An 18th-century cotton mill where pupils can explore water power and working conditions in the past.

INVESTIGATING STANLEY MILLS

Information for teachers
Welcome to Stanley Mills

The mills at Stanley, on the banks of the River Tay, were founded more than 200 years ago. The power of the river was harnessed to manufacture textiles from 1787 almost continuously until the mill finally closed down in 1989. Stanley helped shape the factory system, contributing to events which changed the lives of people all over the world. Today the historic buildings are open once more.

Using this pack

This pack is designed for teachers who are planning to visit Stanley Mills with their classes. It is most suitable for middle-upper primary and lower secondary classes. This pack contains:

- brief history of the mills
- suggestions for preparatory and follow-up activities
- notes for two themed teacher-led tours of the site, with highlights and discussion points, together with a map

The tours in the pack focus on two aspects of Stanley Mills:

Tour 1: Working at Stanley Mills
Investigating the working lives of people in the past, with a particular emphasis on Victorian child labour conditions

Tour 2: Water power at Stanley Mills
The science and technology of harnessing the power of the river

Please note that the material in this pack is designed for teachers and is not intended for independent pupil use. Teachers may find elements useful for preparatory work.

Booking your visit

Two types of visit are currently available for schools at Stanley Mills:

- a general visit which is led by the class teacher
- activity sessions which are led by relevant experts.

General visits can be booked by calling Stanley Mills directly on 01738 828268.

Activity sessions are advertised in the Education Schools Activity Programme (see http://www.historic-scotland.gov.uk/index/education_unit/primaryactivities.htm) and can be booked by contacting Historic Scotland Education Unit on 0131 668 8793.

Risk assessment

Risk assessment of the site is the responsibility of the teacher in charge of the group. Hazard information sheets are available on the Historic Scotland website (www.historic-scotland.gov.uk/index/education_unit/visiting_our_sites/free_educational_visits/hazardsheets.htm). Alternatively, please contact our Education Unit on 0131 668 8793 for information. Pupils should be supervised at all times.

We strongly encourage teachers to make a free pre-visit themselves before bringing a class. This gives teachers the chance to carry out a risk assessment, try out material and become familiar with the site. Please discuss this when booking your class visit.
**How to get to Stanley Mills**

Stanley Mills is seven miles north of Perth, just off the A9. The village of Stanley is signposted from the A9, and Stanley Mills is signposted from the middle of Stanley village. There is a free visitors’ car park located on site, with easy access along a pathway to the mills. Coaches may be parked here.

**Facilities**

- Toilets are available at the mills, both for general visitors, and for groups using the education room.
- There is a small shop on the ground floor of the Bell Mill, in the main visitor centre.
- There are lots of pleasant areas to have picnic lunches, and indoor space can be made available if the weather is poor.
- The site is accessible for wheelchair users, but there may be some restrictions in certain instances. Please check for details.
- As part of our commitment to Green Tourism, we ask that all litter be disposed of back at school.
Supporting learning and teaching

A Curriculum for Excellence

The Curriculum for Excellence aspires to motivate and challenge pupils through a wide range of varied learning experiences. Site visits such as that outlined have a particular role to play in ‘joining up’ learning outcomes, making learning relevant, and in their capacity to offer learners a degree of personalisation and choice.

Stanley Mills can support a range of topics but this resource focuses on two key themes.

Theme 1: Working at Stanley Mills

Stanley Mills is a good place for pupils to investigate what it was like to work in a mill. Because of the report carried out by the Factory Inspection Commissioners in 1833 and their subsequent recommendations on child labour, it is a particularly good place to find out about child labour conditions in the 19th century.

This theme presents learning contexts within Social Subjects: People, past events and societies. In the process of achieving learning outcomes in this area, pupils will develop the four capacities underpinning the curriculum.

A visit, and use of the supporting materials will help to:

develop successful learners by

• challenging pupils to consider how life has changed for people and what has remained the same.
• encouraging pupils to think critically about the nature of historical evidence and arrive at their own conclusions.
• providing a real context for learning which brings the past alive.

develop confident individuals by

• providing opportunities for pupils to share and present their learning to others using a range of media.
• giving pupils opportunities to communicate their own views on social and historical issues raised during the visit.

develop responsible citizens by

• encouraging greater understanding of and respect for their own historic and built environment.
• providing examples of the work of archaeologists and historians and showing how this is important.
• fostering an awareness of the importance of oral history and the contributions of older people to today’s society.

develop effective contributors by

• encouraging pupils to express and record their observations following on-site observations and investigations.
• providing pupils with the opportunity to develop life skills such as photography as they record their visit.

Left: A 19th-century cotton mill
Right: Stanley Mills from the other side of the Tay
Theme 2: Water power at Stanley Mills

Stanley Mills is an ideal place for pupils to explore and investigate the theme of water power.

This theme presents learning contexts within Social Subjects: People, place and environment, and Science: Energy in the Environment and Planet Earth and Technology. In the process of achieving learning outcomes in these areas, pupils will develop the four capacities underpinning the curriculum.

A visit, and use of the supporting materials will help to:

develop successful learners by
- broadening pupils’ knowledge and understanding through investigative, creative and critical thinking in a stimulating context.
- providing a real context for understanding how technology can harness resources and meet needs in a sustainable way.

develop confident individuals by
- giving pupils active learning experiences to enable them to discover scientific principles for themselves.
- allowing pupils the opportunity to communicate their findings to others.

develop responsible citizens by
- engaging pupils with issues relating to power and enabling pupils to develop an awareness of issues of sustainability and how to apply these messages to their own lives.
- showing positive examples of sustainable power.

develop effective contributors by
- encouraging pupils to express and record their observations following on-site observations and investigations.
- promoting a problem-solving attitude to designing and making.
Integrating a visit with classroom studies

Educational visits have the greatest value if they are planned into schemes of work. The suggested activities which follow are intended to supplement existing class work rather than replace them.

Pre-visit activities and suggestions

• Help pupils draft up a list showing what they KNOW about Stanley Mills, and what they WANT to know. After the visit, they can add in what they have LEARNT. These KWL grids can be posted up on a class progression wall. Help pupils identify specific research questions according to the theme they are studying (e.g. What jobs did children do? How did the workers control the sluice gates?) so that they arrive at Stanley with a sense of mission, actively poised to seek out evidence!

Theme 1: Working at Stanley Mills

• A good starting point might be to discuss what happens at a textile mill. Download a picture of a cotton plant and contrast this with an item of cotton clothing. Get pupils in groups to pool what they know about where cotton comes from and how cotton fabric is made. Use this as a starting point to research the topic – from cotton plant to finished fabric. It will help pupils’ understanding of the site greatly if they feel confident about what carding, spinning and weaving actually mean.

• Many women and children worked at Stanley Mills. Discuss with pupils the reasons why children were employed. How do they feel about this? Would they like to go out and work? Why do they think that laws were passed preventing child labour? Pupils could research some of the reasons for and against child labour in the 19th century and could then host a mini-debate on the matter, perhaps in role as mill-owner and humanitarian. This could be an interesting lead-in to the issue of child labour in the developing world today. See the website www.globalmarch.org for details of a charity which campaigns against child labour worldwide.

• Pupils could carry out personal research into the colourful life of Richard Arkwright, to whose design the mill was built.

Theme 2: Water Power at Stanley Mills

• Discuss energy needs – within the classroom, the home, the city and the world. Who needs energy and why? How can the increasing demand for energy be met? Pupils could research different sources of energy in groups, and present their advantages and disadvantages to the rest of the class through a formal talk, a poster, a booklet, a song, a debate. These two websites offer ideas for classroom activities relating to energy needs and sources:
  * Department for Business Enterprise and Regulatory Reform: It’s Only Natural http://www.berr.gov.uk/energy/sources/renewables/schools/teaching-resources/page23238.html

• Discuss water power within the context of sustainable energy. What are its benefits? Its disadvantages? Look at examples of hydro-electric power in Scotland and abroad. The E.on website has a good animation of a hydro-electric power station: http://www.eon-uk.com/EnergyExperience/356.htm

• Discuss water wheels. Use a ‘toy’ water wheel to let pupils explore how the wheel can be made to turn more quickly or slowly. If possible, try attaching a plastic straw to the wheel to represent an axle so that pupils can gain a simple understanding of how the power of the water can be harnessed. Pupils should start thinking about the position of a mill – what is necessary for the mill to be able to operate.

• Discuss gears. The transfer of water power through gear wheels to machinery is complicated. Help pupils with this by using commercially produced technology kits so that they can see how turning one wheel can set a whole process in motion, and how different-sized gear wheels result in different speeds.

• There are lots of technical terms associated with water mills, and it’s not necessary to know them all. However, it would be helpful if pupils had an understanding of the following terms before coming to the mill: sluice gate; lade; water wheel; shaft; belting; turbine; overshot; breastshot; undershot. There is a glossary of these terms on page 41.
On-site activities: evidence collection

Ideally, the site visit should be seen as an opportunity for finding out more about what working life was like at the mills or how water power works in practice, looking for evidence and interpreting what can be seen.

Evidence can be collected by interpreting the buildings, by looking at text panels for a specific reason, by observing audio–visual programmes, by looking at visual evidence and through talking and discussing together. This evidence can be recorded through taking notes, sketching and/or taking photographs.

We have provided notes for a tour of the site based on each of the two themes. These notes contain questions for discussion. Most of the questions do not require knowledge to answer; instead they require pupils to look around them for the evidence and to interpret and consider what they see around them.

Pupils will benefit from being in small groups, each guided by an adult leader. The tour notes can be photocopied and given to adult helpers – please note that they are not intended for independent pupil use.

After your visit

After your visit, try and find time for a whole class feedback session. The KWL grid can be updated on the progression wall; pupils can add to individual records. If pupils were researching different aspects of the mill and water power, give them time to do this and share with the class.

There are plenty of opportunities for presentation, art and language activities – for example, pupils could:

• create a slide show of their visit with commentary.
• design a leaflet or poster illustrated with photographs taken on site to encourage other classes/schools to visit the site.
• provide an illustrated history of the site, perhaps as a mini-guide book.

There is also scope for pupils to respond imaginatively and expressively to the site, using drama, music and/or creative writing, for example by:

• using their characters to describe a day in the life at Stanley Mills.
• making a piece of music based around factory noises.
• writing a diary entry for one of the factory inspectors on the day he visited the mills.
• creating poems based on their imagined experience of mill-work.
The story of Stanley Mills

1729
Tunnel bored through peninsula to power corn mill

1784
John Murray, 4th Duke of Atholl helps found the Stanley Company

1786–7
Construction of Bell Mill for production of cotton

1795
350 people working at Stanley, 300 of them women and children

1823
Mills bought by Buchanan & Co; big expansion of mill buildings

1825
Gasometer built for gas lighting

1833
Stanley visited by Parliamentary Commissioners to report on working conditions

1833
Factory Act forbids employment of children under nine in textile mills; restricts hours for work for 9–14 year olds

1848
Arrival of railway

1861–5
American Civil War disrupts supplies of cotton, mills close

1876
F.S. Sandeman takes over mill

1879
First water turbine installed

1880
Mill starts producing industrial belting for export all over the British Empire

1908
Electric lighting introduced
1914–18
First World War: production of equipment webbing for military purposes

1916
Sandeman introduces tape for cigarette production

1921
Power station built; mill powered by hydro-electricity

1936
Kate Gairns starts at Stanley Mills

1939–45
Second World War boom period for mills

POST-WAR
Workers recruited from Italy and Germany

1979
Management buy-out to form Stanley Mills (Scotland) Ltd

1970s
Experiments with acrylic fibre

1965
All machines now powered by electricity from National Grid

1989
Production ceases at Stanley

1995
Site bought by Historic Scotland

2000
East Mill and part of Mid mill converted to flats

2003
npower reopens hydro-electric power station

2008
Stanley Mills are opened to the public

2009
Production ceases at Stanley

1995
Site bought by Historic Scotland

2003
npower reopens hydro-electric power station

2008
Stanley Mills are opened to the public
The mills at Stanley, on the banks of the River Tay, were founded more than 200 years ago. The power of the river was harnessed to manufacture textiles from 1787 almost continuously until the mills finally closed down in 1989.

**Early years**

By 1831, nearly half of the population of Stanley village was employed by the mills. Most of these were women and children. Out of a workforce of 885 in 1833, 540 were women and 497 were under 18 – not unusual for the textile industry in Scotland. Managers hired more women and children than men, because they could be paid less.

**Who did what?**

Men did the heavy work – working as engineers and mechanics – and also much of the clerical work. It was the women who actually ran most of the machinery in the mill – the power spinning machines and looms.

**Children at work**

Children worked at jobs such as winding bobbins and repairing broken threads, where their sharp eyes and small fingers were valued. They were expected to nip in under moving machinery to clean it. Children could also be trained more easily to the monotony of factory life. Some of the child workers were orphans from the Perth workhouse.
An inspection

In 1833 the mills were visited by a group of Parliamentary Commissioners, who were gathering information on working conditions across Britain. They were particularly interested in the employment of children. Their findings led to the Factory Act of 1833, which banned the employment of children younger than nine in textile mills, and restricted the hours of work for children aged 9–13.

How long was the working day?

Working hours for adults were long – from 5.30am to 7pm, with a 45-minute break for breakfast at 9am and another for dinner at 2pm. There was no such thing as paid holidays in those days; apart from Sundays, workers had only two days' unpaid holiday a year. The working day for children began at the same time, but after the passing of the Factory Act, they left work at 3.15 to attend the company school.

Where did the workers live?

There were no villages close to Stanley Mills when they first opened. In order to attract and keep workers, the Duke of Atholl provided land for a village to be built. Unlike most villages in Scotland, it was built to a plan and laid out on a grid system. The houses were of a higher quality than workers had ever had before. In addition to houses for workers, Stanley village had a main square, a church with a manse and a school for the workers' children. The housing at Stanley influenced the buildings at other factory villages.

Despite conditions which sound harsh to us today, Stanley Mills attracted workers from all over Scotland, from as far afield as Caithness. From croft house to stone tenement, and from field to factor – these were momentous life changes.

Continued over page
Later years

During the 19th century, education began to improve for working people. Workers started to demand their rights and began to form and join unions. These unions called for better wages and working conditions and shorter hours. The Education Act of 1872 made it compulsory for children to attend school between the ages of 5 and 13, so very young children no longer worked at the mills.

Who worked at the mills?

In the 20th century, Stanley attracted workers from across Scotland and the wider world. Some were people whose families had been associated with the mills, like Kate Gairns, who worked for the mills for over 40 years, from 1936 until 1977. Her mother had also worked here.

Others were workers from Italy, Poland and other countries, recruited to work in Scotland by newspaper advertisements. In 1936, there were between 300 and 400 workers. But by the 1960s there were only around 179 people.

A dangerous environment

Although conditions were better than in the 19th century, the working environment was still far from ideal. Injuries from machinery were common, and many workers suffered from respiratory diseases, caused by dust and debris in the air. Workers didn’t wear protective masks and ventilation was poor.

The power looms and carding machines created an incredible amount of noise. Many workers at Stanley suffered permanent damage to their hearing, as they were not provided with ear protectors. The noise also prevented workers in mills from talking to each other, so they invented their own sign language to communicate.

Not all hard work ...

Even though conditions were hard and the work was monotonous, many of the workers look back fondly at their time at Stanley Mills. Some remember singing together as they came down the brae towards the mills, others recall sunbathing on the flat roof of the East Mill, or strolling by the river in their lunch breaks. Shorter working hours gave workers increased leisure time to fish in summer, or even to go curling on the Tay when it froze.
About cotton

Stanley Mills processed cotton and produced cotton goods for most of its life. Pupils can learn something about the processes involved from the objects on display in the exhibition.

From plant to thread

- Cotton was picked in hot countries like India or the southern states of America and sent over the sea to Scotland. It is a downy fibre surrounding a seed pod.
- It was packed into bales, transported by road and then later by rail to Stanley Mills.
- The bales of cotton were unpacked and cleaned before the carding process began.
- The raw cotton was combed by carding machines and formed into fat ropes called slivers, on the ground floor of the mill.
- The slivers were pulled and twisted into smaller strands known as ‘rovings’ by drawing and roving machines on the first floor.
- Spinning machines spun the cotton strands from the drawing machines into finer thread on the second floor.
- On the fourth floor, reeling, doubling and twisting machines turned the spun yarn into finished thread.

This thread could then be woven into fabric using a weaving loom.

From thread to fabric

If this thread was to be woven into cloth, rather than just used as thread, it had to go through several other processes:

- Winding: The thread was wound onto bobbins. Then it could be used as weft – the thread which a weaver actually wove with.
- Warping: the thread was strengthened by passing it through a solution of hot starch which made it smoother and stronger. Then it could be used as the warp on a power loom – the threads which a weaver wove between.

After this, the thread could be woven into cloth, either on a handloom, or on a power loom.

Cotton weaving was carried out on handlooms until the early 19th century. Handlooms were manually operated weaving looms, traditionally operated by weavers in their own homes. Weaving was a relatively highly-paid, skilled job and to begin with, weavers benefited from the start of the mechanisation of the textile industry. Spinning machines greatly increased the supply of yarn and gave weavers a more reliable income. But as steam or water-powered looms began to be widely used, weavers began to find their wages and conditions declining, causing great distress to them and their families.

The first power loom was patented in 1787. From the early years of the 19th century power looms began to be used in Scotland, and Stanley was among the earliest adopters of power looms in Scotland. From the 1820s, the looms were housed in a building on the east side of Mill Square.
Tour 1: Working at Stanley Mills

This tour of Stanley Mills is designed to be led by teachers or well-briefed parent helpers. It stops at eight locations relevant to the theme of working at Stanley. At each point there is a short section of background material – which can be read to pupils – and some questions designed to generate discussion and encourage pupils to interpret their surroundings.

As you leave your minibus or coach, gather your pupils together beside the car park.
TOUR LOCATIONS

1. Introduction and the Lade
2. The Gatehouse
3. Mill Square
4. Bell Mill ground floor: the story of Stanley Mills
5. Bell Mill basement: the tar tank
6. Mid Mill first floor: the carding room
7. Bell Mill first floor: the spinning room
8. Outside the mills
1. Introduction and the Lade

By the car park

_Beckground information: this may be read to pupils._

- We’re coming close to Stanley Mills. If you listen carefully, you might be able to hear the reason why this mill was built here.
- It was built here because of the river. The power of the water in the river turned a water wheel which drove the machines in the mill.
- The mills were built here to make cotton – cotton thread and cotton fabric. _Are you wearing anything made of cotton today – like a T-shirt or sweatshirt?_ The threads that were used to make it were spun on machines in a cotton mill.
- More than 200 years ago, in the 1780s, cotton was a very new fabric in Scotland. It arrived in Scotland at about the time that people were starting to build the first factories. Stanley Mills was one of the first factory-type mills in Scotland. It was used right up until 1989, so it was in use for about two centuries!
- Lots of people worked in the mill to make the cotton – men, women and children. Today we’re going to find out about what it was like for them to work in a mill.

_Take the path from the car park towards the mills. To the left of the path is a wide artificial channel – the mill lade. Stop beside it – and encourage children to keep well back._

- This channel is called the mill lade. It was built more than 200 years ago. It channels the water from the River Tay through a tunnel in the hillside to the mill.
- Later on, in the 1820s, another tunnel was built as well. So much water poured through that there was enough power to drive seven waterwheels at once!

**Discussion points**

<table>
<thead>
<tr>
<th>Teacher prompt</th>
<th>Desired pupil response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which way did the water flow along this lade?</td>
<td>The same way as you are walking, from the river to the mill.</td>
</tr>
<tr>
<td>Do you think there was always this amount of water in the lade?</td>
<td>No – you can see marks on the wall showing it used to be higher.</td>
</tr>
<tr>
<td>Can you see or work out how they would have controlled the amount of water here?</td>
<td>Sluice gates could be raised or lowered to adjust the flow of water, or to cut it off altogether.</td>
</tr>
<tr>
<td>Why do you think they needed to build a mill lade? Why didn’t they just use the water straight from the river?</td>
<td>Easier to control the water if it came through a channel. Could control the amount of water which poured through, and also where the water ended up.</td>
</tr>
<tr>
<td>What would you expect to find at the other end of this mill lade?</td>
<td>A water wheel.</td>
</tr>
</tbody>
</table>

_Carry along the path to stop at the end of the lade by a small building called the Gatehouse. Next to this building is a useful 3D model of the peninsula and the buildings. Stop next to this._
2. The Gatehouse

**Background information: this may be read to pupils.**

- Look at the 3D map next to the Gatehouse. Can you find:
  - the river
  - the mills
  - the mill lade
  - Stanley village, where the workers lived
  - the Gatehouse where we are now
- Look to where the tunnel is cut in the hill. **Why do you think it was built right there?** (water could be diverted easily; very powerful). **Using your finger, can you follow the flow of water from the river through the lades and mill, and out into the river again?**
- Now let’s look at this little round building.
  - People came from all over Scotland to work in the mills. Many people were desperate for work, as they had been moved off their land to make way for sheep farming.
  - This building was one of the first buildings they would pass.

**Discussion points**

<table>
<thead>
<tr>
<th>Teacher prompt</th>
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</thead>
<tbody>
<tr>
<td>What do you think this building was used for?</td>
<td>To check workers in and out – to make sure no one was missing or late.</td>
</tr>
<tr>
<td>Look up at the rooftop of the main mill building. Can you see anything else which might help you know if you were late or not?</td>
<td>The bell on the roof – this would ring to signal the start and end of shifts.</td>
</tr>
</tbody>
</table>

**DID YOU KNOW?**

In 1990, when workers were restoring the Gatehouse, they made an unusual find, buried beneath the floor – a time capsule! It included an old bottle containing a silver coin dated 1900 and a note from two men called James Bryde and John Stewart, who had replaced the floor in 1920.

*Carry on into the courtyard, known as the Mill Square.*
3. Mill Square

**Background information: this may be read to pupils.**

- There are lots of different mill buildings here. They were not all built at the same time. Some were built later, as the mill became more successful. They were altered as the fortunes of the mill changed.
- The Bell Mill is the oldest building. It’s the one on the right. It was designed by an English mill expert called Richard Arkwright. He invented lots of machines to produce cotton thread quickly, and designed his mill buildings around the machines and what would happen inside them. This was one of the very first factories in Scotland.
- Every floor would have been filled with machines and people working them – you’ll see a photo of the workers just as you go in the door to the main visitor centre. It would have been a very noisy and very busy place.

**Discussion points**

<table>
<thead>
<tr>
<th>Teacher prompt</th>
<th>Desired pupil response</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Bell Mill is the oldest building. How is it different from the other mill buildings?</td>
<td>Higher; made of brick as well as stone.</td>
</tr>
</tbody>
</table>

School groups should report to the main visitor centre in the ground floor of the Bell Mill.
4. Bell Mill ground floor: the story of Stanley Mills

The exhibition area may be busy with other visitors. We suggest that you move your group away from the till and gather them together further into the exhibition area.

**Background information: this may be read to pupils.**

- Now we’re standing inside the mill building. More than 200 years ago, this building was new. This room would have been full of machines, and people working them. It was used right up until the 1980s. Now there is an exhibition about the mills. But before we have a look at the exhibition, let’s look at the room itself.

**Discussion points**

<table>
<thead>
<tr>
<th>Teacher prompt</th>
<th>Desired pupil response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the room feel dark or bright to you?</td>
<td>It’s very light.</td>
</tr>
<tr>
<td>Why do you think it was designed with so many windows?</td>
<td>So that the workers could see what they were doing in the days before electric light.</td>
</tr>
<tr>
<td>If cotton gets too cold and dry, it breaks and can’t be used. Can you see any clues for how the room was kept warm?</td>
<td>Signs of fireplaces.</td>
</tr>
<tr>
<td>Do you think they had open fires? Why/why not?</td>
<td>Unlikely – fire risk too great.</td>
</tr>
<tr>
<td>Today this mill room is filled with an exhibition, but there are still lots of signs that it used to be a working mill. What clues can you find?</td>
<td>Slightly rusty iron pillars. Weighing machine in place. Dirty, uneven floor. Roof beams look very old and strong. Paint is flaking on the walls.</td>
</tr>
</tbody>
</table>

*Below: A spinning machine developed at Stanley Mills around 1970*

*Below right: A calender rolling machine, used to smooth cotton tape*
4. Bell Mill ground floor continued: the exhibition

Have a look round the exhibition. It is structured around four key moments in the story of the mills:

1. 1784 – Founding of mill
2. 1833 – Factory inspection!
3. 1876 – Sandeman’s innovations
4. 1936 – Kate Gairns starts work

As there is so much to see, we suggest that after an introduction to the mill at ‘Moment’ 1784, you focus chiefly on moments 1833 and 1936, as they provide a good contrast of working conditions a century apart. You can let pupils choose at will from different displays, or you can focus their attention on key exhibits. Objects, images and interactives likely to be of particular interest to pupils at each stage are listed below:

**1784: Founding of Stanley Mills**

- Building as Machine: a typical Arkwright mill. This is an excellent way of helping pupils understand what happens in a mill. It is a large-scale, hand-cranked, cut-away model of a mill, showing the arrangement of water mill, shafts and cranks. This shows clearly the process of cotton production on each floor. Encourage pupils to follow the route taken as power is transferred from one machine to another, and also to follow what is happening to the cotton at each stage.

**1833: Factory Inspection!**

Explain to pupils that the factory was inspected in 1833 by representatives from the government. They wanted to find out about conditions in the mill and they interviewed all kinds of workers at Stanley – the owners, managers, men, women and children.
Pupils may be interested in the following exhibits:

- **Processing cotton:** This series of exhibits shows how cotton was processed. Pupils can follow the process from raw cotton to woven fabric. There are samples of the cotton at each stage which pupils can touch. There are also samples of the different products manufactured at Stanley.

- **Images of children at work among machines:** Look closely to see a child at work beneath a machine – together with text and quotations describing children’s experiences at the mills.

- **Mill machinery interactive:** This is based on a real machine (a throstle machine – a type of spinning machine used to twist and wind cotton fibres) and includes three different activities. The first replicates the experience of changing bobbins, the second piecing together broken threads and the third the experience of children who had to clean up loose cotton and other debris from beneath moving machines. The games have no time limit to emphasise the monotony of the tasks.

- **Life of a mill worker interactive:** This is a multimedia activity in which players take on the role of a Highland family. They are presented with a series of simple choices to help them decide whether it is better to remain on their farm or move to Stanley for work. This is designed to help players understand some of the difficult choices families at that time had to make in order to survive. It also provides background material to Highland life in the early 1800s.

- **Changes at Stanley Mills interactive timeline:** This highlights key events in the development of the mill 1823–60.

1936: **Kate Gairns starts work**

Kate Gairns worked at the mill between 1936 and 1977. Her story reflects the changing fortunes of the mill in the 20th century.

- There are many objects on display associated with her working life: an identity bracelet, needles for stitching and other tools of her trade.

- **Stories from Stanley Mills:** an audio–visual programme with footage and recordings of former workers telling stories of their working lives.

- **Samples of items produced at Stanley:** these include military equipment, tape for cigarette manufacture, acrylic socks.

- **The secret room display and audio–visual programme:** the process for making cigarette tape was a closely guarded trade secret, and so the room where it was produced was known as the Secret Room.

- **Weighing machine:** these scales could weigh up to 725kg of cotton – the weight of a small car!

- **Interactive timeline:** 1933–now: this final timeline brings the story of Stanley mills up to date, and includes the closure of the mills, the buying of the mills by Historic Scotland and the re-opening of the hydro-electric station.

- **Changing products, changing fortunes:** this display charts the fortunes of Stanley Mills in the 20th century.

*Leave this room by the door at this end, go down a flight of steps to find the basement. Turn left into the room known as the Tar Tank.*
5. Bell Mill Basement: The tar tank

Background information: this may be read to pupils.

- We’re now down in the basement, close to the river and close to the water wheel that powered all the machines.
- There used to be a tank of boiling tar in this room. Can you see the tank? The tar was heated by a coal fire underneath the tank to keep it hot and runny.
- Workers dipped lengths of thick cotton belts into the tar to make them waterproof.
- The tarred belts were then sold all over the world to run machinery. You can see the belting in use in a photo here of a factory in India.

Discussion points

<table>
<thead>
<tr>
<th>Teacher prompt</th>
<th>Desired pupil response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Look for:</td>
<td></td>
</tr>
<tr>
<td>The roll of fabric which has been dipped in the tar</td>
<td>Visible at the back of the room</td>
</tr>
<tr>
<td>Signs of where the tar has dripped in here</td>
<td>Many places with black drips</td>
</tr>
<tr>
<td>How the extra tar was squeezed off the fabric</td>
<td>Machines with rollers are visible</td>
</tr>
<tr>
<td>The last barrel of tar left behind by the last workers!</td>
<td></td>
</tr>
<tr>
<td>What sounds and smells would there have been in here when the mill was working?</td>
<td>Smell of fire and fumes from hot tar</td>
</tr>
<tr>
<td>How would it have felt to work in here?</td>
<td>Sounds of fire burning and tar bubbling</td>
</tr>
<tr>
<td>Why do you think there was a metal fire door in here?</td>
<td>To prevent any fires from spreading</td>
</tr>
<tr>
<td>This might have been quite a dangerous place to work. What dangers can you think of?</td>
<td>Risk of fire Splashing of hot tar dripping from belts Fumes from tar Hot metal from the tank could cause burns Risk of crushing in rollers</td>
</tr>
</tbody>
</table>

Note: if you wish to see the wheel pits where the water wheels used to sit, turn into the Bell Mill basement: the Power House. Pupils can also try out interactives exploring the technology of water power in the adjacent room: Mid Mill Ground Floor.

To continue your tour, leave the tar tank, return up the stairs to Level 1 and enter the Carding Room.

DID YOU KNOW?

Raw cotton and flax (used to make linen) catch fire very easily. One of the first buildings at Stanley Mills burned down after only about ten years, in 1799 – but was soon rebuilt. It is very unusual to find a cotton mill this old which has survived.
6. Mid Mill first floor: the carding room

Note: there is a two-minute video showing what it was like to work in the carding room in the 1950s. It includes archive footage, animation and oral histories.

**Background information: this may be read to pupils.**

- Before cotton can be spun into thread, it has to be combed so that all the fibres are straight. This process is called carding.
- This room was the carding room, right from when the Mid Mill opened until the 1950s. The machines which you can see now are from the 1950s.
- The room used to be much bigger – maybe four times longer. There used to be lots more of these machines.
- Fires often started in the carding room because of all the dust.
- The room would have been incredibly noisy and full of dust and dirt. If you look at some of the big photographs, you can even see the dust in the air.

Note: If you press the button on one of the display panels, you can hear briefly the sound of the carding machines at full volume.

**Discussion points**

<table>
<thead>
<tr>
<th>Teacher prompt</th>
<th>Desired pupil response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Look at the carding machine which has cotton on it. Look at the cotton before and after it goes into the machine. How is it different? Can you see the brushes on the machine?</td>
<td>Pupils’ own responses</td>
</tr>
<tr>
<td>These machines are quite old now. What do you think they would have looked like when they were new?</td>
<td>Shiny, gleaming</td>
</tr>
<tr>
<td>Working in the carding room could be bad for your health. What risks can you think of?</td>
<td>Dust in the air caused breathing problems Injuries from moving machinery Damage to hearing from noise Danger of fire</td>
</tr>
<tr>
<td>Why do you think some of the people in the photographs were wearing a uniform?</td>
<td>To keep clothes clean To keep clothes out of the way of machines To keep hair out of the way of machines</td>
</tr>
<tr>
<td>Can you see anything else in this room which shows how the factory owners tried to tackle the risk of fire?</td>
<td>Fire alarm bell on display</td>
</tr>
<tr>
<td>How do you think you would feel at the end of a shift working these machines?</td>
<td>Exhausted, dirty, deafened, etc</td>
</tr>
</tbody>
</table>

**DID YOU KNOW?**

Because it was so noisy in the carding room, the women here made up their own sign language to communicate.

**Leave the room by the same door, and head upstairs to the second floor. Turn into the Spinning Room.**
7. Bell Mill first floor: the spinning room

Background information: this may be read to pupils.

- This room has hardly changed at all since it opened for business in 1787. People think spinning machines were used here.
- The whole mill, including this room, was originally designed by Richard Arkwright. He also designed a new kind of spinning machine called a water frame, because it was powered by water.
- This room was designed by him specially around these water frames. It was just the right height for his machines – around 2.5m high. And it was the right width to squeeze in as many machines as possible.
- The machines which used to be up here were all powered by the same water wheels down below. The power travelled up through a series of shafts and gear wheels. As the gear wheels turned, they made the machines work.

Note: In this room, a series of life-sized illustrations on glass give an impression of what this room may have looked and felt like when in use at the time when the mills first opened. As you approach the pictures, you can hear recordings of conversations in English, Scots and Gaelic. These can be quite noisy!

Discussion points

<table>
<thead>
<tr>
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<th>Desired pupil response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why do you think the windows are so big here?</td>
<td>To light the room without the need for dangerous naked flames.</td>
</tr>
<tr>
<td>Where do you think the machines would have been positioned and why? (The pictures on glass might help you.)</td>
<td>Between the windows for added light.</td>
</tr>
<tr>
<td>In the corner is the toilet tower – something very modern for the 18th century. Why do you think the mill owners had a toilet inside?</td>
<td>So that the workers wouldn’t waste any time by going to the toilet outside.</td>
</tr>
<tr>
<td>Look at the pictures on the glass. There are lots of children shown working in the mill. What jobs can you see children carrying out?</td>
<td>Threading, carrying, sweeping, fixing machines, crawling under machines, cleaning windows.</td>
</tr>
<tr>
<td>Which person would you most like to have been and why?</td>
<td>Pupils’ own responses.</td>
</tr>
<tr>
<td>Which person would you least like to have been and why?</td>
<td></td>
</tr>
<tr>
<td>You can hear different languages. What does this tell us?</td>
<td>People came from all over Scotland to work in the mills.</td>
</tr>
<tr>
<td>Why do you think people travelled so far to work here?</td>
<td>Desperate for work. Some benefits – e.g. housing.</td>
</tr>
<tr>
<td>How would this room have been different in the old days?</td>
<td>Full of machines, noisy, people talking.</td>
</tr>
</tbody>
</table>

Go back down the stairs and leave the mill via the exhibition area again.
8. Outside the mills

The internal tour of the site is now finished. As you make your way back to the car park you may want to point out the following features to pupils:

- The Tay Terrace: this gives a good view of the River Tay, source of power, and is the site of the very first mill at Stanley, a corn mill dating from the early 18th century.
- The East Mill – which is now occupied by private housing. It was originally built in the 1790s but burnt down in 1799. It was repaired and then reopened in 1802. It has an internal wheel pit. At one point there was also a North Mill. These buildings are impressive today: in the early 19th century they must have sent out a very powerful message.
- The East Range: behind the East Mill is a single-storey warehouse. This was built in the 1820s and was used to store raw cotton. It also housed weaving looms from around the same time.
- The North Range: these are the lower stone-built offices opposite the Mid Mill. These were where the company offices originally were. This was also where the ‘secret room’ was in the 20th century – where the closely-guarded process of cigarette-tape manufacturing took place.
- The gasworks chimney. This chimney is very obvious as you look over Mill Square. It is the oldest gasworks chimney in Scotland. It used to be 10m taller than it is now. You can see a circular shape, which is the site of gasometer, where the gas was stored. The gas was used for gas lighting inside the factory. Before it was built around 1825, the mills were lit by candles, which was a real fire hazard.

Our work tour is now finished. As you leave Stanley Mills, get pupils to think about these questions:

- How did working conditions improve at Stanley over the years?
- Would you have liked to work at Stanley Mills? If so, when, and doing which job? If not, why not?
Water wheels – from timber wheels to npower

The first water wheels at Stanley were made out of wood. They were based on the type of water wheel traditionally used in grain mills. They were known as breastshot wheels, because the water flowed across them about halfway up. They were huge – probably 6–9m across.

In the 1820s the wheels were replaced with new cast-iron water wheels. There were four of these, set into two pairs of wheel pits. These new wheels were undershot: they were turned by water flowing underneath them.

In the 1830s another set of wheels were added. They were known as suspension wheels. They had spokes like a bicycle wheel, and were designed to turn the power shaft using gear teeth around the rim of the wheel, rather than from its central axle. Rim gears turned more quickly and generated faster speeds for the machinery in the mill. These wheels were backshot, which means that the water dropped onto them from above and turned them backwards.

In 1878 there was another innovation – Stanley’s first turbine wheel. The River Tay never dried up but it did have another problem: it often flooded. When this happened, traditional water wheels couldn’t turn, as they were under water in the flooded wheel pits. But turbines could run even during floods, as they operated submerged in a tank. Water was guided into the turbine through an iron tank. The water passed its energy to the blades of the turbine, making it rotate.

In 1908 another turbine was installed at Stanley, but not for driving the mill machines. Instead, it generated electricity through hydro power. To begin with, this electricity was used to light the mills.

DID YOU KNOW?
The River Tay is Scotland’s longest and most powerful river. It drains approximately 15% of the Scottish mainland. It never dries up, which makes it an ideal river for water mills. But... it often floods. In the old days, whenever this happened, the water wheels stopped turning and the mill had to close until the water level dropped again. This could happen up to 50 days a year!
Later, in 1921, a separate turbine house was built. The turbines here powered a generator to drive all the machines by electricity. It also provided power for the street lighting and many of the houses in Stanley. Unlike many mills, the machines at Stanley were never powered by steam. They moved directly from mechanical power to power from hydroelectricity, until 1965, when the mills were converted to mains electricity.

But today, the river is generating electricity once again. In 2003, new turbines were installed in the turbine house by npower to generate electricity for the National Grid.

Transmission: from the wheel to the machine

It wasn’t enough for the river to power the water wheel alone. For the wheel to drive machinery, there had to be a series of connections.

In the early days these connections were made through wooden shafts and wooden gears. Wooden shafts didn’t turn easily, and wooden gear wheels didn’t fit together very well. They often broke or slipped. Lots of power was lost on the journey between the water wheel and the machinery.

The wooden parts were in time replaced by metal shafts and gear wheels. These ran quickly and efficiently. This meant that machines could operate at higher speeds. But the downside was that they were very noisy and required a lot of maintenance to run smoothly.

In the late 19th century, a new solution was found: cotton belting, produced in the mill itself. Most of the shafts and gears were replaced by ropes, cotton belts and pulleys. This was more efficient still and the system ran much more quietly – but needed constant adjustment to make sure that they were running at the correct tension.
Tour 2: Water power

This tour of Stanley Mills is designed to be led by teachers or well-briefed parent helpers. It stops at seven locations relevant to the theme of working at Stanley. At each point there is a short section of background material – which can be read to pupils – and some questions designed to generate discussion and encourage pupils to interpret their surroundings.

As you leave your minibus or coach, gather your pupils together beside the car park.
TOUR LOCATIONS

1. Introduction and the Lade
2. The 3D model and Mill Square
3. The Tay Terrace
4. Bell Mill ground floor: the story of Stanley Mills
5. Bell Mill basement: the archaeology of power
6. Mid Mill ground floor: the wheel pits and power interactives
7. The Power Station
1. Introduction and the Mill Lade

*Background information: this may be read to pupils.*

- We’re coming close to Stanley Mills. If you listen carefully, you might be able to hear the reason why this mill was built here [get pupils to listen for the sound of the River Tay].
- That’s right – it was built here because of the river. The power of the water in the river turned a water wheel which turned the machines in the mill.
- The mills were built here to make cotton – cotton thread and cotton fabric. *Are you wearing anything made of cotton today – like a T-shirt or sweatshirt?* The threads that were used to make it were spun on machines in a cotton mill.
- More than 200 years ago, in the 1780s, cotton was a very new fabric in Scotland. It arrived in Scotland at about the time that people were starting to build the first factories. Stanley Mills was one of the first factory-type mills in Scotland. It was used right up until 1989, so it was in use for about two centuries!
- Even though the mill isn’t in use any more, the River Tay is still being put to work. Today it powers turbines which make electricity to be used all over Scotland.

*Take the path from the car park towards the mills. To the left of the path is a wide artificial channel – the mill lade. Stop beside it, and encourage children to keep well back.*

- This channel is called the mill lade. It was built more than 200 years ago. *Where do you think the water comes from?* [from the River Tay].
- More than 200 years ago they built a tunnel through the hill behind you. The tunnel channels the water from the River Tay along the lade and into the mill.
- Later on, in the 1820s, another tunnel was built as well. So much water poured through that there was enough power to drive seven waterwheels at once!
Discussion points

<table>
<thead>
<tr>
<th>Teacher prompt</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Which way did the water flow along this lade?</td>
<td>The same way as you are walking, from the river to the mill.</td>
</tr>
<tr>
<td>Do you think there was always this amount of water in the lade?</td>
<td>No – you can see marks on the wall showing it used to be higher.</td>
</tr>
<tr>
<td>Can you see or work out how they would have controlled the amount of water here?</td>
<td>Sluice gates could be raised or lowered to adjust the flow of water, or to cut it off altogether.</td>
</tr>
<tr>
<td>Why do you think they needed to build a mill lade? Why didn’t they just use the water straight from the river?</td>
<td>They could control it better if it came through a channel – they could control the amount of water which poured through, and also where the water ended up.</td>
</tr>
<tr>
<td>Can you see anything which shows us how the mill workers would control the water flowing into the mill?</td>
<td>You can see wooden gates, close to the car park and also at the end of the lade.</td>
</tr>
<tr>
<td>How do you think these worked?</td>
<td>Gates would be opened and closed to allow water to flow through or to block the flow of water.</td>
</tr>
<tr>
<td>What would you expect to find at the other end of this mill lade?</td>
<td>A water wheel – or maybe more than one.</td>
</tr>
</tbody>
</table>

*Carry along the path to stop at the end of the lade by a small building called the Gatehouse. Next to this building is a useful 3D model of the peninsula and the buildings. Stop next to this.*
2. The 3D Map and Mill Square

*Background information and discussion points. This may be read to pupils.*

Look at the 3D map. Can you find:

- the river
- the mills
- the Mill Lade
- the Gatehouse where we are now
- Stanley village, where the workers lived

**Discussion points**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Look to where the tunnel is cut in the hill. Why do you think it was built right there?</td>
<td>Water could be diverted easily; very powerful</td>
</tr>
<tr>
<td>Can you use your finger to follow the flow of water from the river through the lades, into the mill, and out into the river again?</td>
<td></td>
</tr>
</tbody>
</table>

*Turn around and go and stand in the courtyard known as Mill Square.*
There are lots of different mill buildings here. They were not all built at the same time. Some were built later, as the mills became more successful. They were altered and changed as the needs of the mill changed. But until the last years, the machinery was all powered by the river.

- The Bell Mill is the oldest building. It’s the one on the right. It was designed by an English mill expert called Richard Arkwright. He invented lots of machines to produce cotton thread quickly, and designed his mill buildings around the machines and what would happen inside them. This was one of the very first factories in Scotland.

**Discussion points**

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>The Bell Mill is the oldest building. How is it different from the other mill buildings?</td>
<td>Higher; made of brick as well as stone.</td>
</tr>
<tr>
<td>Every floor would have been filled with machines, all powered by water wheels. How do you think the power to make the machines work got right up to the top floor?</td>
<td>For the moment, accept any suggestions – the main thing at this stage is to get pupils thinking.</td>
</tr>
<tr>
<td>As the water wheel turned, it drove horizontal shafts. These then transferred the power through gears up vertical shafts to power machines on every floor.</td>
<td></td>
</tr>
</tbody>
</table>

*For now, go to the right of the Bell Mill, past the entrance to the exhibition, and follow the path down to the Tay Terrace, looking over the river. Next to it, the floor plan of the original corn mill is marked out in paving stones.*
3. The Tay Terrace

**Background information. This may be read to pupils.**

- This was where the very first mill was. It was a corn mill, for grinding cereal crops into flour. It was built in the 1720s, more than 50 years before the cotton mill was built.
- Archaeologists have dug up the remains of this building and can work out where it used to be.

**Discussion points**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Look at the river. What makes it such a good river for powering machinery?</td>
<td>Fast-flowing&lt;br&gt;A lot of water – very powerful&lt;br&gt;Very unlikely to dry up in summer time.</td>
</tr>
<tr>
<td>Look carefully at the different coloured stone slabs set into the ground. Can you see the outline of the old corn mill which used to be here? Can you see the stones which mark where the old water wheel used to be? What else must have been here at one time to turn the wheel?</td>
<td>Outline shapes marked out in paving.&lt;br&gt;Wheel marked by series of grooves carved into the stone&lt;br&gt;A mill lade to channel water on to the wheel.</td>
</tr>
<tr>
<td>If you look at the photo on one of the panels, you can see a picture of a winter sport on the river – do you know what it is? What would happen to the mill if the river froze? Can you think of any other disadvantages of water power?</td>
<td>Curling.&lt;br&gt;If the river froze, the wheels would not be able to turn so the mills would have to stop running&lt;br&gt;Risk of flooding, being so close to the river.</td>
</tr>
</tbody>
</table>

*Follow the path back around the building and go into the main entrance to the Bell Mill.*
4. Bell Mill ground floor: the story of Stanley Mills

The exhibition is structured around four key ‘moments’ in the story of the mills:

1784 – Founding of mill
1833 – Factory inspection!
1876 – Sandeman’s innovations
1936 – Kate Gairns starts work

As there is quite a lot to see, we suggest that you focus on the elements as listed below, from moments 1784 and 1833, which display exhibits most relevant to the theme of water power at Stanley. You can let pupils choose at will from different displays, or you can focus their attention on key areas.

Background information. This may be read to pupils.

- Two hundred years ago this room would have been full of machines powered by the water wheel and operated by men, women and children. Today there’s an exhibition about the story of the mills.

1784: Founding of Stanley Mills

- Building as Machine: a typical Arkwright mill. This is an excellent way of helping pupils understand what happens in a mill. It is a large-scale hand-cranked cut-away model of a mill, showing the arrangement of water mill, shafts and cranks. This shows clearly the process of cotton production on each floor. Encourage pupils to follow the route taken as power is transferred from one machine to another, and also to follow what is happening to the cotton at each stage.

1833: Factory inspection

Explain to pupils that the factory was inspected in 1833 by representatives from the government. They wanted to find out about conditions in the mill and they interviewed all kinds of workers at Stanley – the owners, managers, men, women and children.

Processing Cotton: this series of exhibits shows how cotton was processed. Pupils can follow the process from raw cotton to woven fabric. There are samples of the cotton at each stage, which pupils can touch. There are also samples of the different products manufactured at Stanley.

Changes at Stanley Mills interactive timeline. This highlights key events in the development of the mill 1823–60.

Leave this room by the door at this end, go down a flight of steps and then straight on to find yourself in the basement.
5. Bell Mill basement: The archaeology of power

*Background information: this may be read to pupils.*

- Now we are in one of the most important rooms in the whole mill. In this room was the machinery which carried the power from the water wheels to the machines upstairs in the mill.

**Discussion points**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>What sounds can you hear?</td>
<td>Rhythmic thumping; very noisy.</td>
</tr>
<tr>
<td>What do you think this recording is meant to tell us?</td>
<td>The sound of the mill wheel turning close by.</td>
</tr>
</tbody>
</table>

- The water wheels and machinery have all gone now, but archaeologists have discovered clues here which tell us how the machinery worked, and where it was.

*Find the panel called ‘Powering the First Cotton Mill’. It is furthest away from the door where you came in. Press the button to set a projection in motion.*

- **Can you see the shape of a wheel turning round?** That is where the first water wheel used to be.

- **Can you see the shape of another wheel turning, to the left?** That’s where a shaft was attached to the water wheel. As the shaft turned around, it turned another wheel, called a pit wheel. This turned other wheels and shafts, which turned all the machines in the mill.

**Go out on to the little exterior balcony.**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Look down. What do you think used to be here? Do you think there was ever more than one wheel?</td>
<td>The water wheels. Yes, can see evidence of at least two wheel pits. At one point there were seven water wheels working at Stanley!</td>
</tr>
<tr>
<td>Can you see a circular mark rubbed on the stone wall? What do you think made the marks?</td>
<td>Water wheel rubbing against it.</td>
</tr>
<tr>
<td>Can you see where the water came through from the mill lade?</td>
<td>Look up to the left.</td>
</tr>
</tbody>
</table>

**Go along the balcony into the Mid Mill ground floor, where there are a number of interactives on the theme of water power.**
6a. Mid Mill Ground Floor: wheel pits

From the windows of this room you can see into the wheel pits, where the water wheels used to turn.

**Background information: this may be read to pupils.**

- We’re now in one of the other mill buildings, the Mid Mill. We can look right into the wheel pits from here.
- This was where the water wheels would turn.

**Discussion points**

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Can you see where the water would come from? Look for the gates which would control the amount of water which flowed in.</td>
<td>Channels at back, leading from lade.</td>
</tr>
<tr>
<td>Do you think the water flowed over or under the wheels to turn it? This changed over time. To begin with it poured over the wheel about halfway down, then later (1820s) it turned the wheel from underneath. You can see how this worked by looking at the water interactive in a minute.</td>
<td>Pupils’ own responses.</td>
</tr>
<tr>
<td>What would happen to the water after it had turned the water wheel? [you can see the channel leading into the river if you look out of the river-side windows]</td>
<td>It flows under the mill, under our feet and out into the river again.</td>
</tr>
<tr>
<td>What would happen to the wheel if the river level got higher, if it flooded? Why would this be a problem?</td>
<td>Water would come in from the river-side and would flood the wheel pit. The wheel would stop turning and the mill machinery would stop too.</td>
</tr>
<tr>
<td>Can you think of any solution to this problem?</td>
<td>Pupils’ own responses.</td>
</tr>
</tbody>
</table>

- In the 1870s they started using a different kind of wheel, called a turbine. The turbine turned underwater on its side – so it didn’t matter if the river flooded. You can see a model of a turbine in the water interactive.
- If the water level in the wheel pits is very low, you might be able to see six rectangular metal plates. This was where the turbine used to be.
6b. Mid Mill ground floor: the power interactives

In this room are two mechanical interactives exploring various technological principles.

The first interactive relates to the generation of power from water, and looks at different types of water wheel. The other interactive explores how power is transmitted from the water wheel to machines around the mill.

1. Water power interactive

This is an abstract representation of the River Tay and the lade system, complete with sluices leading into three wheel pits. There are examples of three different types of water wheels (breastshot, backshot and undershot) and a turbine. Pupils can experiment with opening and closing various sluice gates to see the effect this has on how quickly the wheels turn. There is lots of water here – pupils should either be very careful, or be prepared to end up a bit wet.

Get pupils to look at and think about:

- Where the water hits the water wheels. Which one is the most effective?
- The turbine – how is it different from the other wheels?
- What happens if more or less water is channelled to the wheels?
- What happens if the wheels become flooded from below?

2. Power transmission interactive – ‘Going up’

This activity demonstrates how water power was used to lift heavy objects at Stanley. Pupils can see how a turning water wheel drives belts which lift a model bale of cotton. Note: this is a ‘dry’ activity – the ‘water wheel’ here is driven by pupil power rather than by water power.

Get pupils to look at and think about:

- The route of power transmission from the wheel to the bale – can they follow it by pointing?
- What is needed before the bale goes up or down?
3. Power transmission interactive – ‘Belting up’ and ‘Getting into Gear’

This interactive helps explain how the power from the water wheel reached and drove the machines in the mill. It shows how power from the water wheel was transmitted around the factory on overhead shafts, and from there to individual machines via loops of cotton belting (of which Stanley was a producer).

When the lever on the left is pulled, a belt tightens. The belt uses friction to grip the pulley wheels, which start turning. This passes power along a shaft to a gear system. As the gear wheels turn, they set three rollers in motion.

A knob at the right of the machine engages different gears. By pulling this knob and changing the gear, pupils can adjust the speed of the rollers.

Get pupils to think about:
- How the power is transmitted to the belt
- What happens if the belt is slack
- How they can make the rollers turn more quickly, and why this happens
- What role water power might play in machines like this one


This machine repeats the message that power was transmitted from the water wheel through to machines via a series of moving shafts and belts. Visitors can engage the belt so that a set of bobbins starts turning.

This interactive also looks at how a cam can be used to make part of a machine move up and down. This mechanism would be used to allow thread to be wound evenly on to the bobbins, for example.

Get pupils to think about:
- How the power is carried to the machinery
- What makes the bobbins move up and down
- What role water power might play in machines like this one

At the far end of this room is a shaft with evidence for power transfer and an illustration of belt drives that could be useful, especially after the pupils have been experimenting with the power transmission interactive.

After this, if you wish to explore the activities of the mill further, then continue upstairs to the carding and spinning rooms. Tour notes may be found on pages 16–25, as part of our other tour, Working at Stanley Mills. To continue the theme of Water Power at the mills, leave the mill building, either by the Tay Terrace exit or back through the exhibition area.

As you come out of the mill building, turn right across Mill Square. You will pass the very obvious gasworks chimney.

Continue past all the mill buildings, crossing another mill lade as you go, and make your way to the Power Station, a small building similar in shape and size to the Gatehouse. It’s about a five-minute walk from the Bell Mill. Go up some metal steps to the left of a squarish modern building to look down into the mill lade.
7. The power station

Background information. This may be read to pupils.

- The mills closed down in 1989. But the River Tay is still being put to work. Today its power is used to generate electricity. This is where it happens.
- This hydro-electric power station was built in the 1920s. A turbine generated electricity to power the mills and also for the houses in Stanley village. So although the machines weren’t directly driven by water power any more, they still depended on the river.
- This power station closed down in the 1960s, but opened again in 2003. Today this power station makes electricity which goes into the National Grid – Scotland’s supply of electricity. The power in your home might come directly from the River Tay!

Discussion points

Teacher prompt | Desired pupil response
--- | ---
Look down into the lade. Why do you think there’s a kind of grille over the entrance to the power station? | To stop any branches or other rubbish going into the station.
What do you think is beyond the grille, where we can’t see? | The power turbines.
Look to the left. Where does the water come from? | Comes from the River Tay, through the tunnel in the hill.
Where does the water go, after it’s been in the power station? | It flows back into the river, and on into the sea.

You can try to get round to the right of the power station to see the water flowing out into the river but it’s quite overgrown.

You can follow the lade up towards the hill, but it’s quite hard to see the water flowing out of the tunnel.

As you make your way back to the car park, look to your right to see the big sluice gates which hold the water in the lade for the power station and prevent it from flowing along the old mill lade.

Our water power tour is now finished.

DID YOU KNOW?
The hydro-electric power station run by npower provides enough electricity to supply 1,200 homes.
Glossary

**Backshot:** a type of water wheel designed so that the water pours from above and turns it backwards

**Belting:** a loop of tough cotton fabric used to drive machines

**Bobbin:** a cylinder on which thread is wound

**Breastshot:** a type of water wheel designed so that the water pours on to it from halfway up

**Bucket wheel:** a type of water wheel which has solid compartments which fill up with water as the water pours over it

**Cam:** a wheel mounted on a turning shaft which can be used to make a piece of machinery move up and down

**Carding:** the process of combing raw cotton to make the fibres lie in the same direction

**Doubling:** part of the process of turning spun yarn into finished thread

**Lade:** a canal for channelling water from a river to a mill wheel

**Overshot:** a type of water wheel designed so that water pours onto it from above

**Paddle wheel:** a water wheel with flat blades fixed all around its edge

**Piecing:** the process of joining together broken threads in spinning and weaving

**Reeling:** part of the process of turning spun yarn into finished thread

**Rovings:** strands of cotton produced by pulling and twisting slivers

**Scavenging:** removing waste material and dirt from under the machines in a mill

**Shaft:** a rigid pole made of wood or metal, which is turned by a water wheel and transmits power to machinery

**Slivers:** fat, loose ropes of cotton prepared for twisting after the carding process

**Sluice gate:** a gate which can be opened or closed across a mill lade to control or stop the flow of water

**Shuttle:** a device which holds the weft thread and is used to pass it back and forth between the warp threads

**Suspension wheel:** a type of water wheel constructed with tensioned spokes, which transmits power through gear teeth around its rim, rather than through a central axle

**Throstle:** a machine once used for the continuous spinning of cotton fibres

**Turbine:** a wheel with blades which turn underwater to generate power

**Undershot:** a type of water wheel powered by water flowing beneath it

**Warp:** the threads which run lengthwise on a weaving loom

**Weft:** the threads which are woven through the warp on a loom

**Wheel pit:** a pit or channel in which a water wheel can rotate
Other places to visit

There are a number of historic sites in Scotland where pupils can investigate working conditions in the past:

**Verdant Works Jute Mill**, Dundee; Dundee Heritage Trust
A restored jute mill in Dundee with award-winning displays.
Tel: 01382 309060 www.rrsdiscovery.com

**New Lanark World Heritage Site**, South Lanarkshire
Restored 18th-century cotton mill village with visitor centre.
Tel: 01555 661345 www.newlanark.org

There are a number of small historic water mills in Scotland where it is possible to see water wheels in action during the summer months:

**New Abbey Corn Mill**, New Abbey, 11km south of Dumfries
Tel: 01387 850260 www.historic-scotland.gov.uk

**Preston Mill**, East Linton, 23m east of Edinburgh
Tel: 01620 860426/08444 932124 www.nts.org.uk

Scotland has a number of hydro-electric power stations with visitor centres open to the public:

**Pitlochry Power Station**, Pitlochry, Perthshire
Displays and interactive exhibits. The turbine hall can be viewed from the Visitor Centre.
Tel: 01796 473152

**Cruachan Power Station**, Dalmally, Argyll
Hydro-electric power station with visitor centre and guided tours inside the mountain to the massive cavern which contains the turbines.
Tel: 01866 822618 www.visitcruachan.co.uk

A number of museums have displays on water power and working conditions in the past. Contact these for details:

**Museum of Scotland**, Chambers Street, Edinburgh
Tel: 0131 225 7534 www.nms.ac.uk

**Glasgow Science Centre**, Pacific Quay, Glasgow
Tel: 08715 401000 www.glasgowsciencecentre.org
Other resources

WEBSITES

Working at Stanley Mills

http://www.bbc.co.uk/schools/victorians/index.shtml
This is an excellent general site on the experiences of children in Victorian Britain. It includes contemporary images, animations and dramatised transcripts. It specifically refers to the Factory Commissioners of 1833. It is designed for English Key Stage 2 – age group 9–11.

Two useful sites giving background information and simple interactives about working in the textile mills of Lancashire.

http://www.scran.ac.uk
A searchable database showing images of objects, documents and places from Scotland’s past. Includes resources for teachers.

http://www.ltscotland.org.uk/scottishhistory/industrialrevolution/index.asp
A library of largely text-based resources on a range of relevant subjects, with some straightforward online interactives. Useful for pupil research.

http://www.victorians.org.uk/
This website allows pupils to read ‘days in the lives’ of a Victorian family. You can examine photographs of relevant museum objects and post messages to members of the family. For more able pupils.

Water Power

http://www.berr.gov.uk/energy/sources/renewables/schools/teaching-resources/page23238.html
An excellent set of resources exploring renewable energy through the It’s Only Natural programme. Includes posters, information sheets and activity cards at a range of levels. Produced by the Department for Business Enterprise and Regulatory Reform.

http://www.eon-uk.com/EnergyExperience
A lively set of resources produced by energy company E-on as part of their Energy Experience – a programme for teachers to help them teach young people about energy, with an emphasis on renewables.

BOOKS

A brief but informative guidebook explaining the site and its history.

A detailed history of the mills and the village, for teachers wishing more detailed information. Strong on social history.

E. Gauldie Spinning and Weaving NMS, 1995
A useful short guide to the history of the textile industry in Scotland. Suitable for teachers.

Brian Moses A Victorian Mill Wayland, 1998
A lovely book for children, full of illustrations and selections from primary source material, making mill life accessible and interesting.

Victorian Scotland, National Archives of Scotland
A resource containing units on many aspects of Victorian Scotland, based on investigating contemporary documents and other archives. From www.scottisharchivesforschools.org/publications.asp

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Historic Scotland
Longmore House
Salisbury Place
Edinburgh, EH9 1SH