Exploring 3D objects, angles and symmetry

Assessment description	Category
Students identify and describe 3D objects, recognise symmetry and identify and compare angles.	Written
	Technique
	Supervised assessment
Context for assessment	**Alignment**
Students are surrounded by 3D objects, angles and symmetry from an early age. Developing understanding of these concepts allows students to work mathematically. This assessment provides an opportunity for teachers to gather evidence of students' developing understanding of these concepts.	• Australian Curriculum v5.1, Year 3 Mathematics Australian Curriculum content and achievement standard, ACARA — Australian Curriculum, Assessment and Reporting Authority, www.australiancurriculum.edu.au • Year 3 Mathematics standard elaborations, www.qsa.qld.edu.au/downloads/p_10/ac_math_yr3_se.doc
	Connections
	This assessment could be used with the QSA Australian Curriculum resource titled *Year 3 unit overview — Mathematics exemplar* (Exploring shapes and angles) available at: www.qsa.qld.edu.au/yr3-maths-resources.html
	Definitions
	Angle: the amount of turning between two lines meeting at a common point **Line symmetry:** an object has line symmetry if it can be divided in half by one or more lines (axes) and both sides match exactly **Three-dimensional object:** an object that has height, width and depth For further definitions, refer to *The Australian Curriculum Mathematics Glossary* available at: www.australiancurriculum.edu.au/Australian%20Curriculum.pdf?Type=0&a=M&e=Glossary.

In this assessment

- Teacher guidelines
- Task-specific standards — continua
- Task-specific standards — matrix
- Sample response
- Student booklet

Teacher guidelines

Identify curriculum

Content descriptions to be taught
Measurement and Geometry
Shape Make models of three-dimensional objects and describe key features ACMMG063 **Location and transformation** Identify symmetry in the environment ACMMG066 **Geometric reasoning** Identify angles as measures of turn and compare angle sizes in everyday situations ACMMG064
General capabilities (GCs) and cross-curriculum priorities (CCPs) This assessment may provide opportunities to engage with the following GCs and CCPs. Refer also to the Resources tab on the Mathematics curriculum hub: www.qsa.qld.edu.au/yr3-maths-resources.html
Literacy **Numeracy** **Critical and creative thinking**
Achievement standard This assessment provides opportunities for students to demonstrate the following highlighted aspects.
By the end of Year 3, students recognise the connection between addition and subtraction and solve problems using efficient strategies for multiplication. They model and represent unit fractions. They represent money values in various ways. Students identify symmetry in the environment. They match positions on maps with given information. Students recognise angles in real situations. They interpret and compare data displays. Students count to and from 10 000. They classify numbers as either odd or even. They recall addition and multiplication facts for single digit numbers. Students correctly count out change from financial transactions. They continue number patterns involving addition and subtraction. Students use metric units for length, mass and capacity. They tell time to the nearest minute. Students make models of three-dimensional objects. Students conduct chance experiments and list possible outcomes. They carry out simple data investigations for categorical variables.
Source: ACARA, The Australian Curriculum v5.1, www.australiancurriculum.edu.au

Sequence learning

Suggested learning experiences

This assessment leads on from the learning experiences outlined in the QSA's Year 3 Mathematics unit overview. The knowledge, understanding and skills developed in the exemplar unit will prepare students to engage in this assessment:

- See unit overview — Mathematics exemplar (Exploring shapes and angles) www.qsa.qld.edu.au/yr3-maths-resources.html

Adjustments for needs of learners

To make adjustments, teachers refer to learning area content aligned to the student's chronological age, personalise learning by emphasising alternate levels of content, general capabilities or cross-curriculum priorities in relation to the chronological age learning area content. The emphasis placed on each area is informed by the student's current level of learning and their strengths, goals and interests. Advice on the process of curriculum adjustment for all students and in particular for those with disability, gifted and talented or for whom English is an additional language or dialect are addressed in *Australian Curriculum — Student Diversity* materials.

For information to support students with diverse learning needs, see:

- Queensland Studies Authority materials for supporting students with diverse learning needs www.qsa.qld.edu.au/10188.html
- Australian Curriculum Student Diversity www.australiancurriculum.edu.au/StudentDiversity/Overview
- The *Melbourne Declaration on Educational Goals for Young Australians* www.mceecdya.edu.au/mceecdya/melbourne_declaration,25979.html
- *Disability Standards for Education* http://deewr.gov.au/disability-standards-education.

Resources

Online

- IXL, P.2 Count and compare sides, edges, faces and vertices, P.3 Nets of 3-dimensional figures, P.4 Symmetry, P.11 Angles: greater than, less than, or equal to a right angle, http://au.ixl.com/math/year-3
- Topmarks, *3D Objects and 2D Shapes*, *Turning Man*, *Symmetry Game*, www.topmarks.co.uk/Interactive.aspx?cat=16
- Leicestershire County Council, Leicester United Kingdom, *Making an "angle eater"*, www.leics.gov.uk/angle_eaters.doc
- Adrian Bruce, Symmetry*: It's All Around You!,* www.adrianbruce.com/Symmetry

Objects

- coloured pencils
- rulers
- manipulable 3D models
- manipulable clock faces
- scissors
- glue or sticky tape

Develop assessment

Preparing for the assessment

Revising

- Revise features of 2D shapes and connect these concepts to faces of 3D objects.
- Revise the vocabulary used to describe 2D and 3D objects and their properties including *surfaces, faces, edges*, *vertices*, *angles*, *right angles* and *symmetry.* Record as a classroom word wall or student learning log.
- Discuss angles using the hands of analogue clocks. Identify quarter and half turns and relate to quarter past, quarter to and half past times.
- Identify lines of symmetry on shapes and simple drawings.

Exploring

- Explore ways to test if an angle is a right angle, e.g. use a corner of a book or a corner of a piece of paper.
- Explore symmetry of 2D shapes by cutting a range of 2D shapes in half to see if the halves match exactly.
- Identify and photograph 3D objects, angles and symmetry in natural and built environments.
- Apply understanding of 3D objects, angles and symmetry to find solutions to simple problems.

Creating

- Create models for a range of 3D objects and use mathematical terms to describe their properties.
- Create an angle tester and test on 2D shapes and 3D objects and in the environment.

Implementing

Section 1. Describing 3D objects

Student role	Teacher role
• Identify features of 3D objects using models. • Identify 3D objects in a robot. • Justify choice of 3D objects in a robot dog.	• Provide 3D models created or used during the learning experiences for Q1. These models could be labelled with names so that any object identification errors made in Q1 do not affect the child's success in Q2–3. • Do not use models and names used for Q2–5.

Section 2. Comparing and identifying angles

Student role	Teacher role
• Identify quarter turn angles. • Identify right angles and angles of different sizes.	• Provide manipulable clock faces (if required) for Q6–8. • Provide coloured pencils and rulers for Q9–11. • Remind children to use a ruler to draw the lines on the angles.

Section 3. Finding symmetry

Student role	Teacher role
• Find and draw the lines of symmetry.	• Check the line of symmetry in Q12. • Clarify symmetry as needed before progressing.

Section 4. Finding angles and symmetry in letters

Student role	Teacher role
• Look at the letter identified in the puzzle as a model to solve the puzzle. Use clues to find the name for the robot. • Write clues for the name “MEX”. Find and draw the lines of symmetry.	• Discuss the model first letter in the robot’s name with the class.

Make judgments

When making judgments about the evidence in student responses to this assessment, teachers are advised to use the task-specific standards provided. The development of these task-specific standards has been informed by the Queensland Year 3 standard elaborations. See www.qsa.qld.edu.au/downloads/p_10/ac_math_yr3_se.doc.

The Queensland standards elaborations for Mathematics

The Queensland Year 3 standard elaborations for Mathematics is a resource to assist teachers to make consistent and comparable evidence-based A to E (or equivalent) judgments. It should be used in conjunction with the Australian Curriculum achievement standard and content descriptions for the relevant year level.

The Queensland Mathematics standard elaborations provide a basis for judging *how well* students have demonstrated what they know, understand and can do using the Australian Curriculum achievement standard.

The Australian Curriculum achievement standards dimensions of Understanding and Skills are used to organise the Queensland Mathematics standard elaborations. Understanding and Skills in Mathematics are organised as Understanding & Fluency and Problem solving & Reasoning.

The valued features of Mathematics drawn from the achievement standard and the content descriptions for Understanding & Fluency and Problem solving & Reasoning are organised as:

- Mathematical understandings
- Recall and use of facts, definitions, technologies and procedures
- Use of mathematical language, conventions and symbols
- Use of problem solving strategies
- Modelling and representation
- Results and conclusions of investigations and inquiries
- Communication of mathematical thinking, choices and strategies.

Task-specific standards

Task-specific standards give teachers:

- a tool for directly matching the evidence of learning in the student response to the standards
- a focal point for discussing student responses
- a tool to help provide feedback to students.

Task-specific standards are not a checklist; rather they are a guide that:

- highlights the valued features that are being targeted in the assessment and the qualities that will inform the overall judgment
- specifies particular *targeted aspects* of the curriculum content and achievement standard
- aligns the valued feature, task-specific descriptor and assessment
- allows teachers to make consistent and comparable on-balance judgments about student work by matching the qualities of student responses with the descriptors
- clarifies the curriculum expectations for learning at each of the five grades (A–E or the early years equivalent)
- shows the connections between what students are expected to know and do, and how their responses will be judged and the qualities that will inform the overall judgment

- supports evidence-based discussions to help students gain a better understanding of how they can critique their own responses and achievements, and identify the qualities needed to improve
- encourages and provides the basis for conversations among teachers, students and parents/carers about the quality of student work and curriculum expectations and related standards.

Task-specific valued features

Task-specific valued features are the discrete aspects of the valued features of Mathematics targeted in a particular assessment and incorporated into the task-specific standards for that assessment. They are selected from the Queensland Mathematics standard elaborations valued features drawn from the Australian Curriculum achievement standard and content descriptions.

Task-specific valued features for this assessment		
The following identifies the valued features for this assessment and makes explicit the understandings and skills that students will have the opportunity to demonstrate. This ensures that the alignment between what is taught, what is assessed and what is reported is clear.		
Australian Curriculum achievement standard dimensions	**Queensland standard elaborations valued features**	**Task-specific valued features**
Understanding and Skills	**Understanding & Fluency**	**Mathematical understandings** Connection and identification of mathematical understandings of 3D objects, angles and symmetry in a range of situations, from simple familiar to complex unfamiliar.
		Recall and use of facts, definitions, technologies and procedures Recall and use of definitions of right angles and symmetry to solve problems.
		Use of mathematical conventions and symbols Use of appropriate mathematical language, conventions and symbols.

The task-specific standards for this assessment are provided in two models using the same task-specific valued features:

- a matrix
- a continua.

Matrix and Continua

Task-specific standards can be prepared as a matrix or continua. Both the continua and the matrix:

- use the Queensland standard elaborations to develop task-specific descriptors to convey expected qualities in student work — A to E or equivalent
- highlight the same valued features from the Queensland standard elaborations that are being targeted in the assessment and the qualities that will inform the overall judgment

- incorporate the same task-specific valued features i.e. make explicit the particular understanding/skills students have the opportunity to demonstrate for each selected valued feature
- provide a tool for directly matching the evidence of learning in the student response to the standards to make an on-balance judgment about student achievement
- assist teachers to make consistent and comparable evidence-based A to E or equivalent judgments.

Continua

The continua model of task-specific standards uses the dimensions of the Australian Curriculum achievement standard to organise task-specific valued features and standards as a number of reference points represented progressively along an A–E continuum. The task-specific valued features at each point are described holistically. The task-specific descriptors of the standard use the relevant degrees of quality described in the Queensland standard elaborations.

Teachers determine a position along each continuum that best matches the evidence in the students' responses to make an on-balance judgment about student achievement on the task.

The continua model is a tool for making an overall on-balance judgment about the assessment and for providing feedback on task specific valued features.

Matrix

The matrix model of task-specific standards uses the structure of the Queensland standard elaborations to organise the task-specific valued features and standards A to E. The task-specific descriptors of the standard described in the matrix model use the same degrees of quality described in the Queensland standard elaborations.

Teachers make a judgment about the task-specific descriptor in the A to E (or equivalent) cell of the matrix that best matches the evidence in the students' responses in order to make an on-balance judgment about how well the pattern of evidence meets the standard.

The matrix is a tool for making both overall on-balance judgments and analytic judgments about the assessment. Achievement in each valued feature of the Queensland standard elaboration targeted in the assessment can be recorded and feedback can be provided on the task-specific valued features.

Use feedback

Feedback to students	Evaluate the information gathered from the assessment to inform teaching and learning strategies. Focus feedback on the student's personal progress and the next steps in the learning journey. Offer feedback that: • maximises the students' opportunities to succeed in the assessment • provides further teaching and learning, particularly in relation to the following tasks: – identifying the features of 3D objects in Question 1 before they attempt Questions 2–5 – identifying a quarter turn and using the term *right angle* in Questions 6, 7 and 8 before they attempt Questions 9, 10 and 11 – identifying and drawing a single line of symmetry in Question 12 before they attempt Questions 13 and 14. The task-specific standards for this assessment can be used as a basis for providing feedback to students.
Resources	For guidance on providing feedback, see the professional development packages titled: • *About feedback* www.qsa.qld.edu.au/downloads/p_10/as_feedback_about.doc • *Seeking and providing feedback* www.qsa.qld.edu.au/downloads/p_10/as_feedback_provide.doc.

Exploring 3D objects, angles and symmetry

Name .....

Purpose of assessment: To identify and describe 3D objects, recognise symmetry and identify and compare angles.

Understanding and Skills		
Understanding & Fluency		
Connection and identification of mathematical understandings of 3D objects, angles and symmetry in a range of situations	Recall and use of definitions of right angles and symmetry to solve problems Use of appropriate mathematical language, conventions and symbols	
	◀ Accurate and efficient recall and use of definitions of right angles and symmetry to solve problems (Q15–16) ◀ Consistent use of appropriate mathematical language, conventions and symbols	**A**
◀ Connection and description of mathematical understandings of 3D objects (Q3–5), quarter turns (Q8), angles (Q11) and lines of symmetry (Q13)		**B**
◀ Recognition and identification of mathematical understandings of names and features of 3D objects (Q1–2), quarter turns (Q7), angles (Q9–10) and lines of symmetry (Q12)	◀ Recall and use of definitions of right angles and symmetry to solve problems (Q15–16) ◀ Use of mathematical language, conventions and symbols	**C**
◀ Identification of simple mathematical understandings of symmetry (Q14)		**D**
◀ States obvious mathematical understandings of quarter turns (Q6)	◀ Attempted recall and use of definitions of right angles and symmetry (Q15–16) ◀ Use of everyday language	**E**

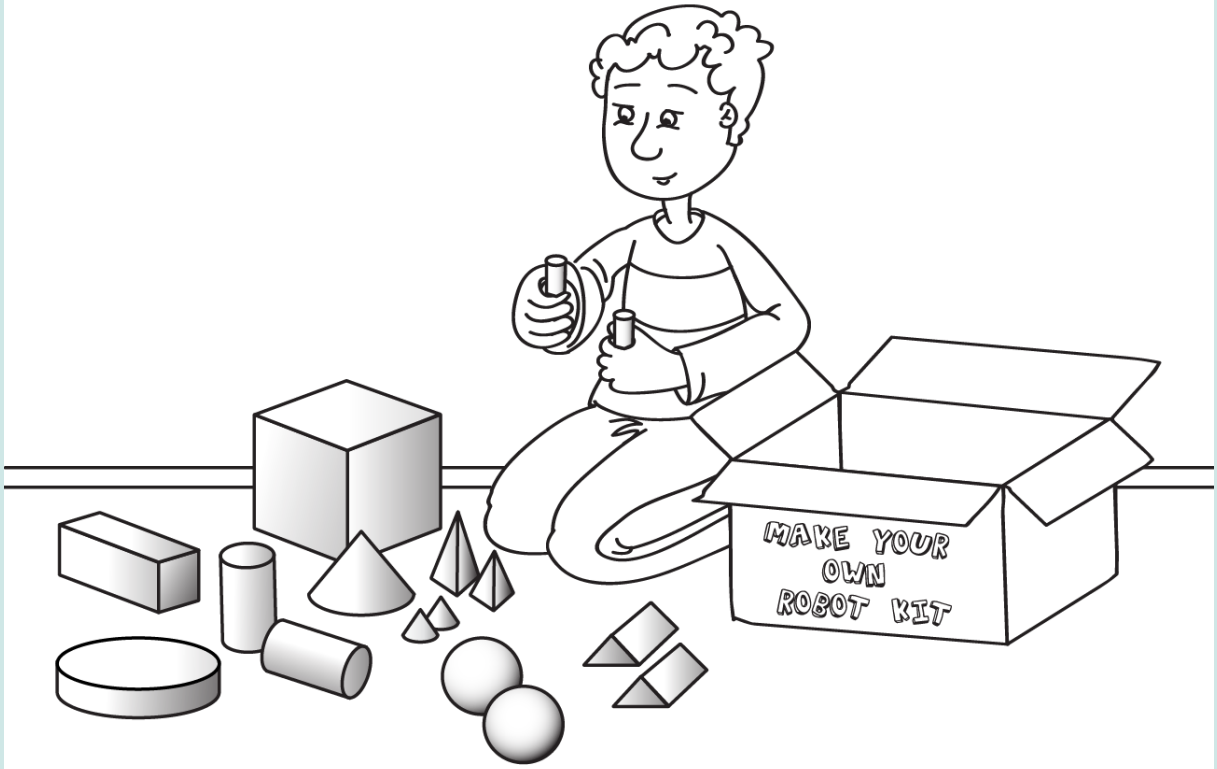
Exploring 3D objects, angles and symmetry

Name .....

Purpose of assessment: To identify and describe 3D objects, recognise symmetry and identify and compare angles.

			A	B	C	D	E
Understanding and Skills dimensions	Understanding & Fluency	**Mathematical understandings** Connection and identification of mathematical understandings of 3D objects, angles and symmetry in a range of situations	No opportunities provided in this assessment for students to demonstrate an A standard for this valued feature	Connection and description of mathematical understandings of 3D objects (Q3–5), quarter turns (Q8), angles (Q11) and lines of symmetry (Q13) in complex familiar or simple unfamiliar situations	Recognition and identification of mathematical understandings of names and features of 3D objects (Q1–2), quarter turns (Q7), angles (Q9–10) and lines of symmetry (Q12) in simple familiar situations	Identification of simple mathematical understandings of symmetry in rehearsed situations (Q14)	Statements about obvious mathematical understandings of quarter turns (Q6)
		Recall and use of facts, definitions, technologies and procedures Recall and use of definitions of right angles and symmetry to solve problems	Accurate and efficient recall and use of definitions of right angles and symmetry to solve problems (Q15–16)	Accurate recall and use of definitions of right angles and symmetry to solve problems (Q15–16)	Recall and use of definitions of right angles and symmetry to solve problems (Q15–16)	Some recall and use of definitions of right angles and symmetry (Q15–16)	Attempted recall and use of definitions of right angles and symmetry (Q15–16)
		Use of mathematical conventions and symbols Use of appropriate mathematical language, conventions and symbols	Consistent use of appropriate mathematical language, conventions and symbols	Use of appropriate mathematical language, conventions and symbols	Use of mathematical language, conventions and symbols	Use of aspects of mathematical language, conventions and symbols	Use of everyday language

Exploring 3D objects, angles and symmetry



Exploring 3D objects, angles and symmetry are all around us.

You will:

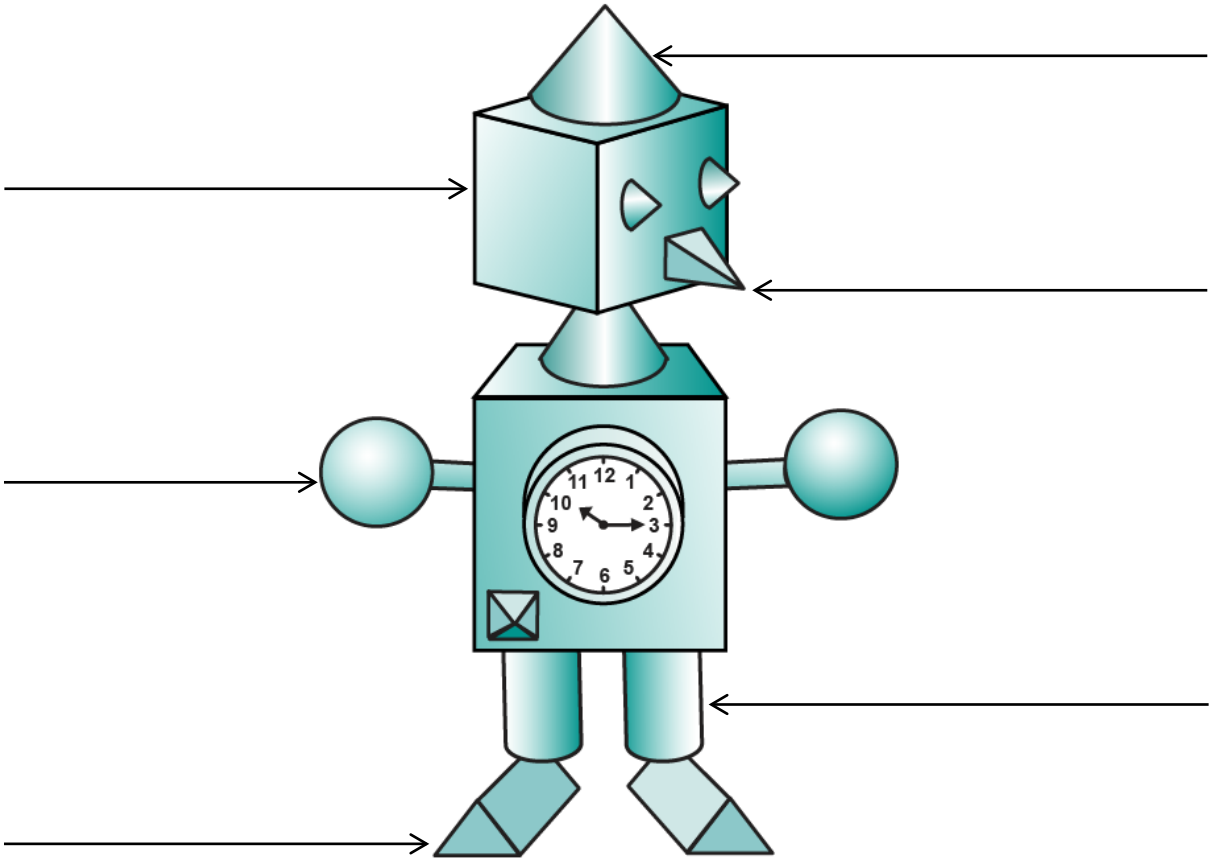
- describe 3D objects
- compare and identify angles
- find symmetry
- find angles and symmetry in letters.

Section 1. Describing 3D objects

1. Look at models of the 3D objects in the table below.
   Complete the table to identify the features.

3D object	How many?						
	square faces 	rectangular faces 	circular faces 	triangular faces 	curved surfaces	vertices	edges
cone							
cube							
cylinder							
rectangular prism							
sphere							
square-based pyramid							
triangular prism							

Dale built this robot from 3D objects, including one with a clock.



2. Use the shape names from the box below to label the 3D objects that Dale used to build his robot.

   (Not all shapes were used).

3D objects			
square-based pyramid	cone	rectangular prism	sphere
cube	triangular prism	cylinder	triangular pyramid

Dale decided to use the same 3D objects to build a robot dog for his robot.

3D objects			
square-based pyramid	cone	rectangular prism	sphere
cube	triangular prism	cylinder	triangular pyramid

3. What 3D object would you choose for the dog's head? Why?

.....

.....

4. What 3D object would you use for the dog's tail? Why?

.....

.....

5. Would square-based pyramids be a good choice for the dog's ears? Why or why not?

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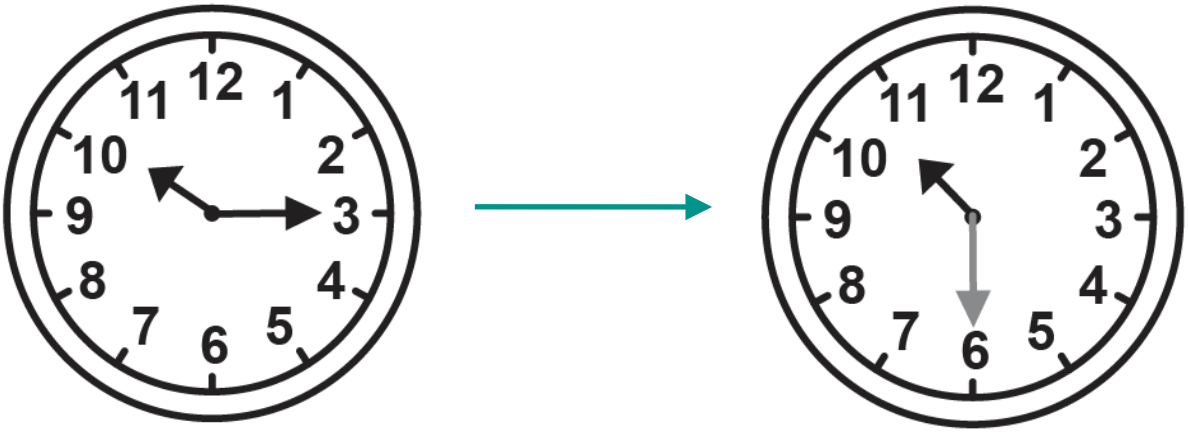
Section 2. Comparing and identifying angles

Dale and the robot left to go to the park at quarter past ten.

When they arrived, the robot's clock showed half past ten.

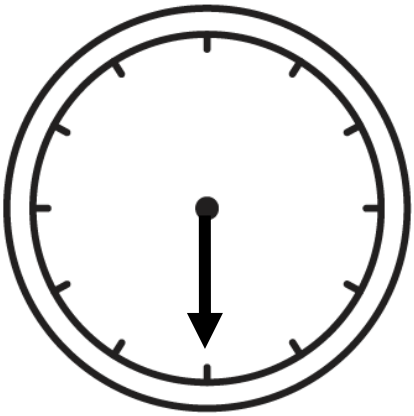


6. What size turn did the minute hand have to make to show half past ten?

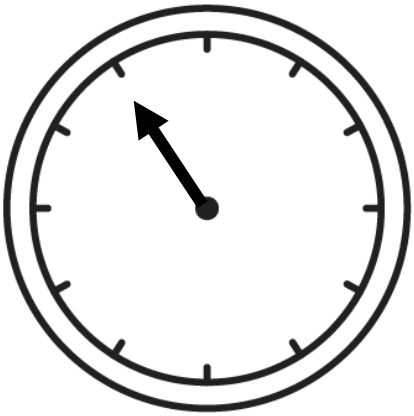
   Circle the answer.

   a half turn **a quarter turn**

7. Draw this hand when it has moved another quarter turn.



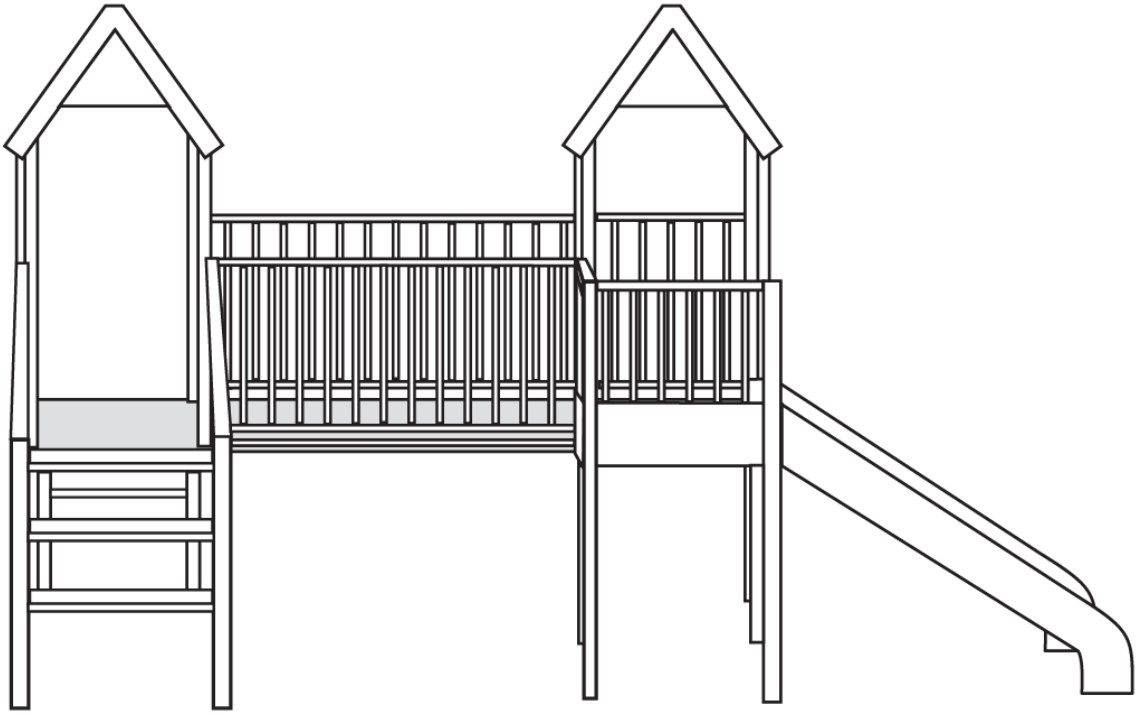
8. Draw this hand when it has moved another quarter turn.



Dale sees a fort at the park.

9. Find 5 angles on the fort that are right angles.

   Mark the angles using one colour.



10. Find 3 angles on the fort that are different from a right angle.

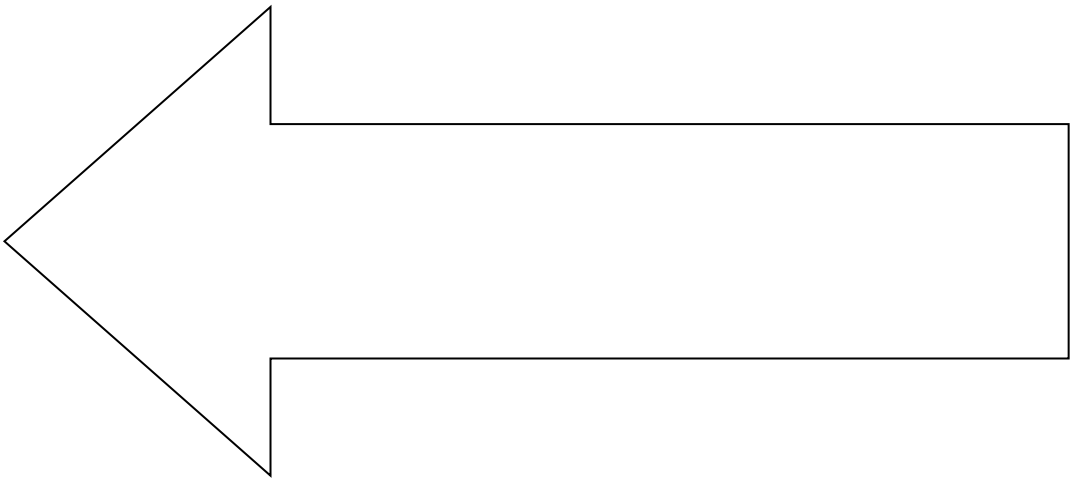
    Mark the angles using a different colour.

11. Circle any letter that has two or more different sized angles.

Section 3. Finding symmetry

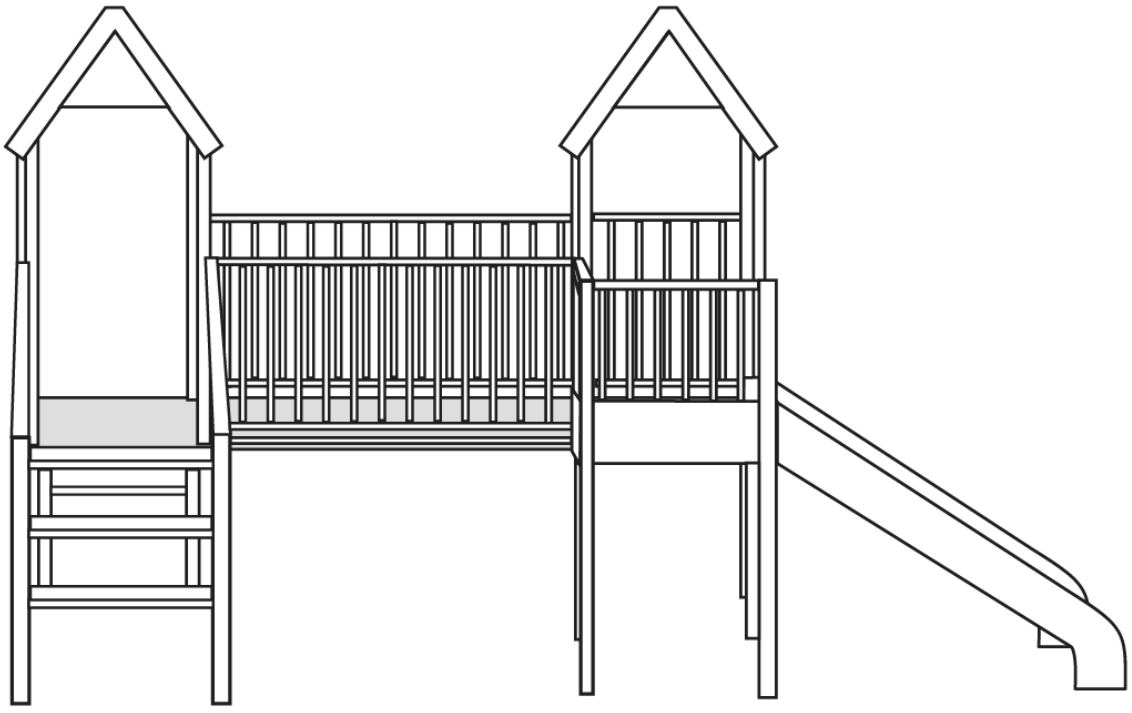
Dale is looking for shapes with symmetry at the park.

12. Draw one line of symmetry on the arrow.



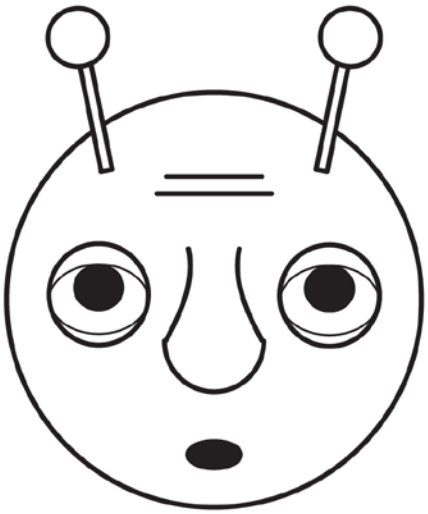
13. Circle a part of the fort that has symmetry.

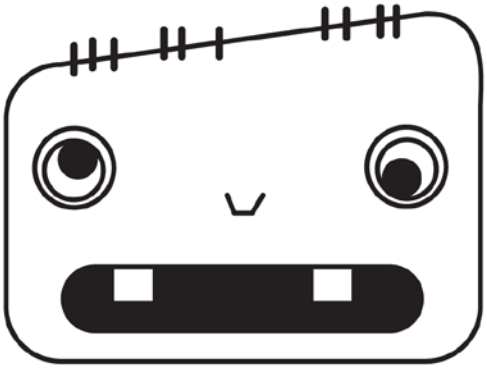
    Draw the line of symmetry on that part.

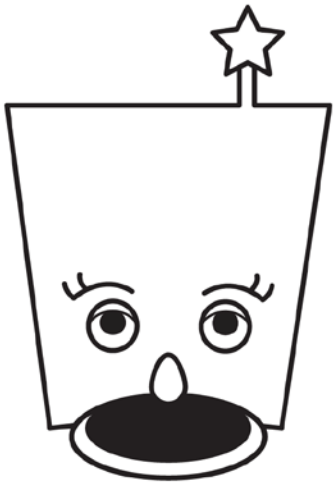


At the park, Dale drew some designs for robot faces.

14. Draw a circle around the robot faces that have symmetry.

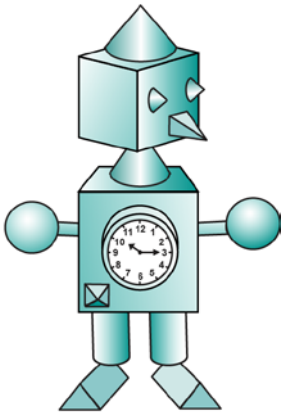






Section 4. Finding angles and symmetry in letters

Dale uses a puzzle to give the robot a name.



15. Look at the symmetry and the right angles in these letters.

E D A P S H L

- Read the clues in the table.
- Choose from the letters above to solve the puzzle.
  (Not all the letters are used.)
- Write the missing letters in the table.

Letter clues	1st letter	2nd letter	3rd letter	4th letter	5th letter	6th letter
Number of lines of symmetry	0	0	0	1	0	2
Number of right angles	0	3	1	0	0	4
Robot's name	S					

Dale wants to make a puzzle for her dog's name.

16. Look at the letters of the dog's name.

Write clues for the letters in the table.

Letter clues	1st letter	2nd letter	3rd letter
Number of lines of symmetry			
Number of right angles			
Dog's name	M	E	X