

Teachers' Notes for Castle Quest

These notes accompany the 'Castle Quest' trail.

Maths Week Scotland engages pupils with maths beyond the classroom and in the world around them. This teacher-led trail explores maths around Edinburgh Castle including the National War Museum, Royal Scots Dragoon Guards Museum and Museum of the Royal Regiment of Scotland.

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These notes include:

- Answers to the challenges
- Pre-visit activities
- Extension activities
- More information on the maths, architecture and history covered in the trail

Practical points

- Aimed at Primary 5–7 pupils
- The full trail takes approximately two hours
- The trail is not sequential and can be completed in any order
- These two activities are not tied to the castle can be completed back in the classroom
 - *Measuring up*
 - *A different angle*
- The trail includes a mix of indoor and outdoor activities. The outdoor activities are:
 - *Castle attack*
 - *Mason's mark*
 - *A different angle*
- The challenges are accessible, with the exception of *Mason's mark* which is accessed via steps.
- *A different angle* can be completed using paces or measuring device like a tape measure or trundle wheel. Please bring your own measuring device. During peak times when the castle is extremely busy, it is best to use paces.

Curriculum Links

This trail is a cross-curricular activity covering the *Numeracy and Mathematics* and *Social Studies* areas of the Curriculum for Excellence.

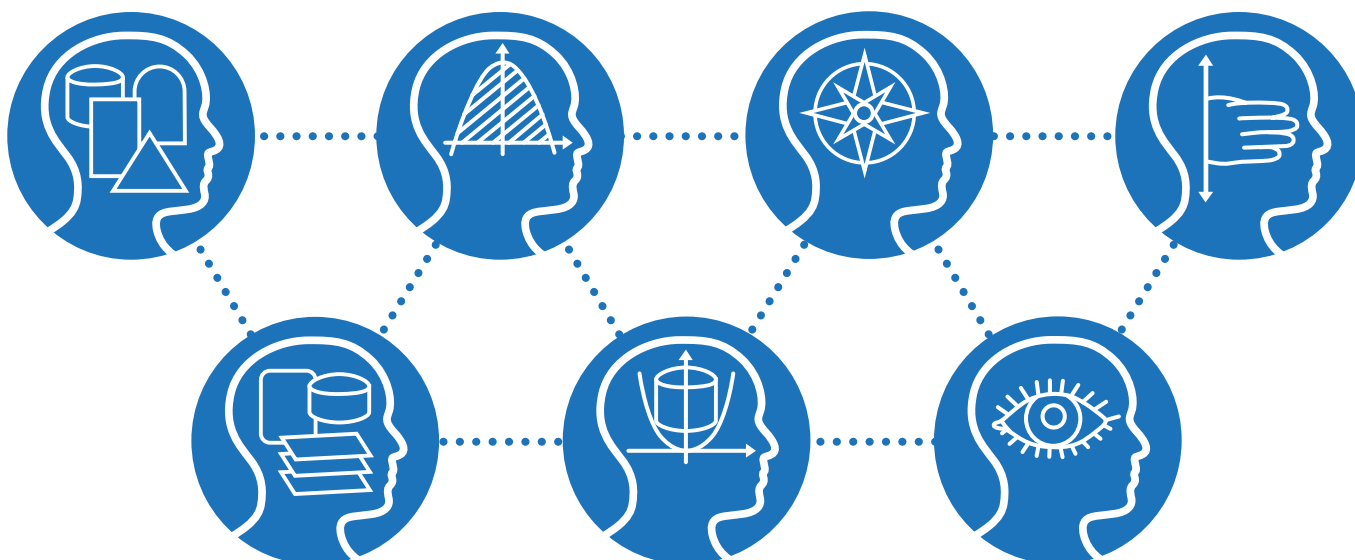
Pupils will use mathematical knowledge and logical thinking skills to solve problems in a new context.

In Numeracy and Mathematics students will cover First and Second level topics including:

- Number Processes
- Estimation and Rounding
- Fractions, Decimals and Percentages
- Measurement
- Properties of 2D and 3D shapes
- Angle, Symmetry and Transformation

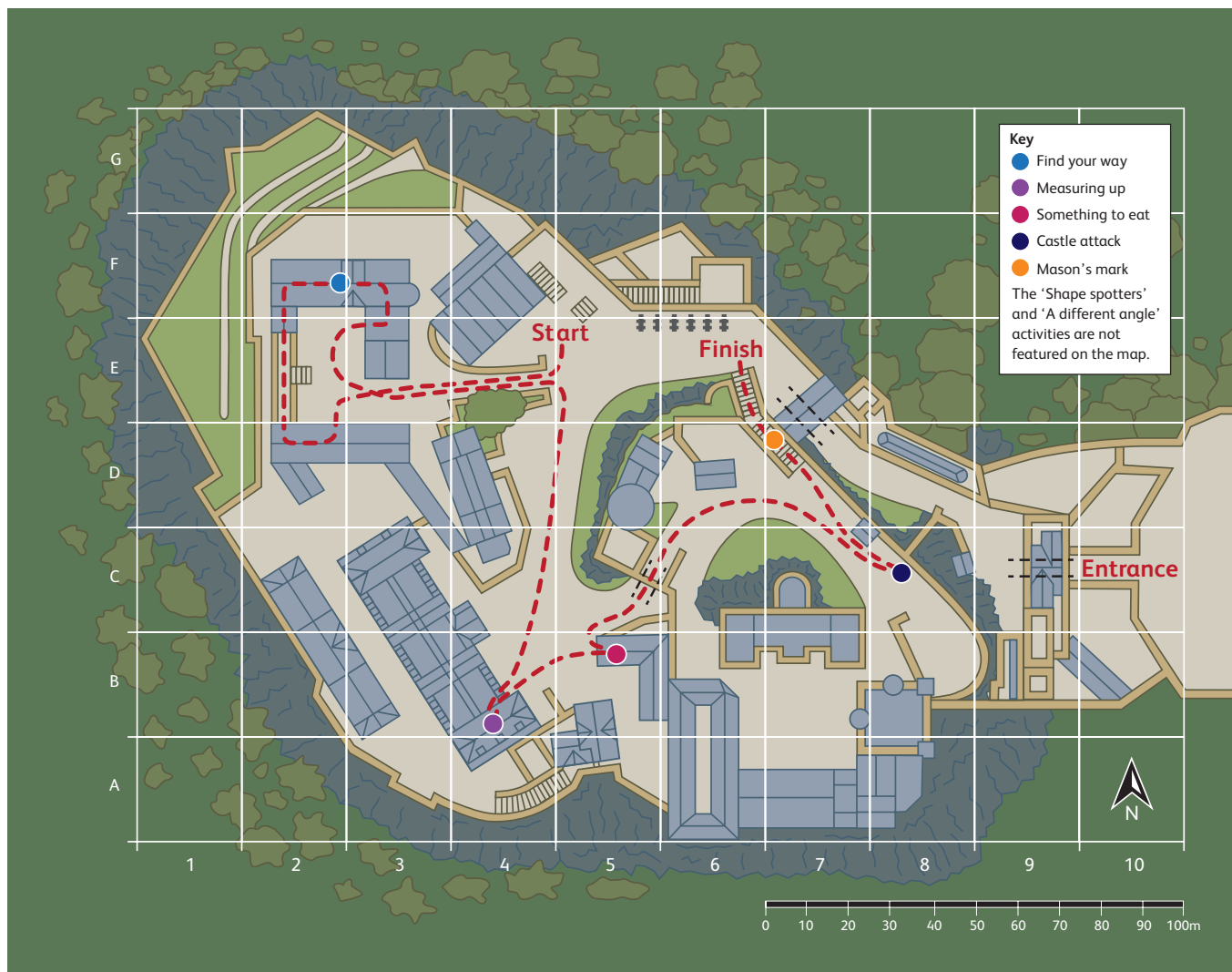
Completing this activity at Edinburgh Castle will develop pupils' understanding of the history, heritage and culture of Scotland.

In Social Studies pupils will cover aspects of People, Past Events and Societies.



Map of Edinburgh Castle

The map of the castle has been divided into squares. In *Shape spotters* pupils are asked to write down co-ordinates from the map where they find features.



The map can be found in the central pages of the trail and is useful for finding your way around the castle.

Extension Activity

Ask pupils throughout the day to identify where they are on the map or use co-ordinates to set challenges.

Shape spotters

Castles are made up of lots of different shapes. Your pupils have been tasked with spotting cylinders, rectangles, arches and triangles in the castle.



There are plenty of shapes to find but here are some suggestions with some extra information on why these shapes were chosen for each feature.

Cylinder

Why a cylinder?

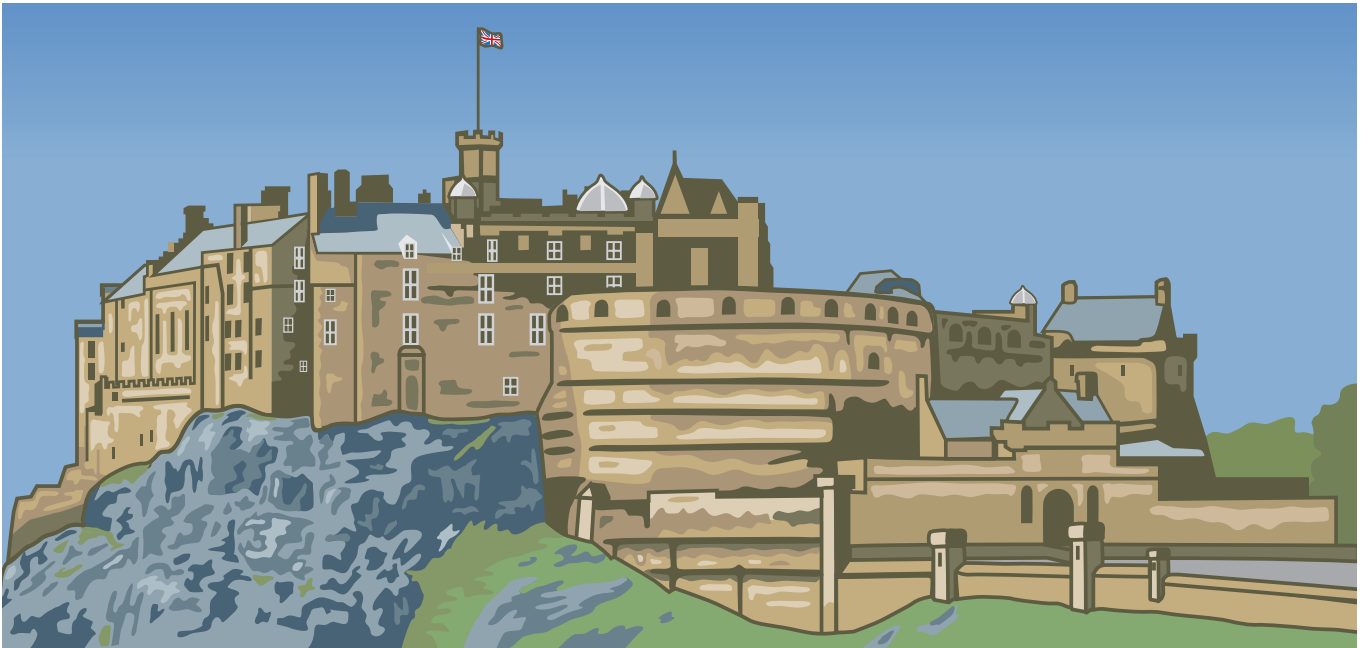
Round walls were difficult to build as they required more precise and complex maths. But they are very useful shapes for deflecting missiles, difficult to undermine, and gave defenders a wide field of view to spot and fire upon attackers.

Examples

Edinburgh Castle's **Half Moon Battery** has a distinctive curve for most of these reasons, though the solid volcanic rock the castle sits on meant undermining was not a concern.

The **pepper pot** turrets visible on the castle's north side provided the soldiers inside a full field of view to watch for and fire upon attackers.

The **water tower** looks like it is designed for defence with its arrow slits and crenelated top but it was built to hold a water tank.



Rectangle

Why a rectangle?

Rectangles were easy and cheap shapes to build making them natural choices for most buildings, windows, and doors in the castle.

Examples

Door and window sizes vary depending on their age. The windows on the 900-year-old St Margaret's Chapel are much smaller than the windows on the 500-year-old Great Hall due to changes in technology and the price of glass.

Gun loops are rectangular to give gunners a good space to fire out of while still providing them with protection.

Crenellations are composed of high merlons and low crenels. These rectangular merlons would offer protection against enemy fire and the crenels would allow the defenders to fire out. Many of the crenellations you see are later decorative additions by the Victorians.

Arch

Why an arch?

Stone Masons used arches as they are strong shapes. The shape of the arch compresses the stones and locks them together. Arches like these have been used in building for nearly 1000 years.

Examples

Doorways and windows are arches to create strong, decorative openings.

Foog's Gate and the **Portcullis Gate** were vital parts of Edinburgh Castle's defences and using an arch made them more likely to survive enemy attack.

Triangle

Why a triangle?

Triangles are very strong shapes because any force applied to them is evenly spread through all three sides.

Examples

Many of the **roofs** in the castle are triangles as the pitch of the roof causes rainwater to roll off them reducing the possibility of water building up and causing a leak.

The **Hammerbeam roof** in the Great Hall is made up of triangles within triangles to give it rigidity and strength. All these triangles lock together and are held in place with wooden pegs. It is so strong that it has been standing for more than 500 years.

Many of the **lintels** above doors and windows are triangular. These are largely decorative but may also be designed to allow water to run off.

While the **gun loops** themselves are rectangular, the embrasures are triangular, flaring outward from the loop. This gives the defenders more space to fire while still protecting them from attackers.

A different angle

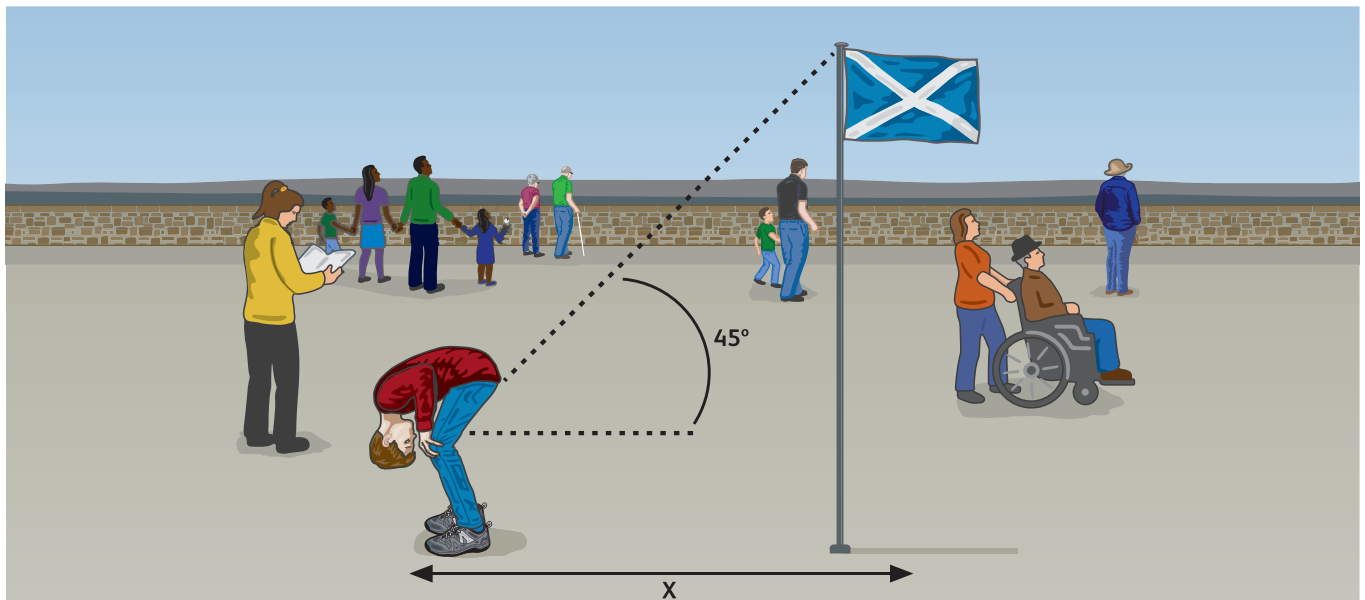


Edinburgh Castle today is very different to how it looked many years ago when the Royal Family lived in it. Many of the landmarks have been changed or replaced over time which is why some of them look a bit different to others.

Accurate measurements were essential when building parts of the castle. Builders have used lots of different ways of measuring over the years, including string, sticks, compasses and even body parts!

Your pupils have been tasked with working out the height of a landmark in the castle.

To do this, they should stand at the base of their chosen landmark and then walk away from it, stopping every so often to bend over and look through their legs back to the landmark. When they can just see the top of the landmark, stop and mark the spot. Now they need to measure the distance along the ground from where they are to the landmark. This distance is roughly equal to the height.



How does this work?

This works because you are looking at the top of the landmark at a 45 degree angle. This makes a right angle triangle between the ground, landmark and line of sight. Therefore the height of the landmark is the same as the distance that you are from that landmark.

Ask pupils to find the height of buildings or landmarks within the castle; such as:

- How high is the tallest flag at the castle entrance?
- How high is the statue in Hospital Square?
- How high is the War Memorial?

It might be helpful to bring your own measuring device. During peak times when the castle is extremely busy, it is best to use paces.

Pre Visit Activity

Have pupils measure out their paces or a piece of string before visiting so they can more accurately estimate the height of the landmark.

N.B: If you are short on time, this activity can be completed in school before or after your visit.

Find your way (National War Museum)

In this activity, pupils will find a compass from a Second World War aircraft which will allow them to fill in the directional points North, South, East and West on an illustration

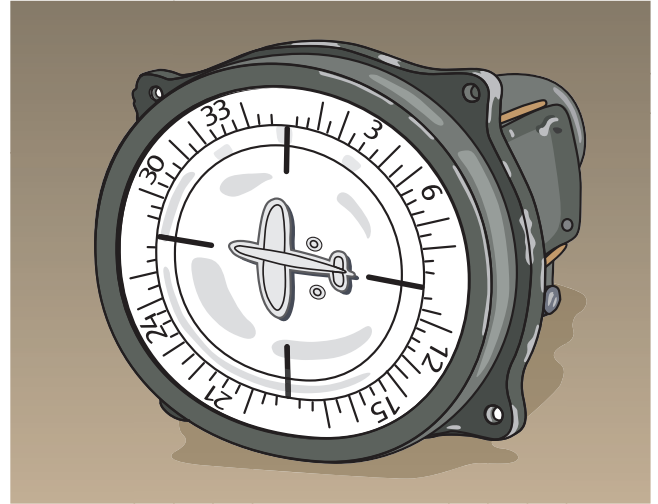
You can find the compass in Gallery 5 (In Defence) of the National War Museum. You will find the case on your right-hand side, opposite a nurse's uniform. The case is about the story of the Heinkel III which was shot down over Scotland during the Second World War. Pupils who have studied the Second World War will be able to put some of the other objects in the case in context.

You can point out to pupils the letter O on the compass where East is marked. The German word for East is Osten.

For the follow up activity, you have two options.

You can go to Gallery 2 (A Grand Life for a Scotsman) by retracing your steps to the main entrance of the museum, then use the lift to go upstairs. This option is fully accessible. Alternatively, continue to follow the gallery round until the exit brings you into Hospital Square (outside the War Museum entrance). Then make your way to the parapet up the stone stairs, behind the Haig statue. This option only has stair access.

From one of these lookout points, ask your pupils to position their paper compasses with North pointing in the correct direction. You may want to bring a compass with you to help with this, or use one on your phone, or you can use the castle map to provide you with guidance.



Extension activity

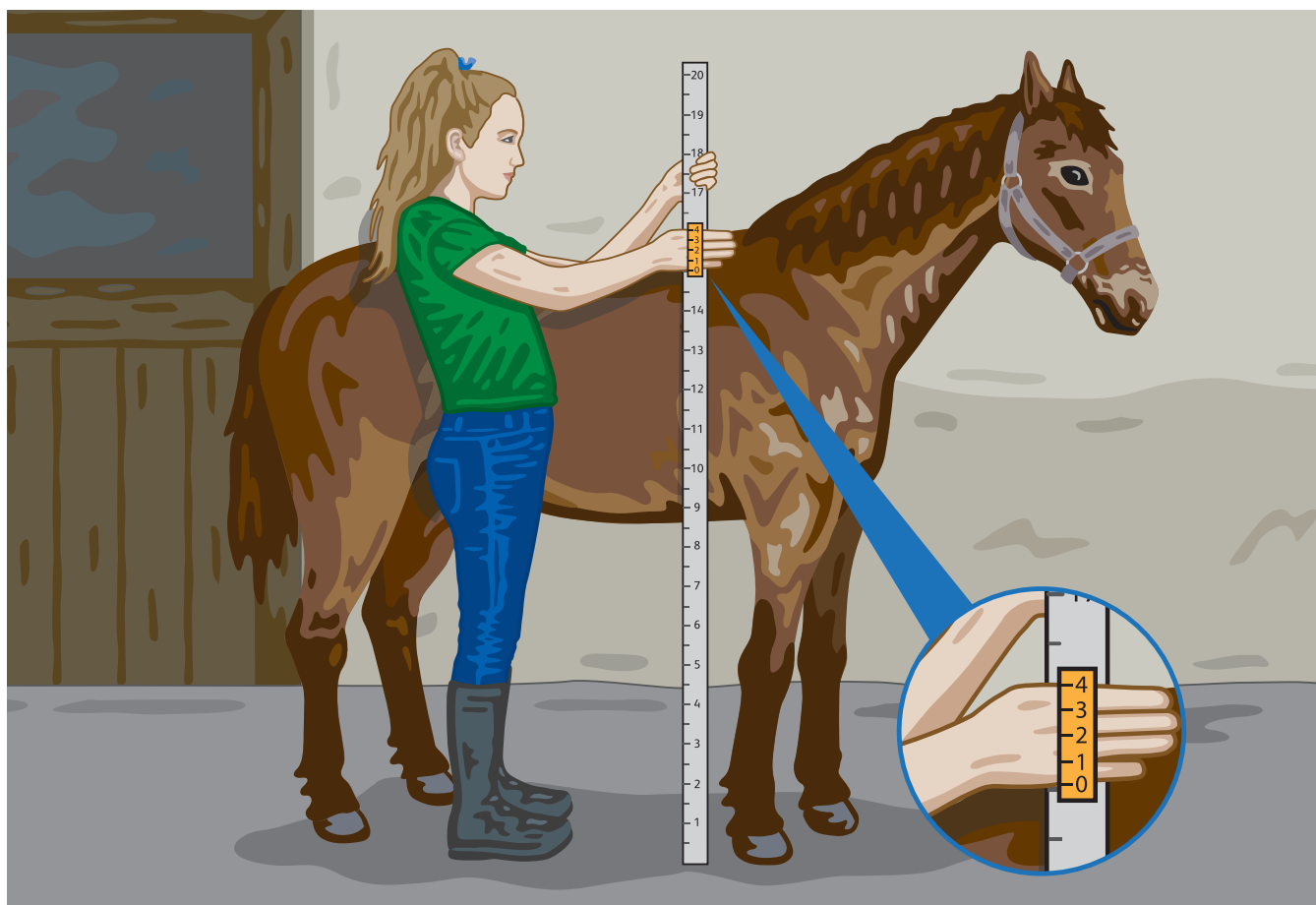
Looking out from this viewpoint, you can still see much of Edinburgh which has not changed since the Second World War. Using a compass, solve these riddles to find some of these key historic landmarks

- 1 Travel to Fife by crossing over me, then I carry on until I meet the sea! (River Forth)
Direction: North-west
- 2 I'm hump-shaped and tall, you can ski on me but don't fall! (Pentland Hills)
Direction: South
- 3 I'm not very far away, under a dome roof where musicians play (Usher Hall) Direction: South-west



Measuring up (Royal Scots Dragoon Guards Museum)

When measuring a horse's height, it is measured in Hands (hh). This is a unit of length that started with the ancient Egyptians and was roughly the breadth of a man's hand. This eventually got a bit confusing, as hand breadth/size is not universal! King Henry VIII standardised the measurement in 1541 so that 1 Hand = 4 inches.



A horse is measured from the hoof to the withers – which is the highest point above the horse's shoulder that doesn't move.

Your pupils have been asked to work out their height in hands.

They should find the measuring tape in Gallery One and use it to measure their height in inches. If it is easier, you could ask them to work in pairs or small groups and measure each other. If a pupil measures between inches, they should round the measurement to the nearest inch – for example, if the measurement is 54.2 inches, they should write down 54; for 54.6, write down 55.

Next they should do a division calculation to work out the measurement in Hands. If 1 Hand is equal to 4 inches, they need to divide their measurement by 4:

$$\text{_____ Inches} \div 4 = \text{_____}$$

Example: $54 \text{ Inches} \div 4 = 13.5$.
So, we would call this 14hh.

The measuring tape is marked with the average height of a war horse. Ask pupils how they measure up against it!

N.B: If you are short on time, this activity can be completed in school before or after your visit.

Something to eat (Museum of the Royal Regiment of Scotland)

All soldiers are familiar with Field Rations. This is what we call food supply when soldiers are out on operations. The 24-hour Ration Pack contains 4000 calories to fully sustain one person for 24 hours and contains high energy snacks, drinks and three main meals which are cooked and ready to eat, hot or cold.



Pupils should find the display case containing the modern-day ration items. You need to walk all the way through the Royal Scots Museum until you reach the gallery dedicated to The Royal Regiment of Scotland. Pupils are tasked with the following:

How many items are there in one box?

Possible answer: 36

How many items contain something to eat?

Possible answer: 21

How many items contain something to drink?

Possible answer: 9

How many items contain something non-edible?

Possible answer: 6

Pupils should then try to work out the percentages; what percentage of the box is food, drink and non-edible? Round your answer off.

Food: Possible answer 58 %

Drink: Possible answer 25 %

Non-Edible: Possible answer 16 %

There may be differences to these answers depending on what your pupils classify as food, drink and non-edible items. For example, the fruit puree might cause some debate as to whether it is food (because it is fruit puree) or drink (because of the type of pouch it is in).

Extension Activity

Complete activity with ratios or fractions.

Discuss why we do not always get 100% when totalling.

Castle attack

Have your pupils prepare for a siege by calculating the volume of water the well would hold if it were full and how long that would last a garrison of soldiers.



Find the well near to the Half Moon Battery. The calculation you ask them to complete will vary depending on their level. Advanced students may be able to calculate the area of the well and then find the volume, for other students you can provide the area.

Recommended tools:

measuring tape, calculator

1 Finding the area of the well surface

If you have your own tape measure you could have students measure the well to find its radius.

$$\text{Area} = \pi \text{Radius}^2$$

$$\pi = 3.14$$

$$\text{Radius} = 0.75\text{m}$$

$$\text{Radius}^2 = 0.75 \times 0.75 = 0.56$$

$$\text{Area} = 3.14 \times 0.56$$

$$\text{Area} = 1.76\text{m}^2$$

2 Finding the volume of the well

The height of the well can be found on the plaque above it. Encourage students to find this themselves (34 meters)

$$\text{Volume} = \text{area} \times \text{height}$$

$$\text{Volume} = 1.76 \times 34$$

$$\text{Volume} = 60\text{m}^3$$

3 Converting m^3 into litres

You have now found how many meters cubed the volume of the well is. But water is measured in litres. Now you need to convert it into litres.

$$1 \text{ m}^3 \text{ is } 1000 \text{ litres}$$

$$60\text{m}^3 \times 1000 = 60,000$$

4 How long would the water last 120 soldiers?

During sieges the castle had to hold a garrison of men at arms and archers, this could be about 120 soldiers.

If each soldier needed to 3 litres of water per day to drink, wash and cook with. How long would 60,000 litres last 120 soldiers?

Answer:

$$3 \times 120 = 360$$

$$60000 / 360 = 167 \text{ days}$$

The castle garrison were always at risk of running out of water. The well was not always full when the siege began. Often water had to be rationed so the soldiers would not always have enough to drink and wash. It got very smelly and uncomfortable in the castle during a siege.

In fact, during the Lang Siege in 1571–3, the well ran dry forcing the garrison to use a well in Princes Street Gardens. They collected water by lowering a person down on a rope. Eventually this well was poisoned by the attackers leaving the garrison with no water supply. This was a big factor in their surrender.

Mason's mark

Masons took large hunks of stone from quarries and turned them into the blocks needed to build castles like Edinburgh. After carving each block they would mark it with their Mason's mark. This mark was so the Mason could claim the stone and get paid for their work. But they could also be identified if they had got something wrong!

- Masons were given their mark by the Master Mason after they had completed their training.
- The marks were normally made of 2–5 strokes of the chisel. Because of the tools Masons used they would mostly be composed of straight lines.
- The tools Masons would use the mark for their whole life, it was like a signature.
- The marks would normally be hidden in the original buildings so stones where you can see tools Masons' marks have probably been moved from their original place.

Where will we find masons marks?

It can be difficult to find Masons' marks on the castle today as much of the surface of the stones has eroded away.

You can spot some Masons' marks on Argyle's Tower by the door and around the window as seen in the illustration.

You can also spot graffiti around the castle carved by soldiers and prisoners who have lived here.

Keep your eyes peeled when visiting other historic buildings too, lots of them have Masons' marks to spot.



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