

SELF-LED ACTIVITY

NATURAL PHILOSOPHER'S TRAIL



KS3

Recommended for

KS3 (Science, History)

Learning objectives

- Learn about natural philosophy and the story of Bolsover Castle
- Explore Bolsover Castle, examining some of its key features and using the techniques and theories of natural philosophy to discover more about the castle and the people who lived here
- Understand the story of Bolsover Castle, its connections to natural philosophy and how science can help us learn more about the history of a place and its people

Time to complete

5–10 minutes per activity;
7 activities



Plants in the borders of the Fountain Garden with the Little Castle in the background.

PRIOR LEARNING

It would be helpful for students to have some contextual knowledge and feel confident with key terms before completing this trail. The glossary on pages 26–32 provides definitions of key terms and the timeline on pages 33–39 can support students' chronological understanding. The pre-visit activity 'Why build here?' can provide more context for their visit.

PRE-VISIT ACTIVITY

This trail includes a short, pre-visit activity that introduces students to Margaret Cavendish and natural philosophy.

PREPARATION AND RESOURCES

You may wish to read the historical information on pages 7–25 before your visit to familiarise yourself with the story of Bolsover and its connection to natural philosophy. To explore the story of William and Margaret Cavendish in more depth you could book our Discovery Visit. You will find the Activity Trail on the following pages. Please read our printing tips and photocopy enough for your class to bring to Bolsover Castle.

The booklet pages have their own sequence which differs from the rest of the Teachers' Kit and they will appear to be in a random order; this is to help you create an A5 booklet that can be easily followed by your students.

To do this you'll need to adjust your Print settings:

1. Select size A4.
2. Select a custom page range of 72–78 (to avoid printing unnecessary pages).
3. Select 'Print on both sides of the paper' and 'Flip on short edge'.
4. This will print four double-sided pages of PDF that can be folded in half and arranged in page number order.

MORE LEARNING IDEAS

You could take students to visit the Cundy House on the other side of the valley to see where the water in the cistern house came from. Search the English Heritage website for 'Cundy House' to find out more.



ENGLISH HERITAGE
BOLSOVER CASTLE

WELL DONE!

Congratulations on completing the trail.

We hope you've learnt loads about Bolsover Castle.

Feel free to explore the rest of the castle with your group leaders.

There's a lot more to discover at Bolsover Castle.

WHAT NEXT?

You could:

- Visit the Cundy House where the water was piped from.
- Write a letter to English Heritage about your visit to Bolsover Castle.
- Create a piece of art or write a poem inspired by your trip.
- Make a short documentary about Bolsover Castle and film it.

Hint: read back through the booklet, including your answers, and look at the castle plan to jog your memory.



NAME:

CLASS:

SCHOOL:

Step into England's story

William Cavendish owned Bolsover Castle in the 17th century. It became an important place for intellectuals to gather and discuss ideas. Both he and his second wife, Margaret, were very interested in natural philosophy, what we today call science.

Margaret Cavendish believed it was important to use your senses to observe the world. Practise your observation skills before your visit.

A Study the image of the rose carefully.



Roses like this one have been planted at Bolsover Castle to recreate the gardens as they might have looked in the 17th century.

B Write down six things you observe about it. HINT: think about its colour, texture and shape.

- 1 4
- 2 5
- 3 6

The first microscopes were developed in the early 17th century. They could make things look 20 times bigger, but they could be unreliable. William and Margaret built up a collection, but Margaret did not think they were very helpful.



A flea drawn by Hooke and published in *Micrographia*. Fleas are so small that it is difficult to observe them without magnification.

B Examine the reconstruction drawing showing how the cistern house worked.

C Read this list of labels.

1. A person operated the wheel.
2. The wheel lifted a bucket full of water.
3. A reservoir of water was under the cistern house.
4. A pipe brought water across the valley and into the reservoir.
5. The bucket was emptied into the tank by a person on the top floor.
6. Underground pipes took water from the cistern house to the fountain.
7. The flow of water to the fountain was regulated in the valve room.
8. Rainwater drained from the lead roof into the water tank.

D Label the drawing by writing the numbers in the correct locations.

E Discuss with a partner why the water tank was up higher than the fountain.

HINT: think about water pressure and gravity.

Write your answer here:

.....

.....

.....

.....

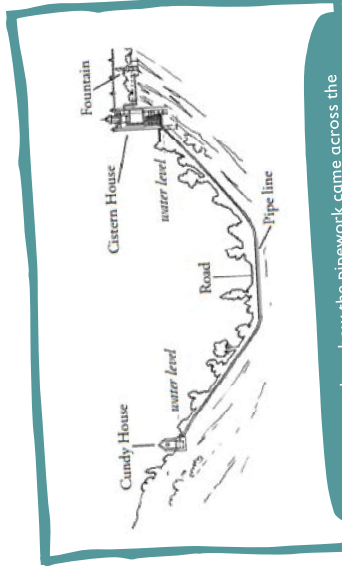
.....

.....

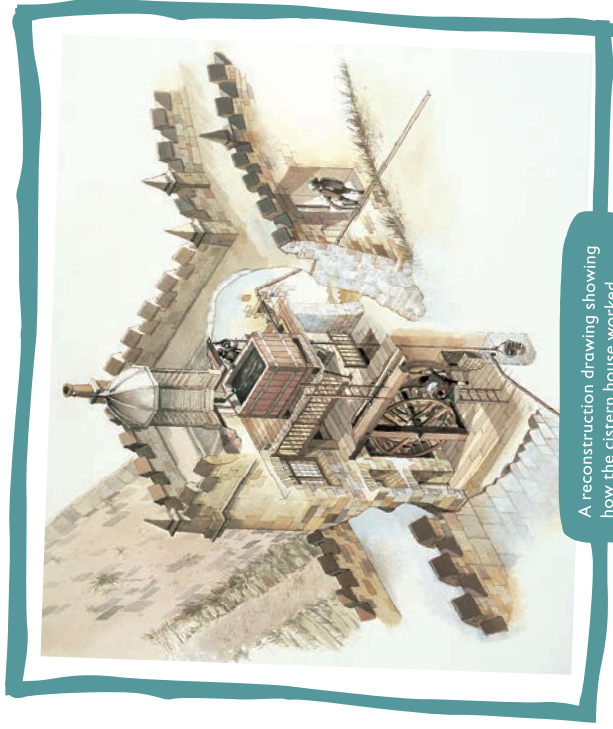
Bolsover Castle is high up on a cliffy ridge. This made accessing water a challenge that was overcome using 17th-century technology.

Bolsover Castle had three different water sources. One of them came into the cistern house from a natural spring across the valley using a pipe and gravity to get it to the reservoir beneath the building.

A Spend a few minutes looking round the cistern house.



A diagram to show how the pipework came across the valley from the spring where the Candy House was built to the cistern house at Bolsover Castle.



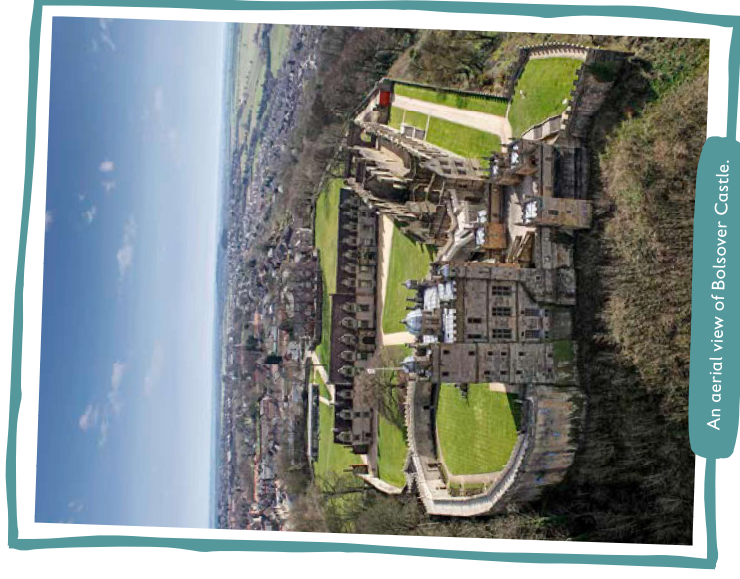
A reconstruction drawing showing how the cistern house worked.

There has been a castle here at Bolsover since the 11th century. William Cavendish inherited it from his father in 1617. He hosted lavish parties here and pursued his intellectual interests, like natural philosophy. You are going to explore Bolsover Castle and discover more about 17th-century natural philosophy.

You'll learn about:

- Natural philosophy in the 17th century
- The scientific experiments that took place here
- How science can help us understand the story of Bolsover Castle

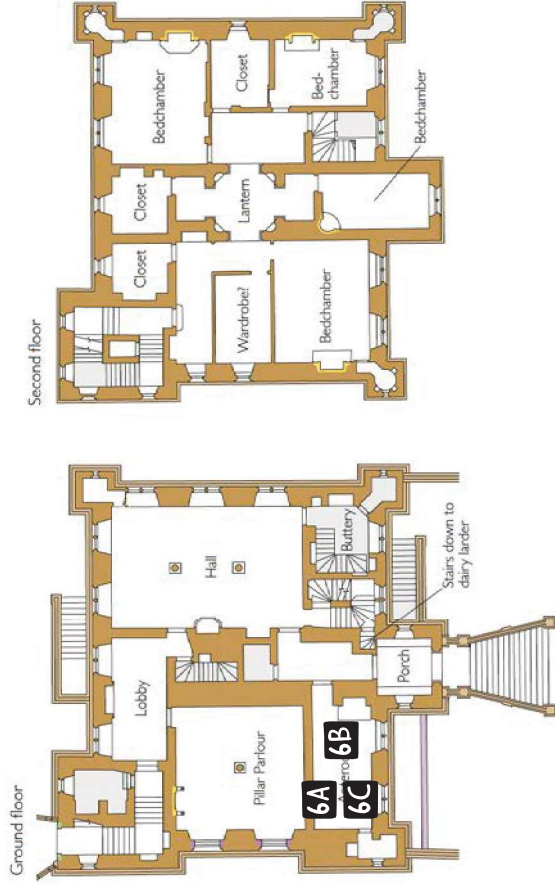
It should take you around 1 hour to complete this trail.



An aerial view of Bolsover Castle.

Use the plans on pages 3–4 to help you find your way around and keep track of the activities.

The trail begins at the **Great Court** (see pages 5–6)



- 1 ACTIVITY 1 – GREAT COURT
- 2 ACTIVITY 2 – GALLERY
- 3 ACTIVITY 3 – OUTSIDE THE RIDING RANGE
- 4 ACTIVITY 4 – FOUNTAIN GARDEN
- 5 ACTIVITY 5 – GARDEN ROOMS
- 6 ACTIVITY 6 – THE LITTLE CASTLE (A, BAND C IN THE ANTEROOM AND D IN THE STAR CHAMBER)
- 7 ACTIVITY 7 – CISTERN HOUSE

Some of the scientific ideas of the 17th century are no longer supported by modern-day science. In the anteroom of the Little Castle there are paintings depicting the theory of the four humours. It said that the body was made up of four liquids known as humours. It was important to keep the humours in balance to be healthy.

A Go into the anteroom.

B Examine the paintings carefully.

C Identify which painting matches each of the descriptions of the four humours below.

- Phlegm is said to make someone phlegmatic (calm). It is also connected to the element of water. The painting depicts this using a fisherman and his wife.
- Blood is said to make someone sanguine (happy and outgoing). The painting depicts this using a stage. It is thought that William performed for guests by standing in front of the painting as if he were on stage.
- Yellow bile is said to make someone a good leader but too much makes them choleric (angry). It is also connected to the element of fire. In the painting a man leads a woman.
- Black bile is said to make someone melancholic (sad) and introverted. They prefer to be alone. It is also connected to the element of earth. In the painting the woman is being offered earthly delights such as jewels, but she also has a book next to her. Perhaps she'd rather be reading and writing.

Beliefs in witchcraft and the supernatural also still existed in the 17th century. Protective marks, also known as 'witches' marks' were carved into walls. The Virgin Mary was said to provide protection to those living in a house with a letter M carved into a wall.

D Explore the Star Chamber to find a circular protective mark beside the fireplace.

Small rooms are built into the outer wall of the garden. The west garden room is believed to be a still room, where herbal remedies may have been prepared.



A view of the Fountain Garden with the doorways into two of the garden rooms visible in the wall.

William Cavendish carried out an explosive experiment in one of these rooms to explore what the sun was made of. He burned saltpetre and brimstone (two ingredients in gunpowder).

- A** Explore the garden rooms.
- B** Read this quote.

‘looking at it a while, I said, Mark it, Mr. Payn, the Flame is Pale, like the Sun, and hath a Violent Motion in it like the Sun; saith he, It hath so, and more to Confirm you, says he, look what abundance of Little Suns, Round like a Globe, appear to us every where, just the same Motion as the Sun makes in every one’s Eyes: So we concluded, the Sun could be nothing else but a very Solid Body of Salt and Sulphur, Inflamed by his own Violent motion upon his own Axis’

Taken from ‘His Opinion Concerning the Ground of Natural Philosophy’ by William Cavendish and published in *Philosophical and Physical Opinions* by Margaret Cavendish in 1663.

- C** Discuss how William reached his conclusion about the sun.



BOLSOVER CASTLE



The plants in the borders of the Fountain Garden were chosen after careful research into 17th-century planting. They are designed to delight the senses and include bulbs such as lilies that originally came from central Asia and were new to English gardens.

Herbs provide food for insects and pleasant smells for visitors. They can be used in cooking or as herbal remedies.

A Walk along the Fountain Garden borders.

B Tick off the herbs when you find them.

ROSEMARY

This herb was thought to relieve headaches and boost memory. It has light purple flowers in the summer. Older plants have wood-like stems.



THYME

This herb was thought to relieve pain. It has much smaller, rounder leaves than rosemary. Older plants may have wood-like stems.



MARJORAM

This herb was thought to help digestion. It has softer, rounder leaves than rosemary. The leaves are usually larger than those of thyme.



C Describe how each herb smells and feels to touch. Do not lick or pick them.

Rosemary

.....

Thyme

.....

Marjoram

.....

Sir Isaac Newton was a member of the Royal Society. He came up with his laws of motion in 1686. His first law said that for every action, there is an equal and opposite reaction.

William trained horses using a technique called lunging. The horse wears a cavesson, a bridle with a tight noseband and no bit in the horse's mouth. A line is attached to it. The trainer holds the other end of the line and the horse is trained to walk in a circle. You can use Newton's law of motion to understand how William Cavendish trained horses.

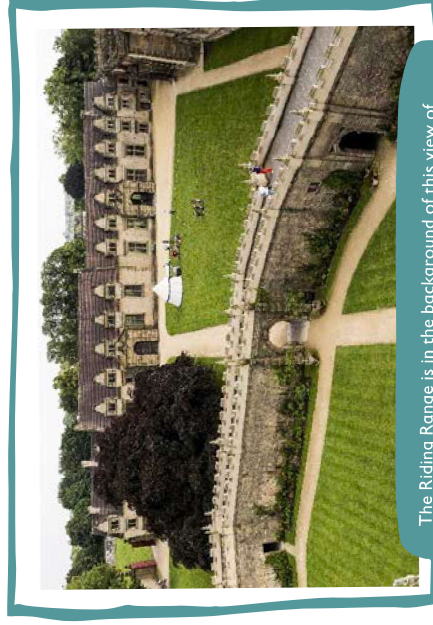
A Find a partner.

B Find a space outside the Riding Range.

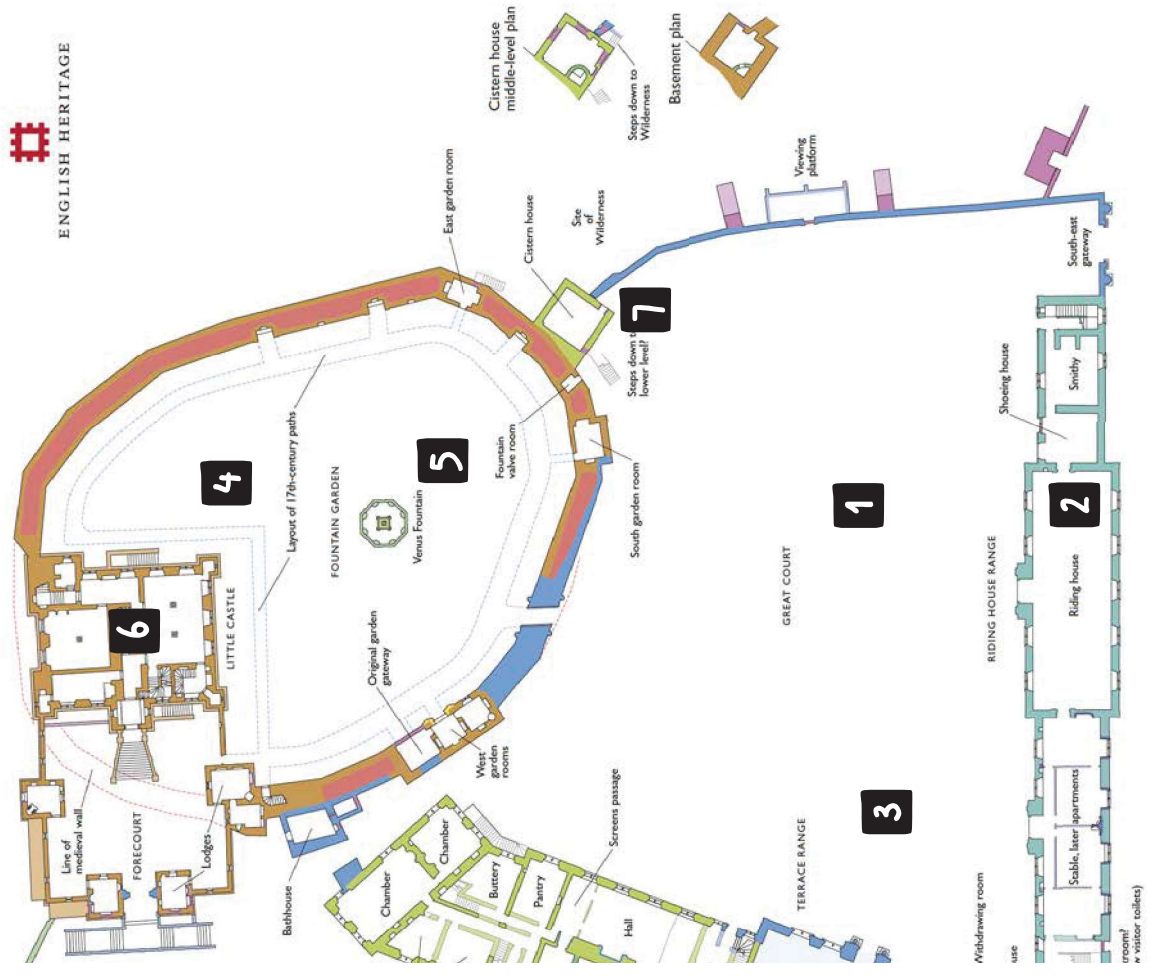
C Complete the following steps:

1. Stand beside each other, holding hands.
2. Straighten your arms to create space between you. This is your line.
3. One person must try to walk forwards. They are the horse. The other must stay where they are but can pivot on the spot. They are the trainer.
4. Observe what happens.
5. How can Newton's idea of action and reaction help us explain what is happening?

The tension on the line (in this case your arm) is pulling inwards, what is sometimes called centripetal force. This is the action. The reaction is the horse leaning inwards and therefore walking in a circle rather than a straight line. In addition, this circular walking motion causes the trainer to pivot in the centre of the circle. The shorter the line, the smaller the circle will be.



The Riding Range is in the background of this view of Bolsover Castle taken from upstairs in the Little Castle.



The Royal Society of London for Improving Natural Knowledge was established in 1660 following a lecture by the architect Christopher Wren. In 1667 Margaret Cavendish was the first woman to attend a Royal Society meeting.

The Royal Society aimed to verify facts through experiments and share their ideas. One member of the society, Robert Hooke, created illustrations to share his findings. He used two techniques:

- look, then draw
- look and draw at the same time.

A Explore and **examine** the architecture in the Great Court.

B Choose one aspect to focus on such as a doorway, stone carving or window.

C Draw your chosen part using Hooke's drawing techniques in the boxes below.

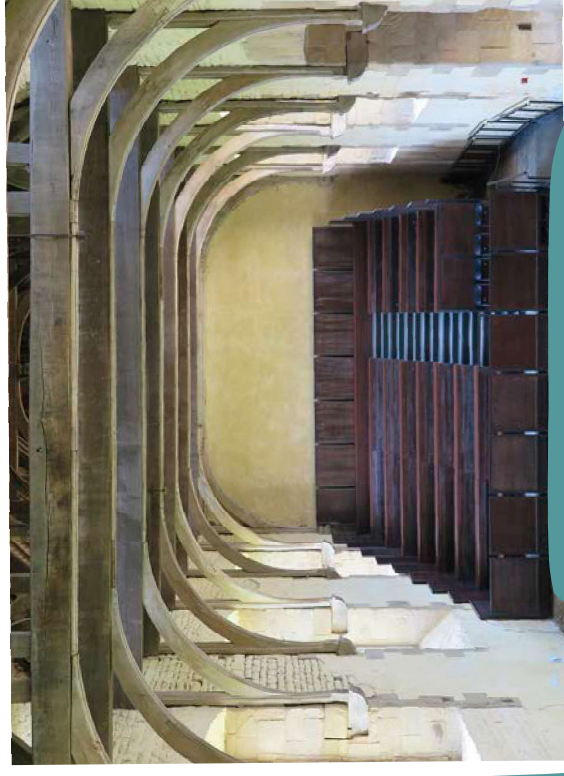
LOOK, THEN DRAW

LOOK AND DRAW AT THE SAME TIME



A view of the Terrace Range and Little Castle from inside the Great Court.

This gallery was for visitors to look down onto the riding room and watch horses performing a kind of dressage known as *manège*. It took great skill and patience to train horses in this way.



The view from the gallery down onto the riding room where William Cavendish trained his horses.

William Cavendish believed it was important to understand horses and be kind to them to get the best out of them.

A Tick off the features as you find them:

- high windows to prevent horses from being distracted or startled
- sand on the floor, which is the ideal surface for horses to train on
- decorative plasterwork on the walls of the gallery
- exposed beams that were not visible in the 17th century.

D Discuss these questions with a partner:

- Which drawing technique did you prefer and why?
- How did focusing on one part help you to understand it better?