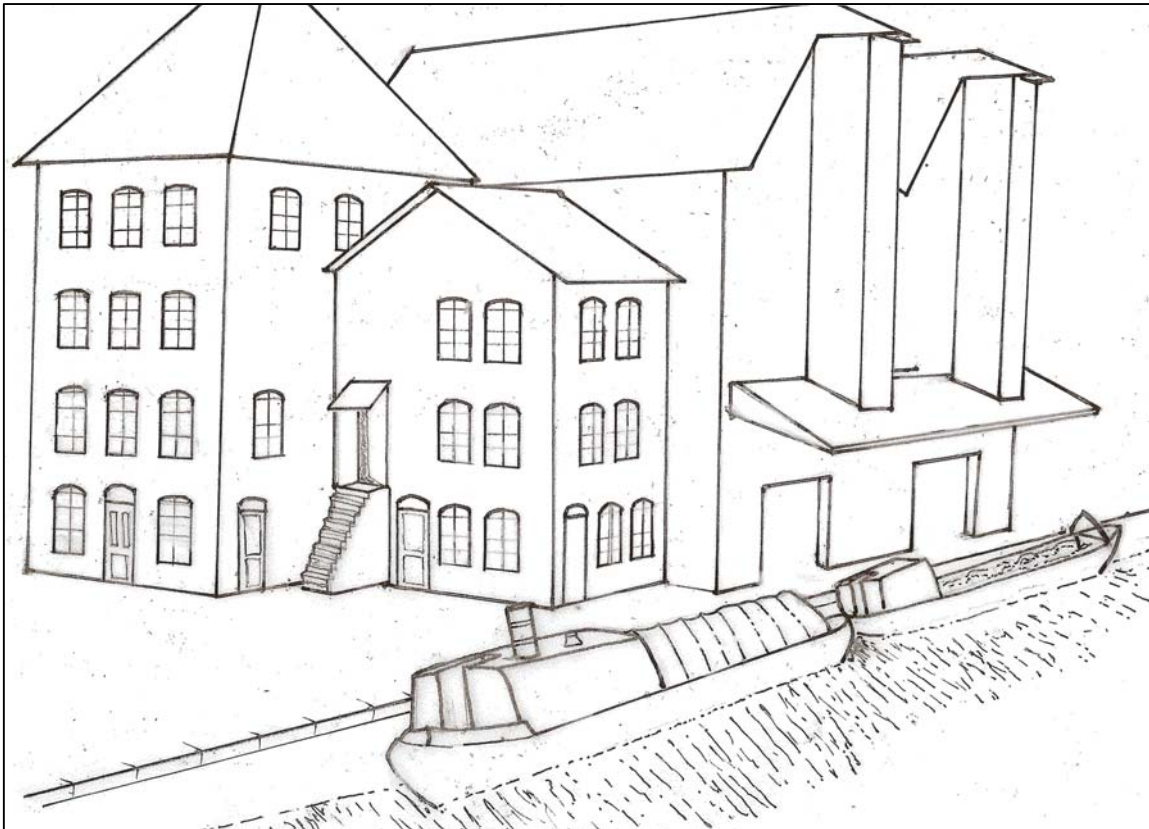


THE REVOLUTION CAME BY WATER



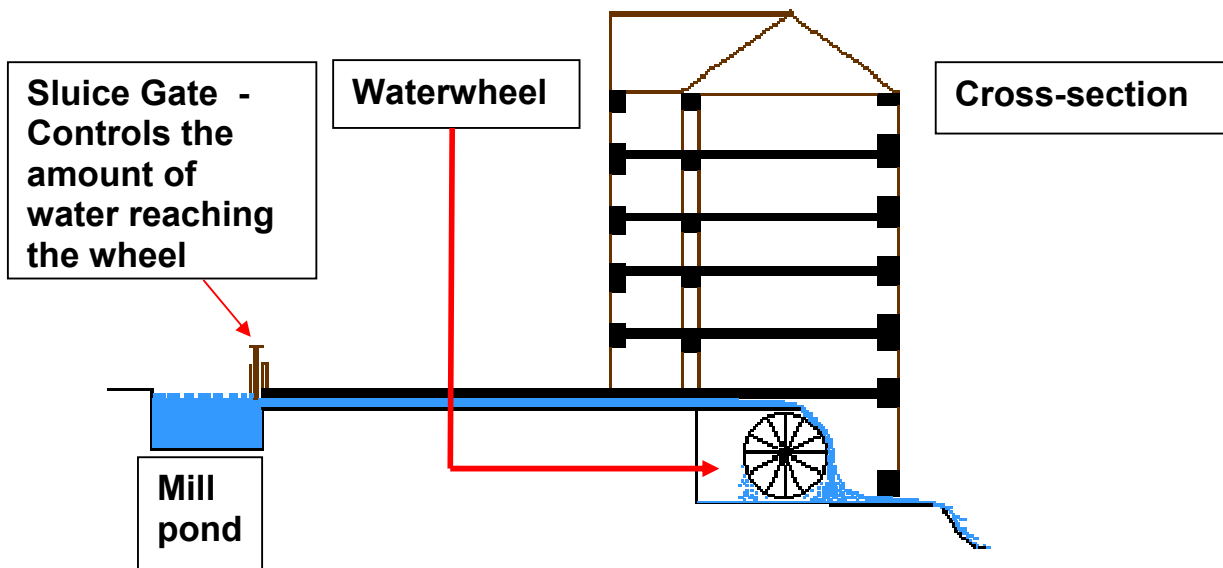
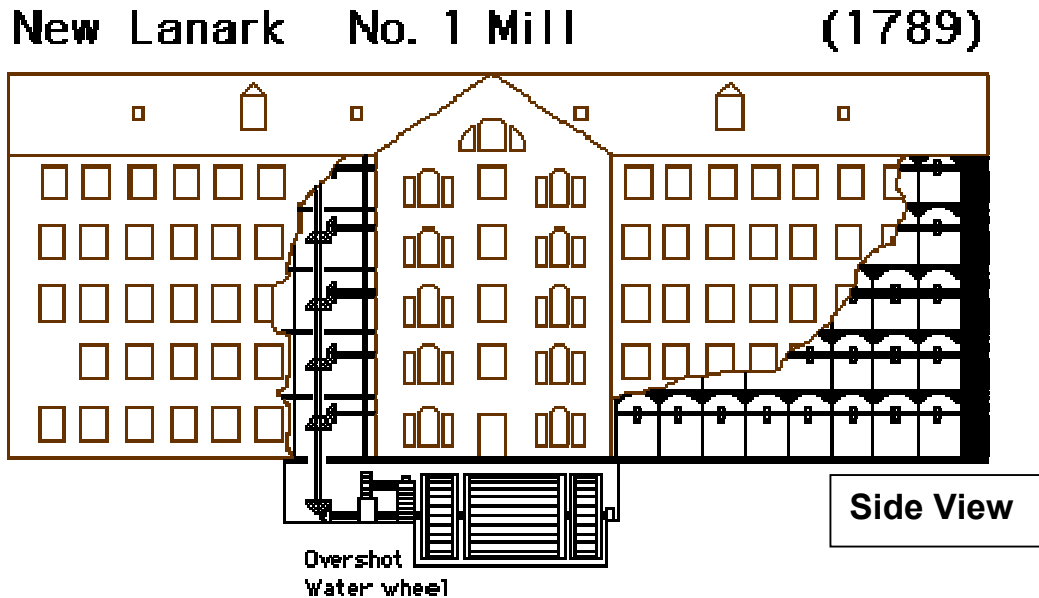
HOW WATER POWERED THE INDUSTRIAL REVOLUTION

School Pack for Keystages 2-3



THE REVOLUTION CAME BY WATER!

1. HOW WATER POWERED THE INDUSTRIAL REVOLUTION



www.aboutscotland.co.uk/watermill.gif

Question 1. This was a **TEXTILE** mill, used to produce cloth. It was powered by water through a

- a. Tap
- b. Water wheel
- c. Water pipe.



Textile mills – which turned cotton (imported from the West Indies and India) into lengths of cloth suitable for making clothes. The workers at the mill – called weavers – worked at large machines called looms. These were powered by the watermill using heavy canvas belts running round pulleys. This way, power could be sent all over the mill.

Before the cotton could be spun, however, it had to be boiled to soften and clean it. Water had to be boiled using coal to heat it.

Question 2. TEXTILE MILLS made

- a. Cloth
- b. Books (Text)
- c. Steel

Question 3. What materials are needed to make textiles?

- a. Cotton
- b. Coal
- c. Iron
- d. Cotton and coal

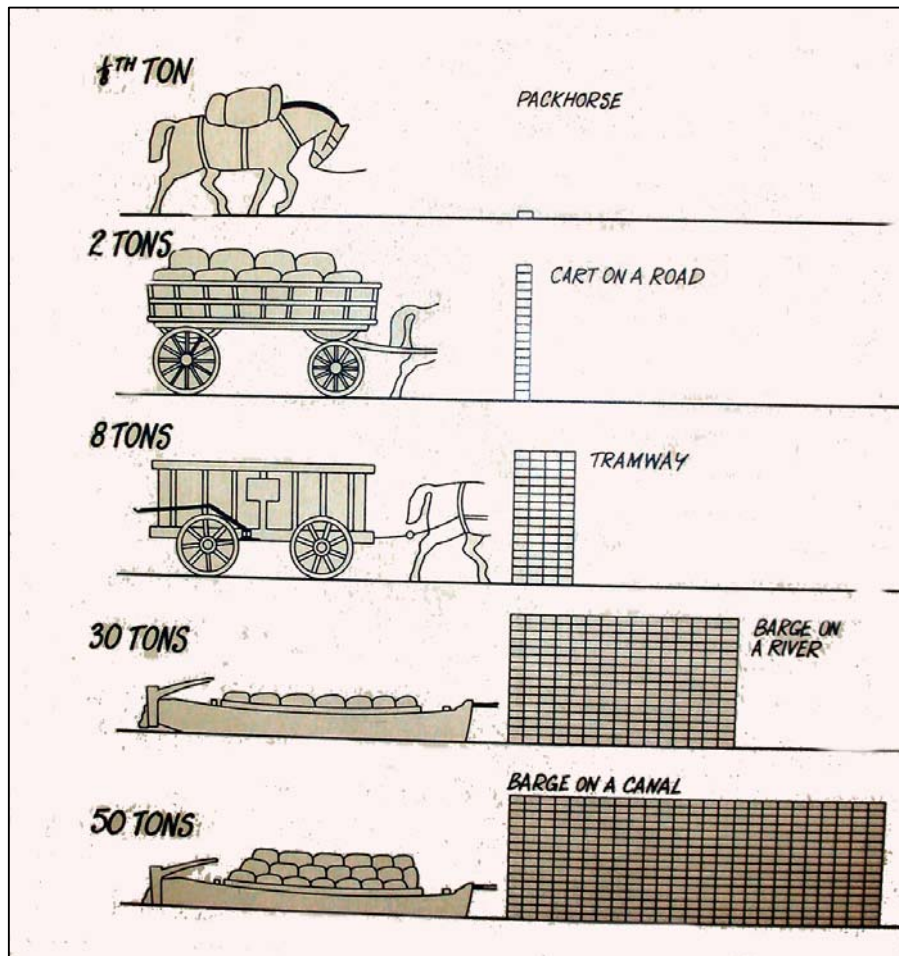
Question 4. During this period (1710-1810 AD) how could that material reach the mill?

- a. By road
- b. By rail
- c. By water
- d. By road and water

2. WHY MOVE LOADS BY WATER?

What were the advantages of moving large or heavy loads by water? Look at the diagram below. This shows that in one day, a horse could carry a load of $\frac{1}{8}$ th of a ton (about 127 kilos) about 10 miles. Further down the chart, the same horse, working on a tramway (a primitive railway) could pull a load of 8 tons (about 8.2 tonnes) the same distance.

However, if the same horse were pulling a barge on a canal, it could pull over 50 tonnes in the same time.



Courtesy of the Waterways Museum, Gloucester

Question 5. Why was it easier to move loads by water?



EXPLORE FOR YOURSELF...

You will need the following items:

- **Two troughs – both the same length**
- **Enough sand to fill one trough**
- **Enough water to fill the other**
- **A model cart and a model boat**
(both with a piece of string as long as the trough attached, with a small weight of about 100gm attached on the other end of the string)
- **A load for each model – the weight of the loads should be the same.**

Now for the fun bit !

- **Fill one trough with sand. The sand trough represents the roads of the period (which were not covered with tarmac or concrete) and were a lot worse than those of today**
- **Fill the other with of water**
- **Place the loads in the cart and the boat**
- **Place the cart in the sand trough, and the barge in the water trough. KEEP HOLD OF THEM!**
- **Lead the string from each over the end of its trough, so the weights hang free**
- **Let the models go**

Question 6. Which one reaches the end of the trough first?

Question 7. Why do you think you achieved this result?



3. BUILDING A CANAL.

‘We worked hard, digging the canal. We started just after sunrise, and kept going all day with only short breaks for food. We only had hand-tools (pick-axes and shovels) and wheelbarrows to move the earth (we called it ‘spoil’) away. Sometimes the earth was used to make embankments to carry the canal around the side of a hill – or to fill in a small valley so the canal could cross it. The work was very hard – out in all weathers. If we stopped work because of the weather, we did not get paid.

We only got one day off a week – the Sunday – and then we were expected to go to church. Sometimes we were right out in the middle of the country, living in tents or wooden huts. Then, sometimes the vicar would come to us.

It could be very dangerous working in bad weather – where the canal went through a hill, we had to make a deep cutting – but the spoil had to be pushed on wheelbarrows up the side of the cutting. Sometimes the barrow tipped over, or the man slipped. Broken legs and arms were very common.

Mind you, it wasn’t half as dangerous as having to make a tunnel through a hill. Then you had to use gunpowder to blast the rock away. It was very hot and dark and we only had candles to light our way. Imagine – candles and barrels of gunpowder – how dangerous.

Yes, the life of the ‘navigator’ (we were often called ‘navvies’) was very hard’.

Question 8. How were the early canals made?

- a. Canals occur naturally, like rivers.**
- b. They were dug out using bulldozers and other machines.**
- c. They were dug out using hand tools like picks, shovels and wheelbarrows.**

Question 9. What were the workmen called?

- a. Ditchdiggers
- b. Navigators (or navvies)
- c. Canallers

“There was a third way of dealing with a hill. We built locks – that’s like a pond with special gates at each end. The water at one end of the lock would be higher than the other. By filling or emptying the lock with water, barges could be raised or lowered to the other section of the canal. If we had to raise or lower the canal a great height, we would use a series of locks, one leading into another”.



Foxton Lock flight (Image: Roger Barefoot)

Question 10. How did canals deal with hills that were on their route?

- a. The canal was dug along the side of the hill sometimes using an embankment.
- b. They dug tunnels were dug through the hills.
- c. They used a series of locks.
- d. They used embankments, tunnels and locks



4. WORKING THE CANALS

'We had to take a cargo of china from Birmingham down to London. First we had to load the barge – fifty tons of china takes some shifting – and you had to be careful. Any breakages were stopped from our pay. Still, the factory owner reckoned it was safer than moving it over them rough bumpy roads! Eight days it took us, down the Union Canal. One of us had to lead the horse, and a couple of the kids would sometimes run ahead to get the next lock set up for us.'

The worst part of any canal journey was having to pass through a tunnel. There was no towpath for the horse to walk on, so one of us had to walk the horse over the hill. The rest of us had to 'leg' the barge through the tunnel.

Lying on our backs, we used our feet to push the barge along the tunnel. There'd be bats hanging from the roof, it was dark – we only had candles, and water (or sometimes something worse) would drip off the tunnel roof onto our faces and into our mouths'.

Question 11. In the early days of canals (before the 20th century), how were canal boats powered?

- a. They were pulled by a horse walking on the towpath.
- b. They were powered by a diesel engine.
- c. They were pulled by people
- d. They were pulled by horses and people

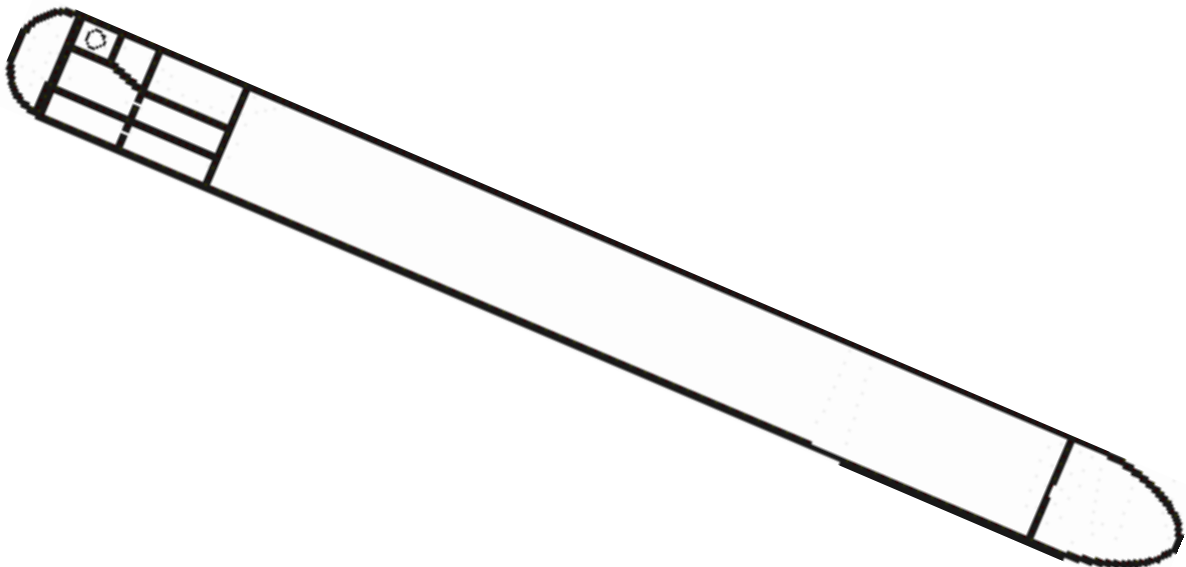
Canals tried to stay as level as possible – but sometimes they came to a hill they couldn't go round, or over, so they had to tunnel. There were no towpaths, so the barge could not be towed through the tunnel.



Question 12. How did the crew get the barge through the tunnel?

- a. The crew used an engine
- b. They 'walked' the barge through the tunnel, pressing their feet against the tunnel-sides.

Barges were the lorries of their day – but much slower. The barge was usually operated by a family – and it might take 5 days to take a load from (say) Birmingham to London. The barges did not generally travel at night, so, looking at the diagram below, where did the family live (remember, that like most other families of the period, there would be several children)?



Plan of a Working Barge

Colour in where you think the family would live, and then where you think the cargo was carried. Do not forget to fill out the key below!

This is where the family lived.

This is where the cargo was carried.



Question 13. Canal-boats were normally brightly-painted and decorated with pictures of flowers and castles. Why would the family do this?

- a. It makes the boat pretty
- b. the barge is always moving, so the flowers are their garden
- c. the family had pride in their barge.



5. BARGE CHILDREN

'It was the winter of 1947 and a hard winter it was. We'd taken a load up to Salford and were waiting for a load to take back. It was Christmas, so we knew we'd have to wait a few days. Then it started to snow. The dock soon froze over. It were a laugh at first – we all went playing on the ice as it got thicker. Then it got bad. We couldn't move the barge. Mam & Dad got really worried – they didn't get paid if the barge wasn't working.

They got their own back on us kids though – there was a village school nearby, and Mam arranged for us to get some real schooling there. When the barge was working, the only schooling we got was in working out the loads of the barge and what they were worth.

We didn't like school – but at least we got dinners there. Mam & Dad with no money had to rely on the dole – and that wasn't very much.

We stayed frozen in for six weeks. By the time we left, it was like moving home'.

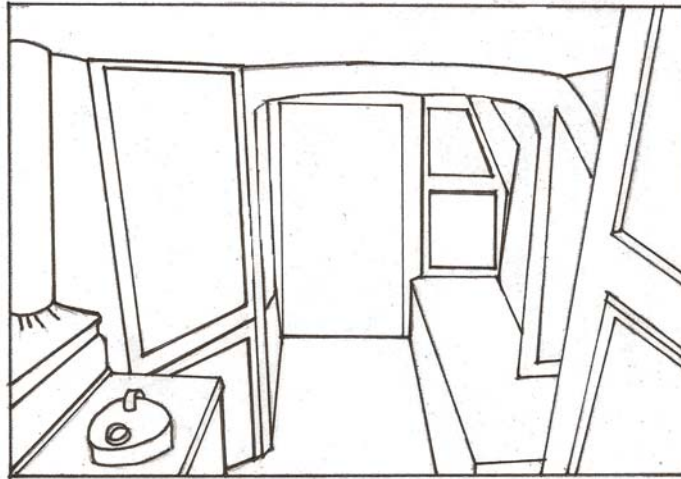
Question 14. If a barge stayed in one place, the crew did not get paid (no cargo – no money). So, if the barge was constantly on the move, how did the children learn?

- a. They only learned how to work and drive the barge**
- b. They did not go to school**
- c. They were sent away to a boarding school**



Question 15. This a picture of the inside of a barge cabin where the family lived. Where do you think the beds are? Put an 'x' on the beds.

All the panels were beautifully painted, and most had lockers behind them. What else might be hidden?

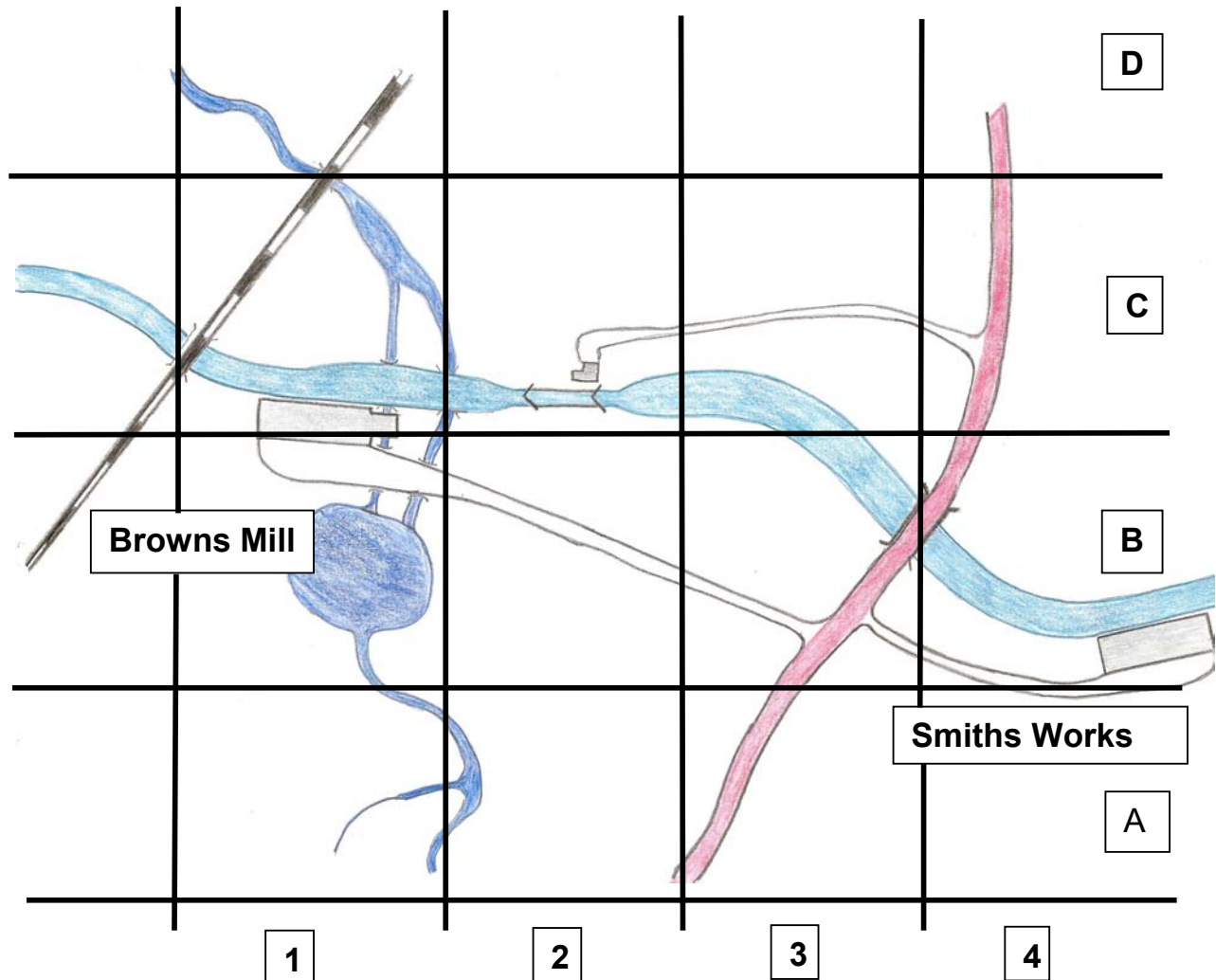


The Living Cabin on a Canal Barge.

Based on the barge *Friendship* at the Ellesmere Port Waterways Museum

Question 16. Do you think it was fun, living on a canal barge? Use the space below to explain what you think.

6. CANALS IN THE LANDSCAPE



The map above shows 'Browns Mill' (Grid Reference 1B) and 'Smiths Works' (Grid Reference 4B). Both the Mill and the factory use the canal to bring material in and send goods out.

Question 17. Look at the map above. Can you find the canal? Use the space below to explain how the canal looks different to a natural river?



Question 18. Look at the map. Can you find the canal lock?
Put an “x” on the lock.

Question 19. Look at the map. What is the map symbol that means a canal lock?

Question 20. Look at the map. What is the grid reference of the canal lock?

Question 21. Look at the map. Which building also uses the river to power a water wheel?

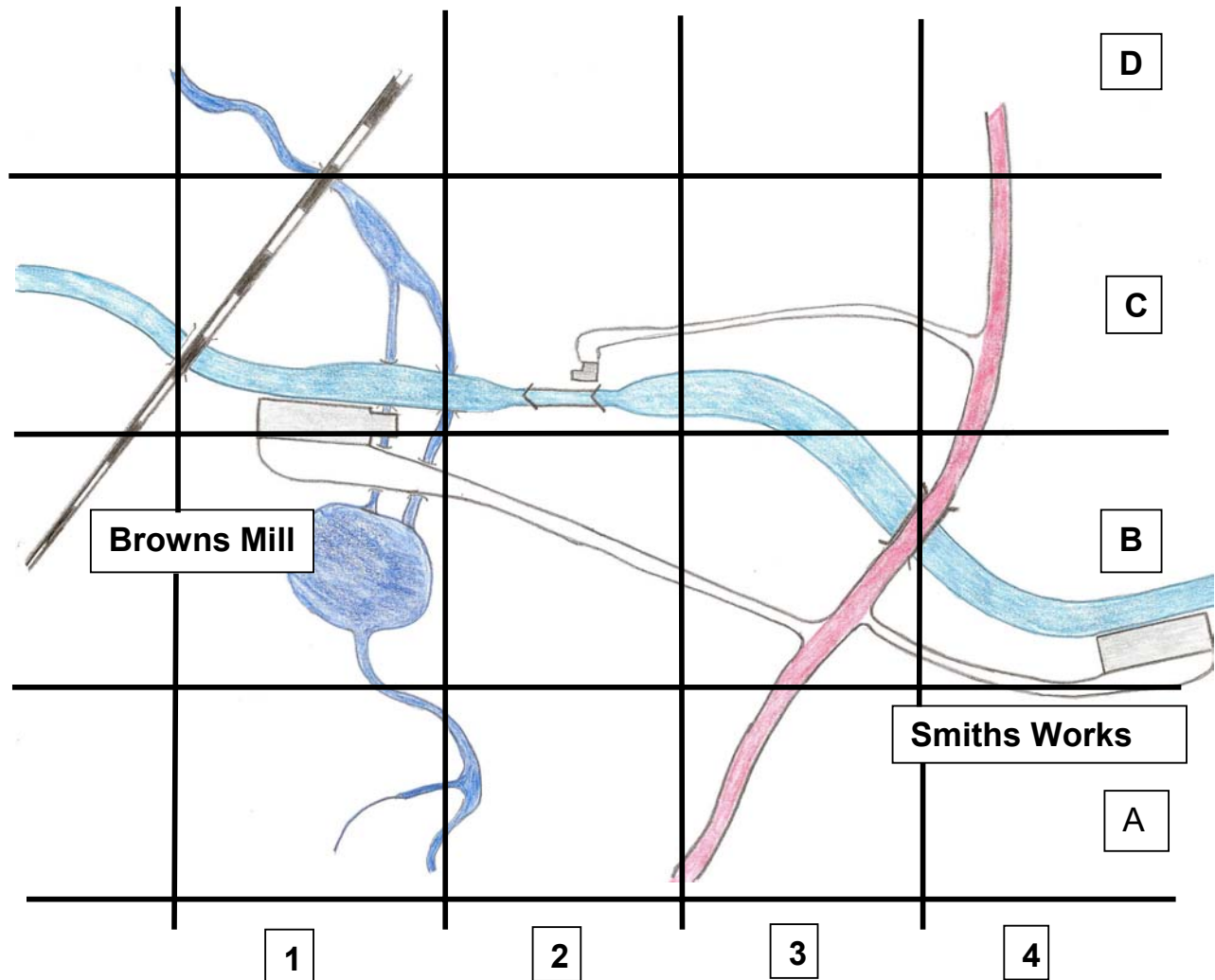
EXPLORE FOR YOURSELF...

Using internet resources, what industries used the canal to move their goods?

Look at a map of your area, where is the nearest canal to your school, and is it still used?

7. THE END OF THE CANALS ?

Railways were being built from about 1825 onward, and were obviously faster at moving goods to and from factories. They began to take loads from the canals, and in fact some canals rapidly fell out of use – and became railway lines!



Question 22. Look at the map. Which of the two factories could easily link to the railway?

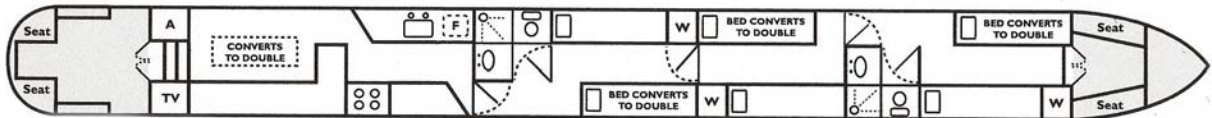


Canals carried on moving cargoes for the next 100 years or more after the introduction of the railway.

Question 23. If the railways were not responsible for the end of the canals, which form of transport did take their cargoes?

A canal barge – even a modern barge with a diesel engine – takes five days to get from London to Birmingham (about 100 miles). A lorry takes only a few hours to get from London to Birmingham.

8. CANALS TODAY



'We had a great holiday this year. We hired a canal-boat and went cruising on the canal system for a week. Most of the time we were cruising through beautiful country – mooring overnight next to a canalside restaurant or pub. We had to work the boat through the locks of course – like they did two hundred years ago. Mind you the canal-boat was lovely as well – we all had separate bedrooms – one of them even had its own bathroom. When we moored up at night, we used a power-lead to plug in to the mains, so we had telly and everything. During the day the boat's engine provided all the electric, so the fridge and freezer were always working. It was great – just like home'.

EXPLORE FOR YOURSELF.....

Have you – or anyone you know – been on a canal holiday? If so what did you think of it? Was it like the experience described above?



Apart from providing people with a type of holiday, how do canals affect the local community?



Basingstoke Canal Centre (Image: Nautical Archaeology Society)

Look at the picture below – this is a Canal Heritage Centre (on the Basingstoke Canal in Hampshire). What do you think the Heritage Centre tries to do?

Question 24. Look at the picture above – this is a Canal Heritage Centre (on the Basingstoke Canal in Hampshire). What do you think the Heritage Centre tries to do?

Question 25. Does the preservation and use of canals have any other benefits? Are there any problems? Think about things like employment opportunities, the natural environment and traffic problems.



The Revolution Came By Water

Teachers notes

INTRODUCTION

Thank you for selecting this teaching pack. It has been formulated by the *Nautical Archaeology Society* to enable young people to explore various aspects of ways in which we have historically interacted with the marine environment – from the search for food, to naval combat and the effects of waterpower and transport on the industrial revolution. More importantly it seeks to put that interaction in to a personal context. The narratives are based on both archaeology and historical documentation – however, to ‘personalise’ the narrative, these facts are made into a storyline. For example, in this narrative the italicised sections are fictional accounts – but are based on archive material

The narrative is split into sections and each could be the basis for a lesson period. To enable interaction, the major illustrations are in line-form, encouraging the student to colour them – there is much literature to enable them to do this with a fair degree of accuracy. Whilst most of the questions posed can be answered from the narrative, children should be encouraged to examine other sources such as the school library and the internet.

THE SECTIONS

SECTION 1. HOW WATER POWERED THE INDUSTRIAL REVOLUTION

It is a common fallacy that the industrial revolution was powered by steam! In fact, water, directed through water-wheels, has been providing a source of power since at least Roman times, and as can be seen by the diagram, was in heavy industrial use before Trevithick designed the first steam engine.

Whilst not mentioned in the text, you may like to consider how the textile industry (in particular) links to other areas of study such as slavery. Without the slave trade (which produced the cotton) the mills would probably not have existed – and a percentage of their production went to fuel slavery as it was re-exported as finished goods and used to purchase more slaves.

Answers:

Question 1. B – Water wheel

Question 2. A - Textile mills made cloth

Question 3. D - Cotton and Coal

Question 4. D - By road and water

Railways did not come into common usage before 1825 (although some colliery systems were using them in 1810-20).



SECTION 2. WHY MOVE LOADS BY WATER?

Water systems have provided us with our longest-lived mode of transportation – particularly for heavy loads. There is archaeological evidence dating back to the Bronze Age (5,000 years) for the transportation of cargoes by log-boat. Canals merely represent a channelling of that effort.

The diagram adequately illustrates how water could be used to move heavy loads – and even a 50-tonne load in a barge can be moved in less than 60cm of water!

Question 6 and 7. The experiment demonstrates this effect graphically – water is less resistant (creates less friction) for two reasons:

- 1. On the cart, the load is effectively carried on a very small area of the wheel's surface. This not only results in more friction, but also more load per square centimetre.**
- 2. The barge, on the other hand spreads the load and the friction, over a much wider area.**

SECTION 3. BUILDING A CANAL

Most of this section is self-explanatory – but in comparison with our modern life-style it might be advantageous to ask the students to think about the sheer physical effort involved. If you have access to the right facilities, they could be set the task of digging a shallow (less than 30cm-deep) trench, using only hand tools.

Answers:

Question 8. C - They were dug out using hand tools like picks, shovels and wheelbarrows.

Question 9. B - Navigators (or 'Navvies')

Question 10. D - Embankments, tunnels and locks

SECTION 4. WORKING THE CANALS

Again, there is potential scope here for encouraging the students to use their imagination, particularly with respect to working through a tunnel. For example, what else might drip from the tunnel roof (think bats...)?

Answers:

Question 11. D – by horses and people

The question deliberately introduces 'before the early 20th century' – the advent of the petrol & diesel powered engine. Whilst not specifically mentioned in the text, this links to the student's knowledge of other areas of technical advancement.

Question 12. B – they walked



Life on a Working Canal Barge

Again, there is scope in this section for an element of imagination and play-acting. Arrange the classroom into a representation of a canal-boat cabin (the area should be approximately 3m x 2m) and invite several children (canal families often had 4 or 5 children) to make themselves as comfortable as possible for a night's sleep!

The actual cabin (as shown in the diagram) was a marvel of utilisation of available space – but often some children slept on the cargo..!

Answers:

Plan of a working barge – **the family lived in the small cabin at the stern (rear) of the barge.**

Question 13. C - Pride in their barge.

SECTION 5. BARGE CHILDREN

The (fictional) extract is based on several accounts of an incident which happened less than sixty years ago – some of the student's grand-parents will remember the 'freeze' of the winter of 1947. It was this event which really sounded the death-knell of the canals as a form of transportation. Whilst the canals were frozen solid, loads were increasingly moved by road – and never came back to the canals.

The effect on canal children was profound. For many this represented the longest period many of them ever spent in formal education. For their parents it represented the nightmare of no earnings. Many were owners of their own barges, and received no pay for the period.

Answers:

Question 14. A and B

Some went to local schools whilst the barge was not working but most simply learnt how to work and drive the barge. In this respect they were very similar to the other 'travelling people' – the gypsies.

Question 15. See the sketch on page 18.

Question 16. Do your pupils think it would be fun to live on a canal boat?

SECTION 6. CANALS IN THE LANDSCAPE

If you have access to *Ordnance Survey* maps of a particular area, you could use them. However, the sketch-map provided also relates to other elements covered later. However, the principles of 'grid referencing' is followed on the sketch map & associated questions.



Answers:

- Question 17.** The canal crosses the map from 'East' to 'West' and is much more regular in it's appearance.
- Question 18.** Did they find the canal lock on the map?
- Question 19.** <=<
- Question 20.** 2C (along the corridor to (2) then 'up the stairs' to (C)).
- Question 21.** Browns Mill uses a watermill to provide power to it's machinery.

SECTION 7. THE END OF THE CANALS?

As previously outlined, the coming of the railways did have an effect on the canal system, and some (like the 'Wilts & Berks') were in part purchased by railway companies and converted into railway trackbed.

Answers:

- Question 22.** Browns Mill would most easily access the railway. 'Smiths Works' would later make use of the road network (and in the 1980's, with the passing of that style of railway freight – so would Browns Mill!).
- Question 23.** Motor cars

SECTION 8. CANALS TODAY

With today's accent on the environment, re-invigoration of the canals as a major highway for the transportation of merchandise could make sense. The effects of the small diesel engines used by canal craft is in marked contrast to those used by heavy goods vehicles – and both move the same weight of merchandise. This has been recognised by at least one major commercial operation (*Tesco's*) which now uses canal systems where possible (in Manchester) for the transportation of goods.

The remaining sections are rather subjective, but the students should be encouraged to use their imagination as well as knowledge in their answers.

Questions 24 and 25.

The section on canals in the local community asks the student to think about various aspects of canal preservation, and it's likely effects on the community. It is a fact that canal preservation is a factor in engendering community pride (most are initially re-opened by volunteer societies). They then become (in the main) an asset to the local community providing opportunities for employment (ask the students to consider in what fields).



They include warden activities, maintenance work, education (through the Heritage Centre) and heritage. The centres also provide employment opportunities through staffing, provision of amenities such as refreshment areas, boat maintenance & hire, and watersport activities.

Other areas of impact on the local community include the provision of new/enhanced leisure activities such as water sports, angling, and walking (along the towpath), photography and art. However, they may also suffer increased traffic problems due to increasing visitor numbers and increased traffic over local infrastructure not designed for such loads.