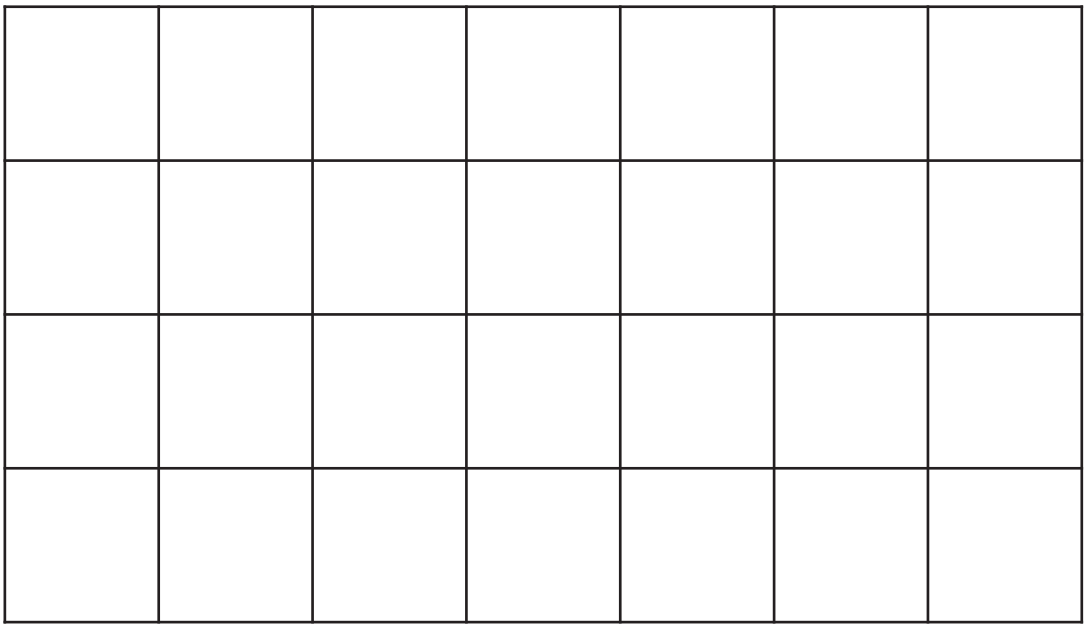
Small group or whole class

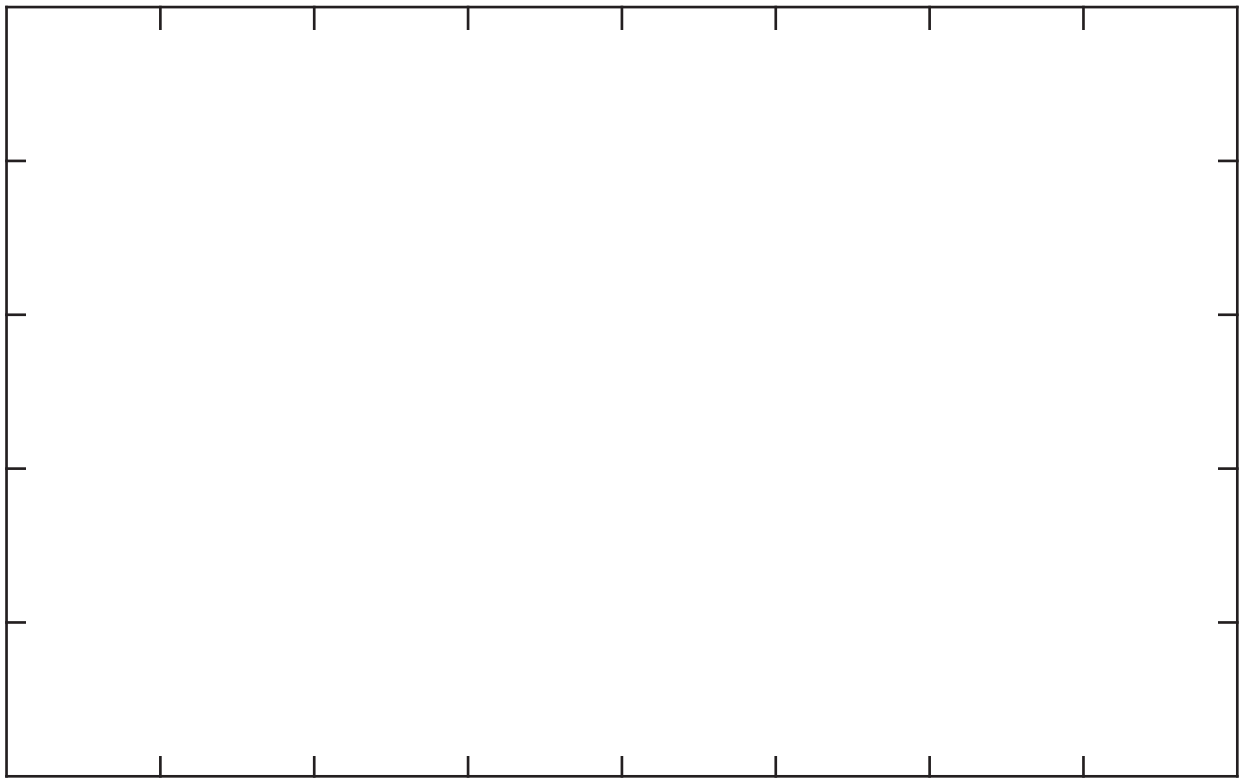
These tasks may be administered in small groups or with the whole class. Read and familiarise children with the task on the sheet. Students carry out the task and record how they worked it out. They may need assistance to record this information. Observe and record how the students worked it out and what they refer to as their unit of area.

What Is the Area? 1

Name _____ Year _____ Date _____

What is the area of these shapes? Write how you worked each one out?

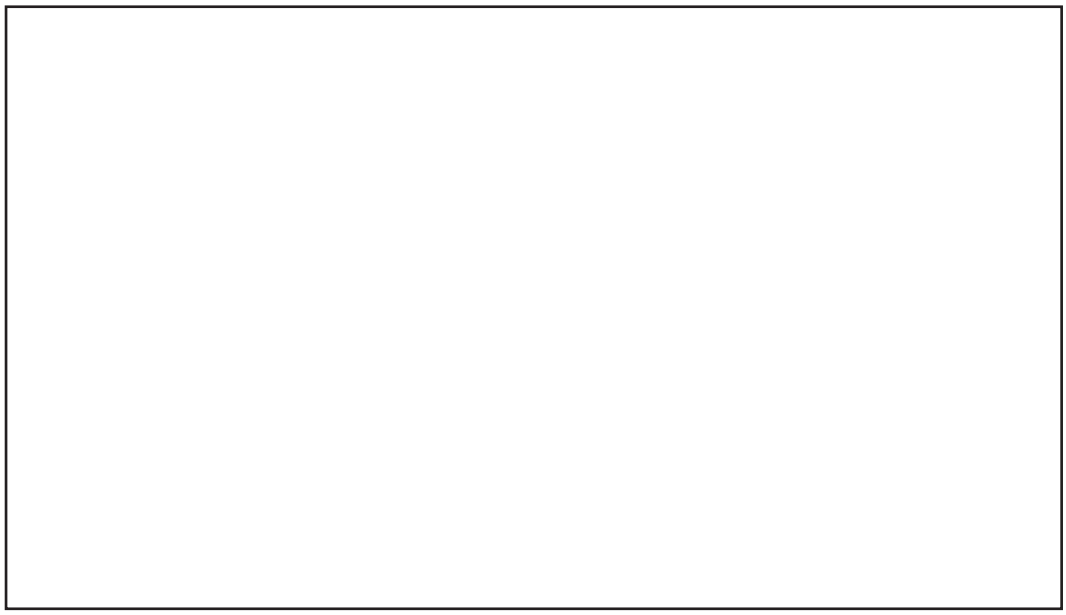


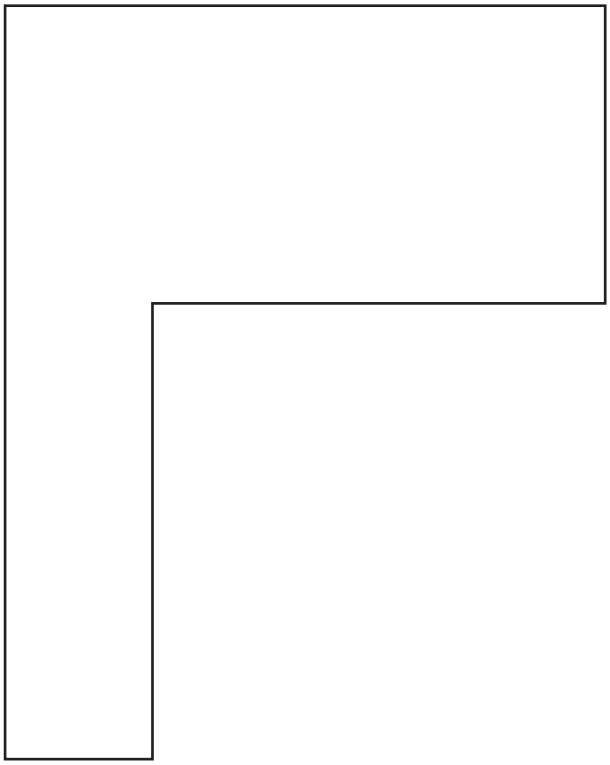


What Is the Area? 2

Name _____ Year _____ Date _____

What is the area of these shapes? Write how you worked each one out?





Diagnostic TASK

FOCUS

Understand Units

- Key Understanding 1, 3, 7

Direct Measure

- Key Understanding 3

Indirect Measure

- Key Understanding 1

Tiling Problem

K–Year 4

Purpose

To investigate how and if children use an array structure when working out how many tiles fit in a rectangle.

Materials

One 2 cm tile, cardboard square or block along with the worksheet.

The rectangle may have to be adapted to match the dimensions of the available tile if it is not exactly 2 cm square.

Producing the work samples

Individual interview

Interviews are appropriate for younger students or for students whom teachers consider may be at risk. Read and familiarise children with the task on the sheet. Students carry out the task and record how they worked it out. They may need assistance to record this information.

Small group

Administering this task in small groups is appropriate for Years 3–4 children. It is advantageous for the teacher to observe and record what the children say and do throughout the activity. Read and familiarise children with the task on the sheet. Children carry out the task and record how they worked it out. They may need assistance to record this information.

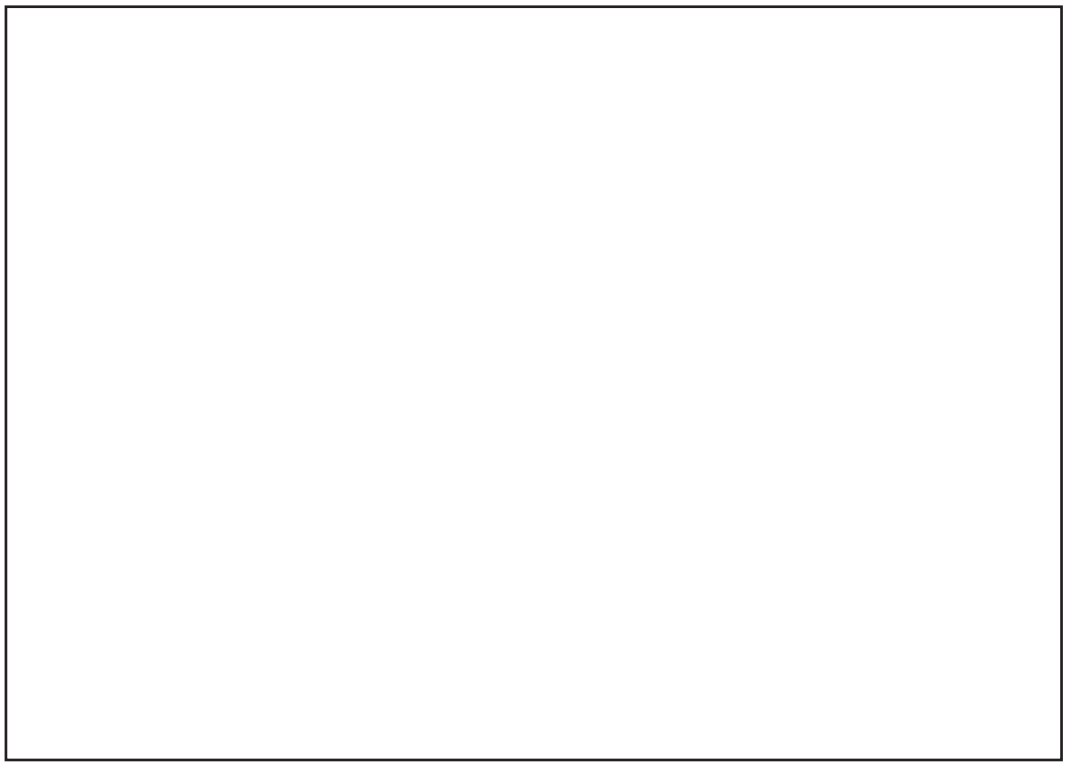
Whole class

This task is suitable for a whole class for Year 3 and 4 children who are able to write how they work things out. Children may need help to record this information.

Tiling Problem

Name _____ Year _____ Date _____

Materials: one 2 cm square of cardboard, tile or cube and the worksheet.
How many 2 cm squares or tiles would you need to cover the rectangle?



How did you work it out?

Diagnostic TASK

FOCUS

Understanding Units

- Key Understandings 1, 2, 3

Direct Measure

- Key Understandings 1, 2, 5

Indirect Measure

- Key Understandings 1, 4

Which Has More Volume?

Years 5–7

Purpose

To investigate:

- what students know about the attribute of volume
- what students know about directly comparing volume
- how they use units to measure and compare volume
- whether they understand the relationship between millilitres and cubic centimetres (Direct Measure, Key Understanding 5).

Materials

A wooden or plastic block (about 5 cm x 5 cm x 5 cm = 125 cm^3)
A lump of playdough or Blu Tac rolled out to look longer and thinner than the block
Assorted objects that can be used as units, e.g. 1 cm and 2 cm cubes, marbles and pattern blocks
Sand and water, two identical transparent measuring jugs, ruler, pencil, measuring cylinders, balance beams, kitchen scales, string and square grid paper
Teacher Recording Sheet

Producing the Work Samples

Individual interview

Interviews are appropriate for students whom teachers consider to be at risk. They can also be used to sample a range of ability levels in order to give the teacher an idea of the students' thinking about volume.
Ask the questions from the Teacher Recording Sheet and encourage students to use whatever they need to answer them.

Small group or whole class

This task is appropriate for Year 6 or 7 students. The objects are placed in a central position and the last two questions modified to:

- How could you use the materials in front of you to work out which object has more volume?
- How could you use the materials to work out how much more volume the larger one has?

Which Has More Volume? Teacher Recording Sheet

Name _____ Year _____ Date _____

1. What does volume mean?

2. Do the two objects in front of you have the same volume? Explain.

3. Which object has more volume? Use the materials in front of you to work it out. How did you work it out?

4. How much more volume does the larger one have? Use the materials in front of you to work it out. How did you work it out?

Diagnostic TASK

FOCUS

Understanding Units

- Key Understandings 1, 2, 3

Direct Measure

- Key Understanding 1, 3

Indirect Measure

- Key Understandings 1, 4

Which Lunchbox Holds More? Years 3–7

Purpose

To investigate:

- what students know about the attribute of volume
- how they use units to measure and compare volumes.

Materials

Two small lunchboxes or small boxes that are different in volume but not easy to compare visually (it is important that some of the inside dimensions not be a whole number measure)
Assorted objects that can be used as units, e.g. 1 cm and 2 cm cubes, marbles or pattern blocks (no rice, sand or water); have only enough units to fill the larger container
Ruler, pencil, measuring cylinders, measuring jugs, balance beams, kitchen scales, string and square grid paper
Teacher Recording Sheet

Producing the Work Samples

Individual interview

Interviews are appropriate for students whom teachers considered to be at risk. They can also be used to sample a range of ability levels in order to give an idea of the students' thinking about volume. Interviewing those students who have carried out diagnostic tasks with other attributes will help build a more complete picture of the understandings of a few individuals.

1. Point to the two lunchboxes and ask, *Which lunchbox (or box) holds more? Which lunchbox holds more volume?* If the student guesses ask, *How can you be sure?*
2. If appropriate ask, *How much more volume does the larger one hold?*

Small group

Small groups are appropriate for Year 3 or 4 students if they each have two lunchboxes to compare and there are enough materials available. It is useful for the teacher to observe and record what the children say and do, using the Teacher Recording Sheet. Read and familiarise students with the task. Observe and record how children carry it out.

Which Lunchbox Holds More? Teacher Recording Sheet

Name _____ Year _____ Date _____

1. Which lunchbox (or box) holds more lunch? Which holds the largest volume? How can you be sure?

2. How much more volume does it hold? How did you work it out?

Diagnostic TASK

FOCUS
Indirect Measure
- Key Understandings 1, 4

Block Towers

Years 4–9

Purpose

- To investigate if and how students use the array structure when counting blocks in three-dimensional arrays
- To provide an idea of the range in students' thinking about three-dimensional arrays

This task is appropriate for students in the later primary years who are unable to correctly carry out the Volume of Prisms (1) task. These students may have had difficulty interpreting the two-dimensional representations of the prisms. Their problem may be spatial and not related to measurement or number.

Materials

Three-dimensional representations (1 cm wooden cubes glued together) of the prisms in the Volume of Prisms (1) task (see below)
Teacher Recording Sheet

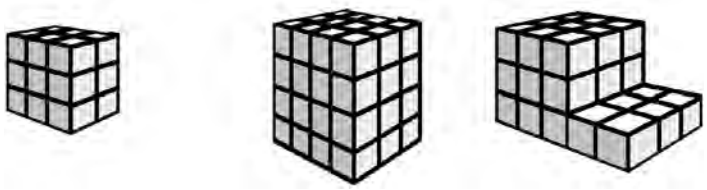
Producing the Work Samples

Individual interview

Interviews are appropriate for students whom teachers consider to be at risk, particularly those unable to correctly carry out the Volume of Prisms (1) task.
Give the student a block tower to handle and ask, How many cubes in this block tower?
Then ask, How did you work it out?
Observe and record what the student says and does throughout the activity.

Small group

This task is appropriate for older students if there are enough block towers available.
Read and familiarise students with the task. Observe and record how they carry it out.



Block Towers: Teacher Recording Sheet

Name _____ Year _____ Date _____

Give the student the block towers in turn and ask:

1. How many cubes in this block tower? How did you work it out?

2. How many cubes in this block tower? How did you work it out?

3. How many cubes in this block tower? How did you work it out?

Diagnostic TASK

FOCUS
Indirect Measure
- Key Understandings 1, 4

Volume of Prisms (1) Years 4–9

Purpose
To investigate what students understand about:
- using an array to work out the volume of rectangular prisms
- using the *l* x *w* x *h* formula
- working out the volume of more complex prisms.

Students who make errors with this task may not be able to interpret the two-dimensional representation of the prisms. They need to carry out the Block Towers task.

Interviewing those students who have carried out diagnostic tasks with other attributes will help build a more complete picture of the understandings of a few individuals.

Materials
Volume of Prisms (1) sheet
Teacher Recording Sheet

Producing the Work Samples

Individual interview
Interviews are appropriate for students whom the teacher considers to be at risk. They can also be used to sample a range of ability levels in order to give the teacher an idea of the students' thinking about volume.

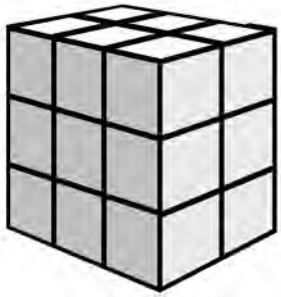
Read and familiarise students with the task. Students carry out the task and record how they worked it out. They may need help from the teacher to record their method of working.

Small group or whole class
Read and familiarise students with the task. Observe and record how the students work out the problem and how they refer to their unit of volume.

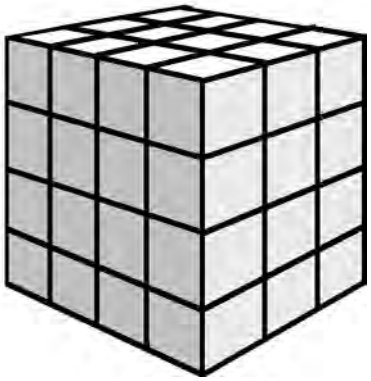
Volume of Prisms (1): Teacher Recording Sheet

Name _____ Year _____ Date _____

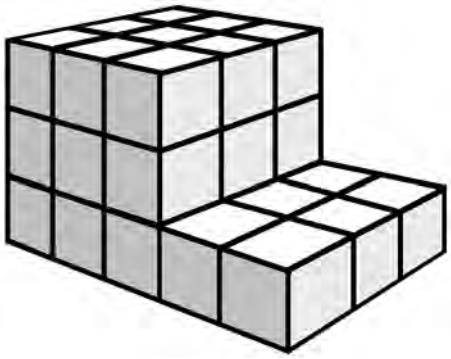
1. What is the volume of this prism? How did you work it out?



2. What is the volume of this prism? How did you work it out?



3. What is the volume of this prism? How did you work it out?



Diagnostic TASK

FOCUS
Indirect Measure
- Key Understandings 1, 4

Volume of Prisms (2) Years 5–9

Purpose
To investigate what students understand about:
- working out the volume of rectangular prisms that have fractional side lengths
- using the *l* x *w* x *h* formula
- working out the volume of more complex prisms.

Materials
Volume of Prisms (2) sheet
Teacher Recording Sheet

Producing the Work Samples

Individual interview
Interviews are appropriate for students whom the teacher considers to be at risk. They can also be used to sample ability levels in order to give the teacher an idea of the students' thinking about volume.

Read and familiarise students with the task. Students carry out the task and record how they worked it out. They may need help from the teacher to record their method of working.

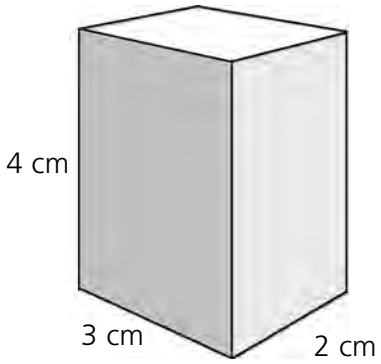
Small group or whole class
Read and familiarise students with the task. Observe and record how the children worked it out and how they refer to their unit of volume.

Please note: the volume of the prism in the second diagram is 4.5 cm x 3.5 cm x 2.5 cm. It includes fractional lengths but does not indicate this with numbers, to see if students understand the formula as above *l* x *w* x *h*.

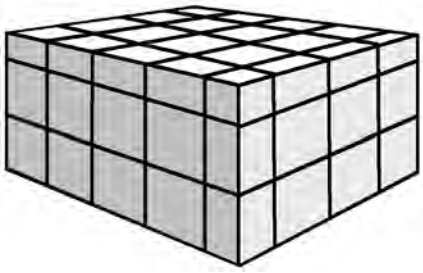
Volume of Prisms (2): Teacher Recording Sheet

Name _____ Year _____ Date _____

1. What is the volume of this prism? How did you work it out?



2. What is the volume of this prism? How did you work it out?



Diagnostic TASK

FOCUS

Understanding Units

- Key Understanding 8

Direct Measure

- Key Understanding 4

Page Sections

Years 5–9

Purpose

To investigate children's understanding of standard centimetre lengths and their relationship to decimal numbers (to one or more decimal places).

Materials

Page Sections sheet.

Producing the work samples

Whole Class

Hand a copy of the Page Sections sheet to each child. Read through the instructions so students are clear about what is required, but do not mention 'divide' or 'division' or give any clues about how they should proceed.

Remind students to write down what they did to find the correct mark for each ruler. Follow-up questioning may be needed if individual students give insufficient information about their thinking.

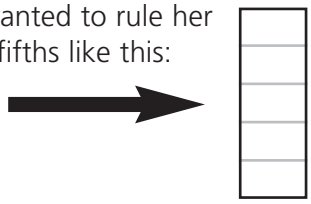
Individual interview

These are appropriate if children are unable to read the information. As with the whole class, avoid giving clues about what to do. You can scribe the child's explanations if they are unable to do this for themselves.

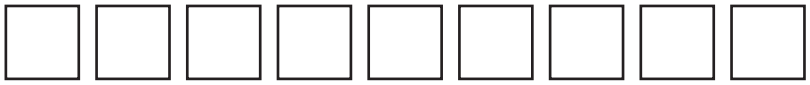
Note: Students may recognise that when measuring in centimetres, one decimal place tells how many millimetres. But they may not realise that the first decimal place always shows how many millimetres, and that decimal places beyond the first place are therefore about parts of a millimetre. The language students use to explain their interpretation of the numbers can help you to see whether they understand why this is so.

Page Sections Name _____ Year _____ Date _____

Carrie wanted to rule her page in fifths like this:



She measured the length of the page and it was 29.5 cm long. Show the calculator keys she would need to press to work out where to draw the lines.



This is the answer Carrie's calculator gave:

5.9

Show on this ruler where she needs to draw the **first** line, and the **second** line.

How did you know where to mark the ruler?

Carrie wanted to rule another page in quarters. She used her calculator and this is the answer she got:

7.375

Show on this ruler where she needs to draw the **first** line and the **second** line.

How did you know where to mark the ruler?

Carrie wanted to rule her last page in thirds. She used her calculator and this is the answer she got:

9.8333333

Show on this ruler where she needs to draw the **first** line only.

How did you know where to mark the ruler?

Diagnostic TASK

FOCUS
Understanding Units
- Key Understanding 8

Decimals and Measures Years 5–9

Purpose
To investigate children's ability to relate decimal numbers to units of mass, time and length.

Materials
Decimals and Measures sheet.

Producing the work samples
Whole Class
Hand a copy of the Decimals and Measures sheet to each child. If necessary, read it to them, without giving any clues as to how to complete it.
Encourage the children to give a full explanation for each part.
Follow-up questioning may be needed if individual students give insufficient information about their thinking.

Individual interview
These are appropriate if students are unable to read the information. As with the whole class, avoid giving clues about what to do. You can scribe the child's explanation if they are unable to do this for themselves.

Decimals and Measures

Name _____ Year _____ Date _____

We know that **3.25 metres** is equal to **3 metres** and **25 centimetres**.

So why can't **3.25 kilograms** be equal to **3 kilograms** and **25 grams**?

What does **3.25 kilograms** equal? _____ kilograms and _____ grams

And why can't **3.25 hours** be equal to **3 hours** and **25 minutes**?

What does **3.25 hours** equal? _____ hours and _____ minutes

And why can't **3.25 centimetres** be equal to **3 centimetres** and **25 millimetres**?

What does **3.25 centimetres** equal? _____ centrimetres and _____ millimetres

Jacob had to cut 33 metres of rope into 8 equal length pieces.

He used his calculator and pressed: 3 3 ÷ 8 =

This is what he saw on his calculator: 4.125

What length will he need to cut each piece of rope? _____

Explain how you know.

Jacob knew you can measure the same length using different units, so he said the length of each piece is:

_____ metres OR _____ centimetres OR _____ millimetres