

How old is your height?



Photograph by Lewis W. Hine © George Eastman House

Objectives

Children should learn:

- to relate individual statistical techniques to a wider problem;
- to think analytically about a statistical problem;
- to apply a variety of techniques to solve a problem

Context

(provided for the teacher's benefit – this is introduced through the slides)

After the Industrial revolution child labour in Britain was rife. Children worked long hours being poorly paid for their efforts. The factory act of 1833 was one of several acts introduced to protect children from poor working conditions (even having to work at all). The act was difficult to enforce however so inspectors were employed to help protect the children. They collected the age and height of thousands of children and calculated the average height of children at different ages to provide a guide.

These materials can be used to consider the use of an average as a guide for children's age or used to compare the heights of children in 1837 with children of today. Pupils can hypothesise and then use data from the censusatschool database to examine the reality.

Points to note:

The presentation requires Microsoft PowerPoint version 2002 or above. You may download the free PowerPoint viewer from our website if you have an earlier version.

This presentation contains 30 slides.

How old is your height?

The **Industrial Revolution** began in the 18th century.

When steam power was introduced factories opened all over Britain. Many people moved from the countryside into the cities.

Why do you think people moved into the cities?

Britain started getting its money from **factories** (*industry*) instead of **farms** (*agriculture*).

The population in Manchester and Salford (cities) grew from **25 000 people** in 1772 to **455 000** in 1851.



Objectives

Children should learn:

- about the industrial revolution
- the significance of the industrial revolution

Activities

The emphasis placed on this slide will depend on your cross curricular requirements for the activity. Activities be soft discussion about the industrial revolution. The following questions could be used to direct discussion:

Why did people move to the cities?

What impact did the shift have? [introduction of canals, improved roads and then railways. Later came steam powered ships, the internal combustion engine and electricity]

How old is your height?

Before 1833 there were **no laws** about working in factories because they were not needed.

Factories used dangerous machinery

Factory workers had to work long hours - often through the night.

Driver	General bruise, March, 1840, by the rolleys
Trapper	Laceration of fingers, Nov., 1840, by switches
Putter	Point of finger removed, Jan., 1840
Putter	Fracture of fingers, Jan., 1840, by the tub
Assistant to putter	Laceration of hand, March, 1841, by the tub
Driver	Laceration of hand, Jan., 1841, by the tub
Trapper	Fracture of leg, Jan., 1839, horse running away
Assistant putter	Lacerating of hand, Jan., 1840, by the tub
Driver	Compound fracture of arm, Aug., 1840, run over byrolley
Driver	Compound fracture of leg, Aug., 1840, run over byrolley
Putter	Laceration of finger, Jan., 1840, jambed by coal
Driver	Fracture of finger, Jan., 1840, by tub
Hower	Contusion of foot, Jan., 1841, jambed by rolley
Driver	Lacerated fingers, 16 March, 1841, jambed by coal carriage
Putter	Laceration of hand, March, 1841, nipped by tub
Putter	Lacerated fingers, 17 March, 1841, jambed by coal carriage
Putter	Fracture of leg, Nov., 1839, jambed by rolley
Putter	Fracture of legs, June, 1840, by fall of roof
Putter	General bruise, June, 1840, by fall of roof
Driver	Fracture of thigh, Jan., 1840, by the horse
Trapper	Fracture of jaw, Feb., 1840, run over by horse
Driver	Laceration of leg, Nov., 1840, by the rolley

What sort of laws would you have written?

Objectives

Children should learn:

- why working law was introduced

Activities

Discussion points from the slide.

Points to note:

The factory act of 1833 was one of a series of acts written for factory workers.

How old is your height?

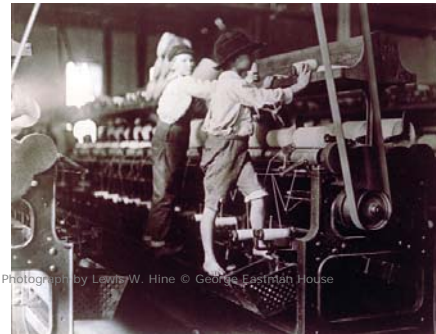
Families sent their children to work in the factories. They were useful because their small hands could get into tiny gaps between machines.

What do you think the work was like?

To protect children from the **dangers** of factory work laws were written.

One of these was the **Factory Act** in 1833.

It applied to textile factories but other laws for other types of factory followed.



Objectives

Children should learn:

- to think about the historical experiences of others
- why the factory act of 1833 was written

Activities

Discussion of the points on the slide

Points to note:

How old is your height?

The law put limits on the number of days and hours that children of different ages could work.



What do you think was the youngest age children could work in a factory?

How many hours-a-day and days-a-week do you think children could work?

The act also talked about schooling. How many hours-a-day do you think children had to get?

Objectives

Children should learn:

- to think about the historical experiences of others
- to think about how working conditions *then* relate to now

Activities

Discussion: predictions of what they think the rules were

Points to note:

The Factory Act 1833



VICTORIA REGINA

Children under 9 years of age are **not permitted to work**.

Children aged 9-13 years are permitted to work:
no more than 9 hours a day.

Children aged 13-18 years are permitted to work:
no more than 12 hours a day.

Children are **not to work at night**.

Two hours of schooling each day for children.

Objectives

Children should learn:

- what the factory act of 1833 said
- how current law compares

Activities

Discussion: [How does the factory act compare with what the students expected?](#)

[How does it compare to today?](#)

Points to note:

Today's law: These apply to businesses where work is done for profit)

- no work during school hours or lunch breaks
- no work before 7am or after 7pm
- only 2 hours work allowed on a school day (no more than 1 hour before school)
- no more than 8 hours work on a Saturday or during the holidays (5 hours for those under 15)
- no more than 35 hours a week during the holidays (25 hours for under 15's)
- no more than 12 hours a week when attending school
- young children should get at least a 2 week break during the school holidays at any point during the year

Enforcing the Factory Act

The passing of this Act didn't mean the everyone stopped employing under-age children.

Four inspectors were hired to enforce the law across the whole country.

FACTORIES.

Why might young children have continued being illegally employed?

How might the employers or even the families try to get around the new laws?

My Lord, in the case of Taylor, Ibbotson & Co. I took the evidence from the mouths of the boys themselves. They stated to me that they commenced working on Friday morning, the 27th of May last, at six A.M., and that, with the exception of the hour and a half at the high noon, they did not cease working till four o'clock on Saturday evening, having been two days and a night thus employed. At the same time, as it was scarcely possible, I asked every boy the same questions, and from each received the same answers. I then went into the house to look at the time book, and, in the presence of one of the masters, referred to the cruelty of the case, and stated that I should certainly punish it with all the severity in my power. Mr. Rayner, the certificating surgeon of Bastile, was with me at the time.

Objectives

Children should learn:

- how the factory act was enforced
- why the act needed enforcing

Activities

Discussion of questions on the slide.

Points to note:

Many families depended on the income of the children in order to live.

Plan



Collect

Process

Discuss

How old is your height?

Imagine that you are one of those four factory inspectors. They weren't sure they could trust everyone to tell the truth.

They needed a way to judge a child's age.

What measurements do you think they could use to help judge how old a person is?

Objectives

Children should learn:

- to think about questions which can be answered using statistics
- to think about what information data can provide

Activities

Brainstorm attributes which might be age related – some examples might be – height, weight, size of waist, length of ears, teeth

Points to note:

Plan **Collect** **Process** **Discuss**

How old is your height?

They decided to survey children's heights and use the data to judge the age of employees.

What information would they need to collect?

How big a sample do you think they took?

Objectives

Children should learn:

- what data was collected
- what things need to be considered when planning to collect data

Activities

Discussion: How could they collect the data?

What problems might they encounter?

How could they ensure the data is truthful?

Points to note:

The height data was recorded from 15000 children. Only a summary of the data is available today (including average heights). The next slide gives a choice of looking at the original table or a 'tidied up' metric version.

Plan Collect Process Discuss

How old is your height?

A summary of the data they collected from **15 000** children was printed in the *Penny Magazine* in 1837.



[Original table](#) [Metric version](#)

Objectives

Children should learn:

- that data often needs reorganising to enable processing

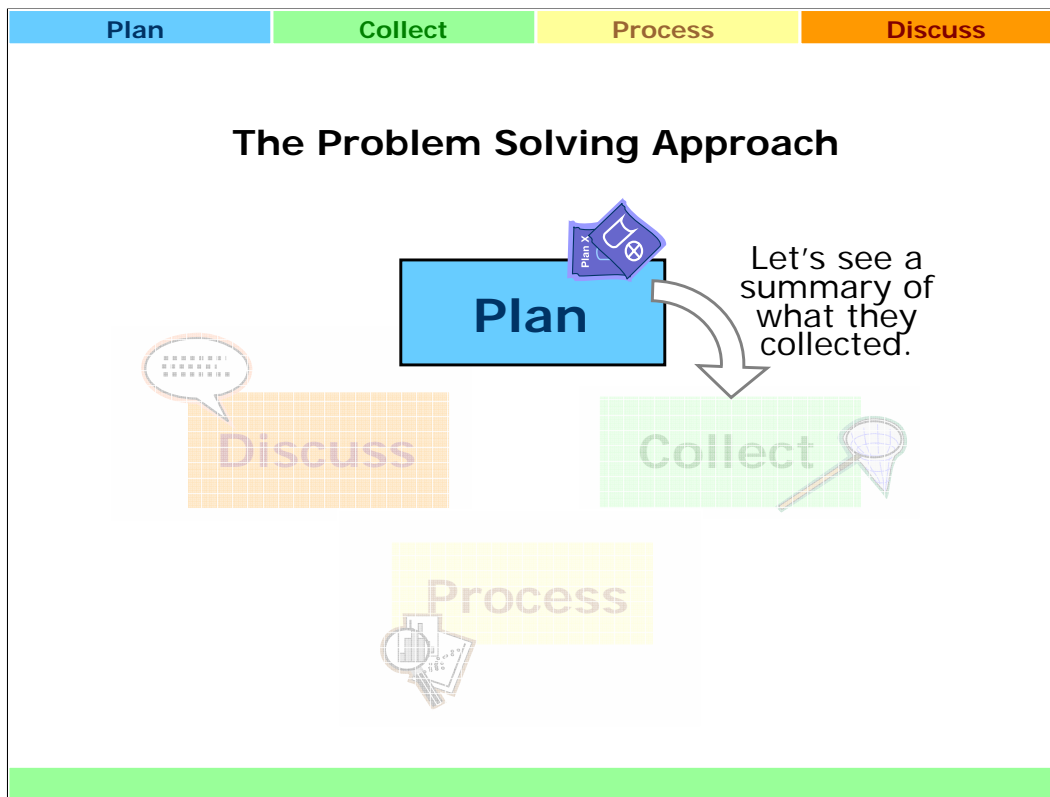
Activities

Depending on students' ability and the amount of time available, either the original table or a reorganised metric version can be used.

ORIGINAL TABLE: Higher ability students could be given this and asked to adapt it to get it in a usable state. There are slides illustrating the process for review purposes.

METRIC VERSION: This version of the table is ready for students to use with the exception of finding the midpoint of the age groups.

Points to note:



Objectives

Children should learn:

- where the current task fits within the 'problem solving approach'
- to review prior work.

Points to note:

After they **planned** what to do, the inspectors **collected** information to help them answer the problem.



How old is your height?

Age years	Number of boys	Number of girls	Average height of boys		Average height of girls	
			feet	ins	feet	ins
8 and under 9	666	539	3	10 ⁵ / ₁₆	3	9 ³ / ₁₆
9 and under 10	945	813	3	11 ¹³ / ₁₆	3	11 ⁵ / ₈
10 and under 11	1 124	927	4	1 ⁷ / ₁₆	4	1 ¹ / ₄
11 and under 12	723	1 055	4	2 ³ / ₈	4	2 ⁵ / ₈
12 and under 13	1 427	1 330	4	3 ¹⁵ / ₁₆	4	4 ¹ / ₄
13 and under 14	2 133	2 240	4	5 ⁹ / ₁₆	4	5 ¹¹ / ₁₆
14 and under 15	117	140	4	8 ¹ / ₄	4	9
15 and under 16	82	106	4	10 ¹ / ₂	4	10 ³ / ₄
16 and under 17	43	90	5	0 ¹ / ₂	4	11 ¹ / ₁₂
17 and under 18	47	112	5	0	5	0

Summary from the *Penny Magazine* in 1837.

“If a child be 3ft 11” in height it may be assumed that it is nine years of age...”

Objectives

Children should learn:

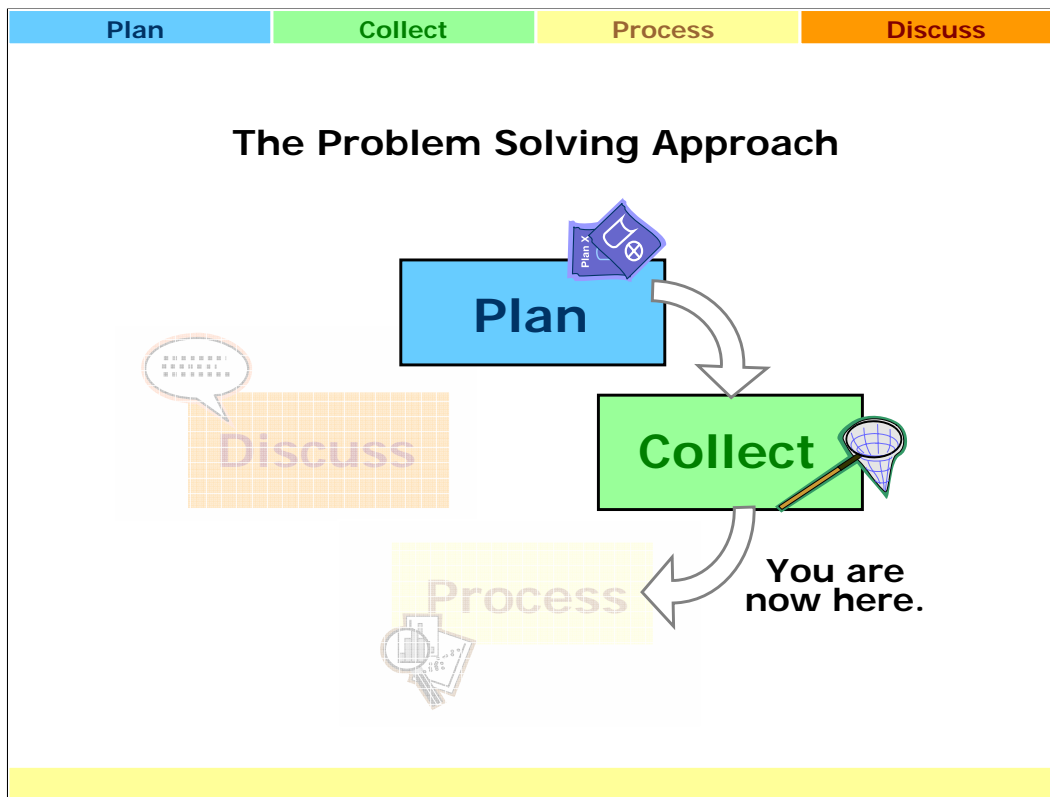
- that data often needs to be put into a more user friendly form

Activities

Points to note:

The chart needs some work – changing the measures into metric and so on. Some stronger students may enjoy the challenge of this. Areas to highlight – Age groups

Imperial heights



Objectives

Children should learn:

Where their current task fits within the whole 'problem solving approach'

To review their prior work.

Points to note:

Now we have **collected** our data, we need to **process** it. We need to get it into a form that is easier to manage by drawing some graphs and charts and doing some calculations.



How old is your height?

What processing has already been done to the raw data?

Age years	Number of boys	Number of girls	Average height of boys		Average height of girls	
			feet	ins	feet	ins
8 and under 9	666	539	3	10 ⁵ / ₁₆	3	9 ³ / ₁₆
9 and under 10	945	813	3	11 ¹³ / ₁₆	3	11 ⁵ / ₈
10 and under 11	1124	927	4	1 ⁷ / ₁₆	4	1 ¹ / ₁₆
11 and under 12	723	1055	4	2 ³ / ₈	4	2 ³ / ₈
12 and under 13	1427	1330	4	3 ¹⁵ / ₁₆	4	4 ¹ / ₁₆
13 and under 14	2133	2240	4	5 ⁹ / ₁₆	4	5 ¹¹ / ₁₆
14 and under 15	117	140	4	8 ⁴ / ₁₆	4	9
15 and under 16	82	106	4	10 ¹ / ₂	4	10 ³ / ₁₆
16 and under 17	43	90	5	0 ¹ / ₂	4	11 ¹ / ₁₂
17 and under 18	47	112	5	0	5	0

Let's consider how we could make the data easier for us to use...

Objectives

Children should learn:

- to consider what has already happened to data that is presented
- to make figures more easy to use and understand

Activities

Discussion: What processing has already been done?

- the data has been grouped and averages calculated

Why are the heights recorded in feet and inches?

What are feet and inches?

What type of average is it likely to be?

Why is the mean a good average to use here?

- [because the data is not likely to be skewed]

Which figure will be the most and least reliable? Why?

- notice the different numbers of people being surveyed in each

case

Points to note:



How old is your height?

Age range years	Number of boys	Number of girls	Average height of boys		Average height of girls	
			feet	ins	feet	ins
8 and under 9	666	539	3	10 ⁵ / ₁₆	3	9 ³ / ₁₆
9 and under 10	945	813	3	11 ¹³ / ₁₆	3	11 ⁵ / ₈
10 and under 11	1124	927	4	1 ⁷ / ₁₆	4	1 ¹ / ₄
11 and under 12	723	1055	4	2 ³ / ₈	4	2 ⁵ / ₈
12 and under 13	1427	1330	4	3 ¹⁵ / ₁₆	4	4 ¹ / ₄
13 and under 14	2133	2240	4	5 ⁹ / ₁₆	4	5 ¹¹ / ₁₆
14 and under 15	117	140	4	8 ¹ / ₄	4	9
15 and under 16	82	106	4	10 ¹ / ₂	4	10 ³ / ₄
16 and under 17	43	90	5	0 ¹ / ₂	4	11 ¹ / ₁₂
17 and under 18	47	112	5	0	5	0

First let's convert feet and inches into metric units (cm).

Objectives

Children should learn:

- to make figures more easy to use and understand

Activities

Students to convert the figures to cm.

Conversion used: 1 inch = 2.54 cm
 1 foot = 12 inches

Points to note:



How old is your height?

Age range years	Number of boys	Number of girls	Average height of boys cm	Average height of girls cm
8 and under 9	666	539	117.6	114.8
9 and under 10	945	813	121.4	121.0
10 and under 11	1124	927	125.6	125.1
11 and under 12	723	1055	128.0	128.6
12 and under 13	1427	1330	131.9	132.7
13 and under 14	2133	2240	136.0	136.4
14 and under 15	117	140	142.9	144.8
15 and under 16	82	106	148.6	149.2
16 and under 17	43	90	153.7	150.1
17 and under 18	47	112	152.4	152.4

The age range can be simplified by using a mid-point.

Objectives

Children should learn:

- to make figures more easy to use and understand

Activities

Discussion

Points to note:



How old is your height?

Mid-point age years	Number of boys	Number of girls	Average height of boys cm	Average height of girls cm
8.5	666	539	117.6	114.8
9.5	945	813	121.4	121.0
10.5	1124	927	125.6	125.1
11.5	723	1055	128.0	128.6
12.5	1427	1330	131.9	132.7
13.5	2133	2240	136.0	136.4
14.5	117	140	142.9	144.8
15.5	82	106	148.6	149.2
16.5	43	90	153.7	150.1
17.5	47	112	152.4	152.4

Objectives

Children should learn:

- to make figures more easy to use and understand

Activities

Discussion

Points to note:

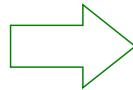


Process

How old is your height?

Now the data is easier to use we can draw a graph to help us look to see if age and height are linked.

Mid-point age years	Number of boys	Number of girls	Average height of boys cm	Average height of girls cm
8.5	666	539	117.6	114.8
9.5	945	813	121.4	121.0
10.5	1124	927	125.6	125.1
11.5	723	1055	128.0	128.6
12.5	1427	1330	131.9	132.7
13.5	2133	2240	136.0	136.4
14.5	117	140	142.9	144.8
15.5	82	106	148.6	149.2
16.5	43	90	153.7	150.1
17.5	47	112	152.4	152.4



We will plot age on the x-axis
 We will plot height on the y-axis
 What kind of graph(s) would be best for displaying this data? And to use to check a persons possible age?

Objectives

Children should learn:

- that graphs can help us understand information

Activities

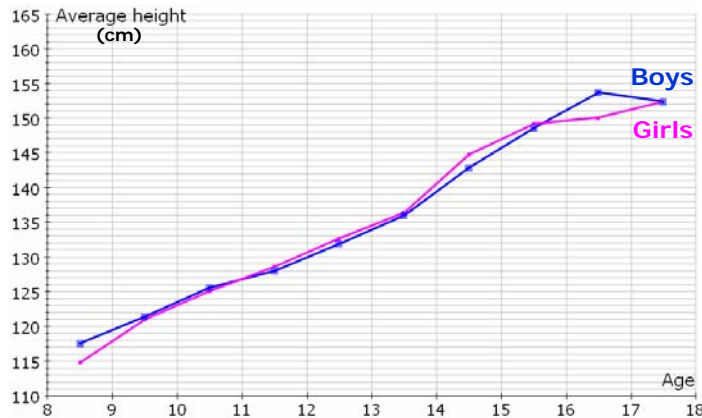
Discussion of questions on the slide

Points to note:



Height against age for children 8-18

data from The Penny Magazine, 1837



Can you see a relationship between average height and age?

What do you notice about the boys heights?

Can you see any reason for the unexpected pattern?

Hint: Look again at the table of data

Objectives

Children should learn:

- to look at graphical information and interpret it

Activities

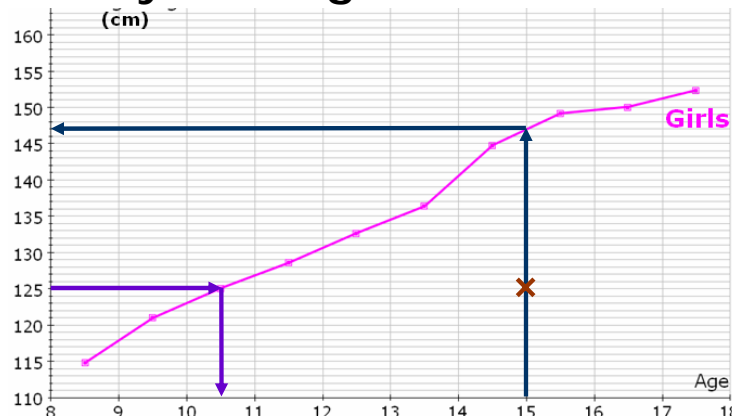
Discussion of the questions posed.

Points to note:

It should be noted the small numbers of people involved in the survey at the 16+ age group. This is likely to explain the drop in average for the boys.



How old is your height?



One inspector interviewed a girl that was 4'1" tall (125cm). She claimed to be 15.

How would you find out if she was lying or if she was telling the truth?

Objectives

Children should learn:


- to read information from a graph
- to reason with data

Activities

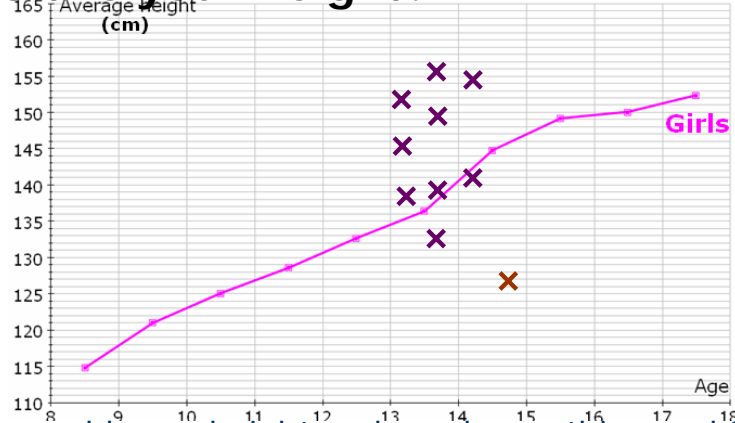
Discussion of the likely age of the girl

Points to note:

Plan **Collect** **Process** **Discuss**

 **Process**

How old is your height?



Where would your height and age be on this graph?
 What about the rest of your class?
 How many of your class would be able to work in 1837?

Objectives

Children should learn:

- to relate presented information to their own experiences
- to question presented information

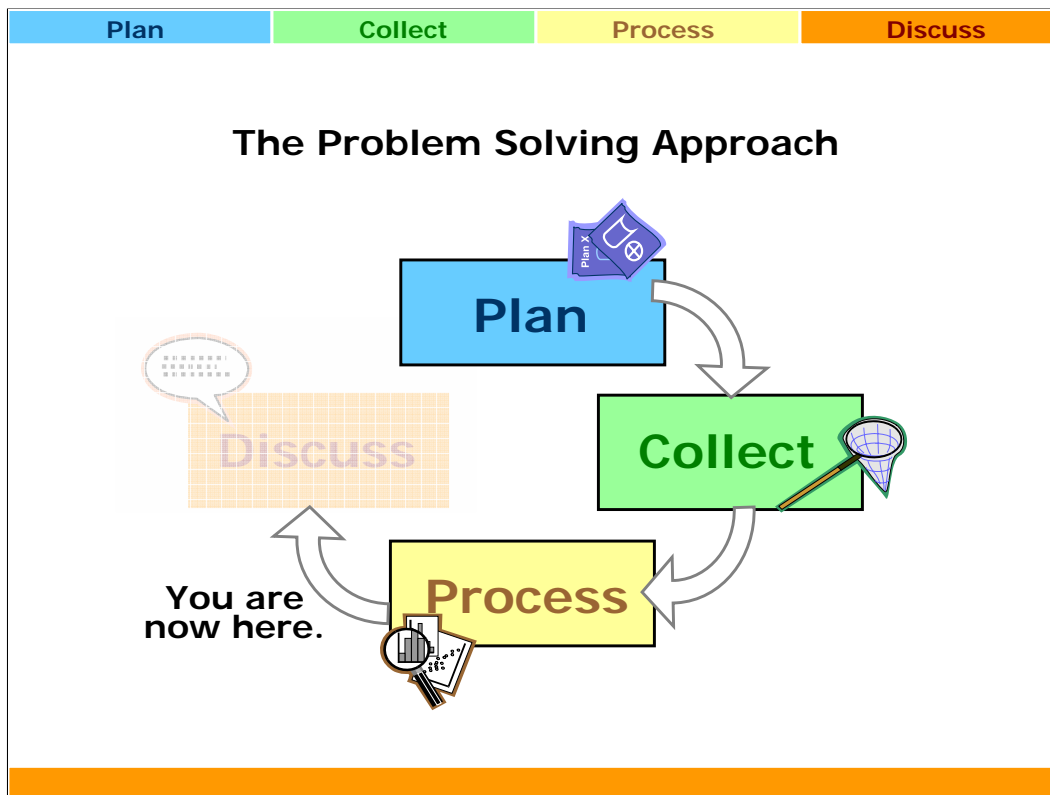
Activities

Discussion of questions on the slide

Points to note:

It is intended that students relate themselves to the presented data. Since the mean is plotted, it would be expected that roughly half of the children surveyed would be above and below the line. By plotting the groups heights on the graph you are likely to see that well over half of the group are above the line (thus would be unable to work)

Pupils should be encouraged to think about why this might be and how it can be investigated further. In actual fact, children are taller (on average) now than they were in 1837. This will be explored in the remainder of the presentation



Objectives

Children should learn:

- where the current task fits within the whole 'problem solving approach'
- to review prior work.

Points to note:

Now we have **processed** the information by drawing charts and doing calculations, we need to **discuss** what our results show us and how they help us consider the problem.



How old is your height?

Were there any patterns linking age and height (in the information collected by the inspectors)?

Are there any problems with the graphs created from the age and average height?

Does your own height and age fall above or below the lines the inspectors used?

How do your class results relate to the 1837 data?

What would you expect a graph of young peoples' heights today to look like?

Objectives

Children should learn:

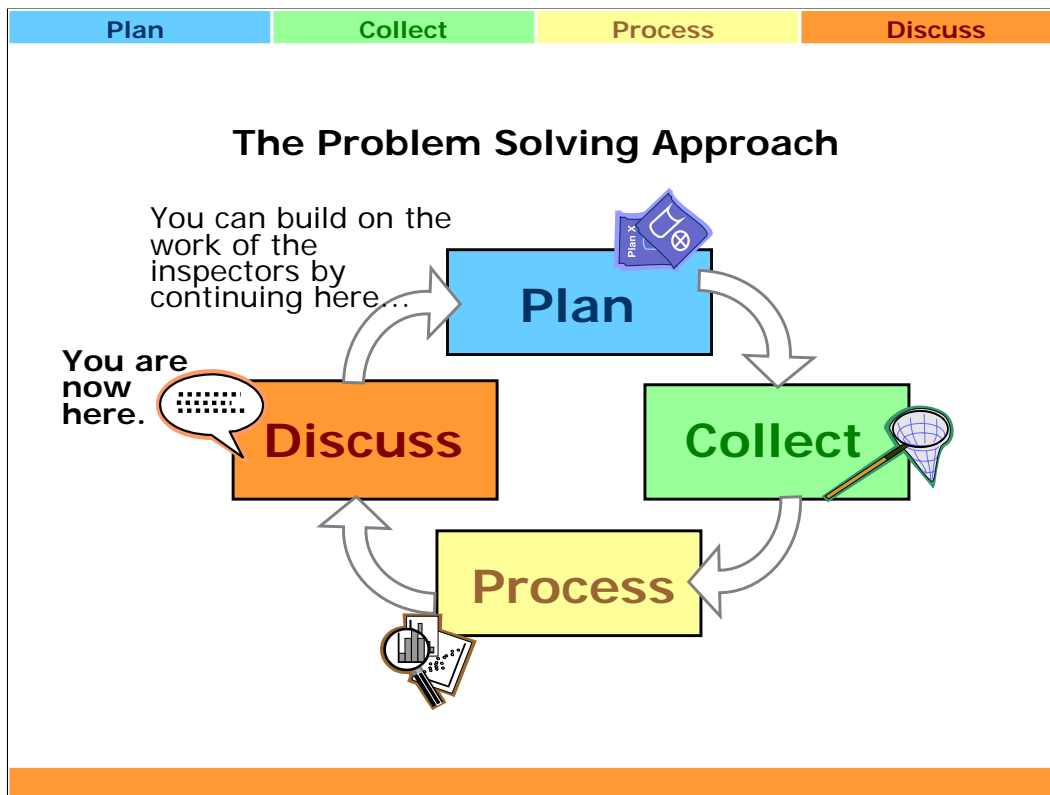
- to discuss their findings and relate them to the original problem and the data
- to come up with new questions or hypotheses about the information

Activities

Discussion around the questions on the slide

Points to note:

The remaining slides will lead students to taking samples of data from censusatschool and comparing data for 'now' to 1837. Students may come up with hypotheses they wish to investigate. Data is also available to compare other countries with the UK data.



Objectives

Children should learn:

- where their current task fits within the whole 'problem solving approach'
- to review their prior work.

Points to note:

At the end of the work, having **discussed** our findings we could now start the whole cycle again.

Plan



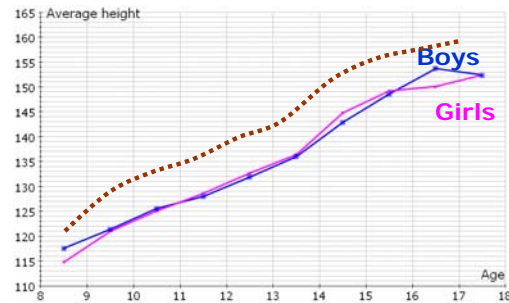
Collect

Process

Discuss

How old is your height?

The data used by the inspectors was taken over 150 years ago.
Is it 'out-of-date' ?



If we collected similar data from young people (8-18) today
What would you expect to be similar?
What would you expect to be different?

Objectives

Children should learn:

- to pose a new question

Activities

Discussion of questions posed

Points to note:

Plan



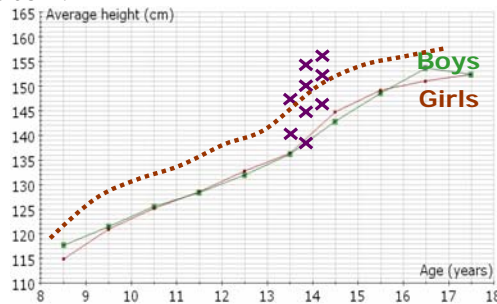
Collect

Process

Discuss

How old is your height?

The data used by the inspectors was taken over 150 years ago. Is it 'out-of-date' ?



When the class's heights are plotted how many are **now** above the line or below?

Objectives

Children should learn:

- to pose a new question

Activities

Discussion of points on the slide

Points to note:

Plan **Collect** **Process** **Discuss**

How old is your height?

You will need to carry out a survey of modern children.

What information do you need to collect?

How big a sample do you need to take?

[Extra processing](#)

Objectives

Children should learn:

- to plan what data they intend to collect

Activities

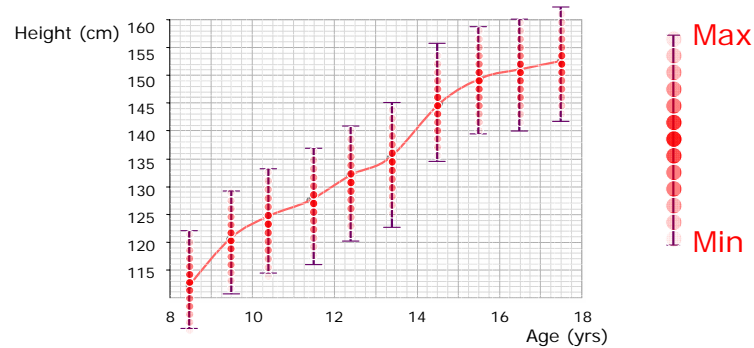
Discussion of questions posed

Points to note:

The extra processing option on this slide explores the usefulness of drawing box and whisker plots to better illustrate the data.



How old is your height?



When you plot the data for modern children, you have additional data which can be added to the graph...

What do you think these lines are trying to show?

Objectives

Children should learn:

- to think about what information is being presented
- to consider what affect the spread has on 'children being able to work'
- to think about maximums and minimums

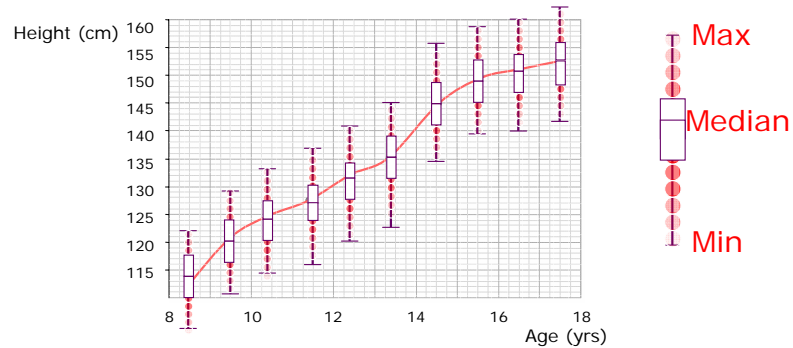
Activities

Discussion of the questions posed

Points to note:



How old is your height?



Box plots show the range of the information about the middle portion. If the data came from 100 people, the boxes show where the 50 people closest to the median can be found. Instead a box-whisker plot can be used.

Objectives

Children should learn:

- what a box plot is
- how a box plot can be helpful in interpreting data like this

Activities

Pupils can draw box plots for their own age group.

Points to note:

This slide is not intended to give all the information about how a box plot is drawn – instead it should give information about how they can be a useful tool in data analysis.

Plan

Collect

Process

Discuss

