

QCA-RSSCSE

Handling Data and Statistics Project



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

Activities

- Setting the context of the problem:

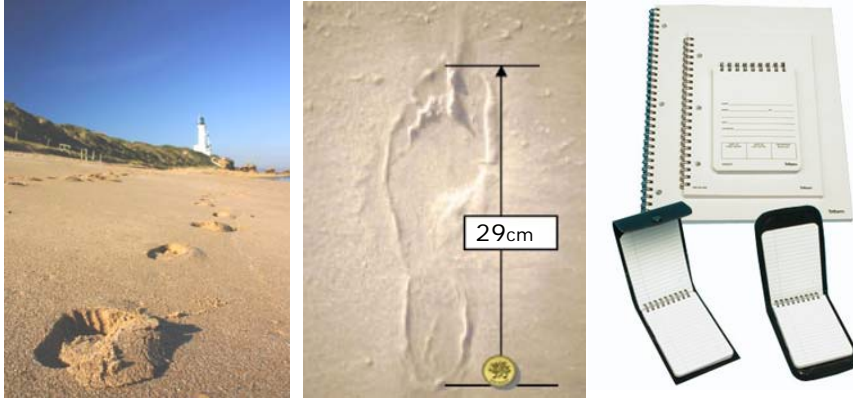
"This year's summer holiday had some great beaches, warm water and not too many crowds on the beach. Early one morning the only people around were a few other teenagers; I chose a deserted part of the beach and thought it would be okay to hide my wallet and mobile in the bottom of my shoes next to my towel, with my bag. When I got back from swimming, my wallet and phone were still there, but my MP3 player had been stolen from my backpack."

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 19 slides.



Crime Scene Evidence



Police thought that the footprint was not that useful.

Objectives

Children should learn:

- The context of the problem
- What the problem is

Activities

- Setting the context of the problem (continuation)


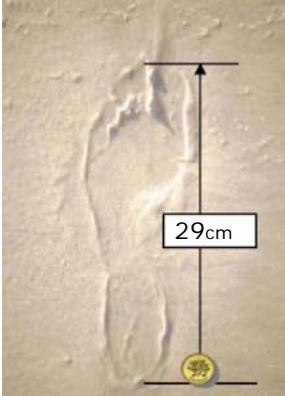

I took a photograph of a footprint I found around my stuff.

I reported the crime to the police and filled in some paperwork. They said that my footprint photograph was not going to help them.

I don't think they were right – I am sure they could have used it to work out something about the thief."

- Discussion:

Why did the victim of the theft put a coin next to the footprint when they took the photo?

Plan	Collect	Process	Discuss
 <h2 style="text-align: center;">Scene of Crime Evidence</h2> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Gender?</p> <p>Shoe size!</p> <p>Age?</p> </div> <div style="text-align: center;">  </div> <div style="text-align: center;"> <p>Height?</p> <p>Injuries?</p> <p>Weight?</p> </div> </div> <p style="text-align: center; color: blue;">What could the footprint tell us about the thief?</p> 			

Objectives

Children should learn

- To engage with the problem and think about how useful the information they have been given is

Activities

- Discussion:

How might the footprint help?

How might each factor tell us something?

What patterns might you expect to see if you explored relationships?

- Boys might have bigger feet than girls
- Taller people might have bigger feet
- Older people might have bigger feet
- Lighter people might have smaller feet


How might a footprint tell you about a person's injuries?

- Depth of print
- Webbed feet and Bunions!

How useful could a footprint be in determining gender?

- It would probably be more helpful in population of adults. Since it was teenagers on the beach, we only consider these here.

Plan	Collect	Process	Discuss
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Scene of Crime Evidence


Foot length

29cm

Gender? Height?

Age? Weight?

What could the footprint tell us about the thief?



Objectives

Children should learn

- To ask questions about presented information
- To hypothesise

Activities

- Discussion:

What do we need to do to be able to investigate possible **relationships**? (and strength of relationships?)

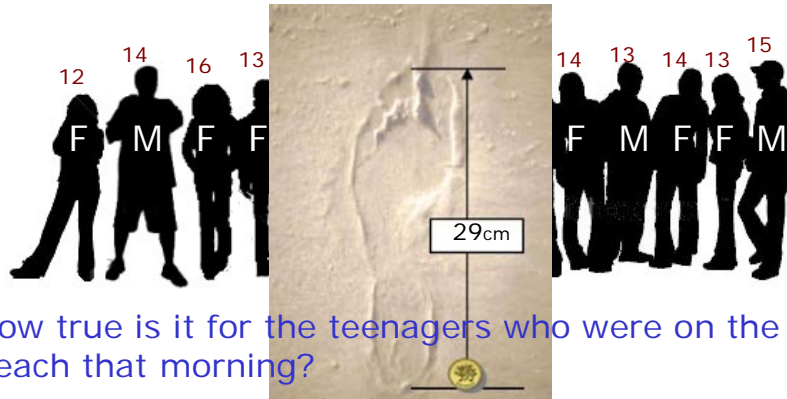
We need some data from suitable sample and enough to draw graphs or find patterns that could help us.

Points to note:

Ignoring injuries (since the footprint seems 'normal') and foot size (not gaining extra but equivalent info) we concentrate on these four variables. The depth of the footprint was not recorded and so weight could also be discounted.



Crime Scene Evidence



How true is it for the teenagers who were on the beach that morning?

The police said that a foot length of 29 cm would be quite common for teenagers.

Objectives

Children should learn:

- To think about what they hope to get out of an investigation
- To state what they *think* might happen

Activities

- Discussion:

Encourage pupils to describe what they **expect** will happen. Try to use phrases like:

- I wonder ...
- I noticed ...
- I expect ...

Try to encourage them to support their thoughts with reasons.



Crime Scene Evidence



How many of the teenagers here are likely to have a foot length of 29 cm?

Is someone here more likely than the others to have this foot length?

Objectives

Children should learn:

- To think about what they hope to get out of an investigation
- To state what they *think* might happen

Activities

- Discussion:

Points to note:

The teenagers shown represent the group who were on the beach during the period the victim was swimming.



Crime Scene Evidence

General questions:

Were the police right or wrong to ignore the footprint?

Is the foot length useful for identifying a suspect?

How strong a link is there between foot length and a person's age/gender?

Key questions:

How common is a foot length of 29cm in young people (11-15yr)?

Is there a type of young person more likely than others to have a foot 29cm long?

Objectives

Children should learn:

- To specify a problem to investigate
- To hypothesise regarding the result of an investigation

Activities

- Pupils should choose here what they would like to investigate.
- The framework here suggests pupils investigate:
 1. Distribution of foot lengths according to age and gender – leading to looking at the likelihood of a person having foot length 29cm given that they are a female aged 13 for example.
 2. The pupils are leads through an additional pass through the cycle, considering whether there is a correlation between height and foot length using scatter diagrams.

Points to note:

You could edit these questions – this will mean editing later slides also.

Plan



Collect

Process

Discuss

Crime Scene Evidence

I am going to see if **foot length** can be used to suggest a person's age.

I will also use measurements from a sample of young people to see if there is a pattern between **foot length** and **age**.



I **expect** to see that...

Objectives

Children should learn:

- To state their intentions as they begin an investigation

Plan	Collect	Process	Discuss
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Crime Scene Evidence

What data should we collect?

How big a sample should we take?

Objectives

Children should learn:

- To plan what data they will need to address their question
- To think about where they can get relevant data from
- To consider sample size and data collection methods
- That sometimes it is sensible to collect additional information that may help later.

Activities

- Discussion:
 - What data is needed to investigate the pupils' questions?
 - What is the best way to collect the data?
 - Efficiency? Sampling?
 - How are we going to record the data?


Points to note:

This is an opportunity for students to plan **how** they will collect the data, think of an appropriate way of recording the data and discuss measurement.

You could discuss what sample size should be taken and could also think about different ways of taking random samples.

You have a choice of pupils collecting their own **primary** data or being supplied with **secondary** data; random samples have been collected from the CensusAtSchool website and made into **PDF** files to print off. Alternatively you can go to www.censusatschool.ntu.ac.uk and obtain random samples of up to 200 people.

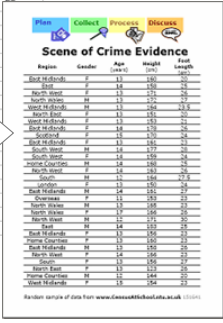
Plan
Collect
Process
Discuss



This data can be broken down by age and by gender.

Some **real** data already exists at this website.

	A	B	C	D	E	F
1	gender	age	height	footLength	wristCirc	thumbCirc
2	F	11	149	20.5	130	40
3	F	11	146	21	145	55
4	F	11	155	22	150	50
5	F	11	160	26	152	
6	F	11	169	24	140	
7	F	12	148	23	160	
8	F	12	150	22	120	
9	F	12	134	18.5	150	
10	F	12	162	20.5	160	
11	F	12	163	25	146	
12	F	12	160	27	170	
13	F	12	154	20	150	
14	F	12	151	22		
15	F	12	164	25		
16	F	12	141	24	140	
17	F	12	155	23	169	
18	F	12	152	25	150	
19	F	12	148	18	130	
20	F	13	170	25	125	
21	F	13	160	24	150	



Objectives

Children should learn:

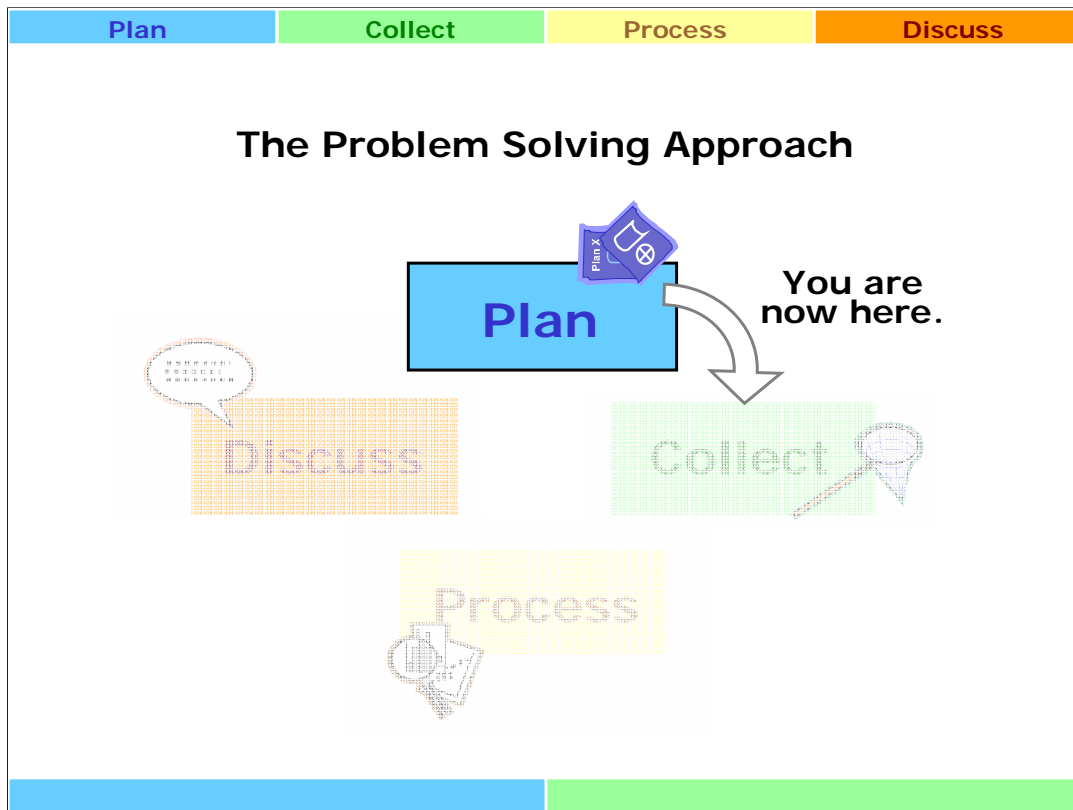
- The difference between primary and secondary data
- To think about when it might be appropriate to use a secondary as opposed to primary data source

Activities

- Discussion: When would it be better to use a secondary source?
What are the problems with using a secondary data source?
What are the advantages of secondary data sources?

Points to note:

Since it was teenagers on the beach, school children are an appropriate population to consider.



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 **planned** our work, we need to **collect** some data that will help us answer the problem.

Plan

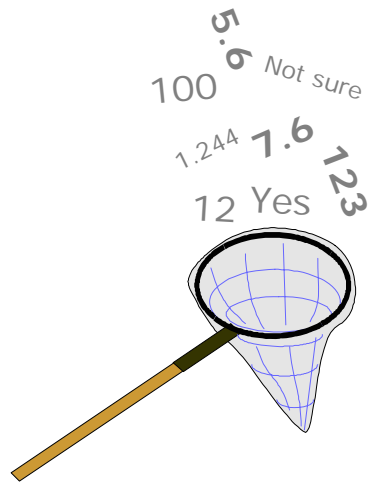
Collect



Process

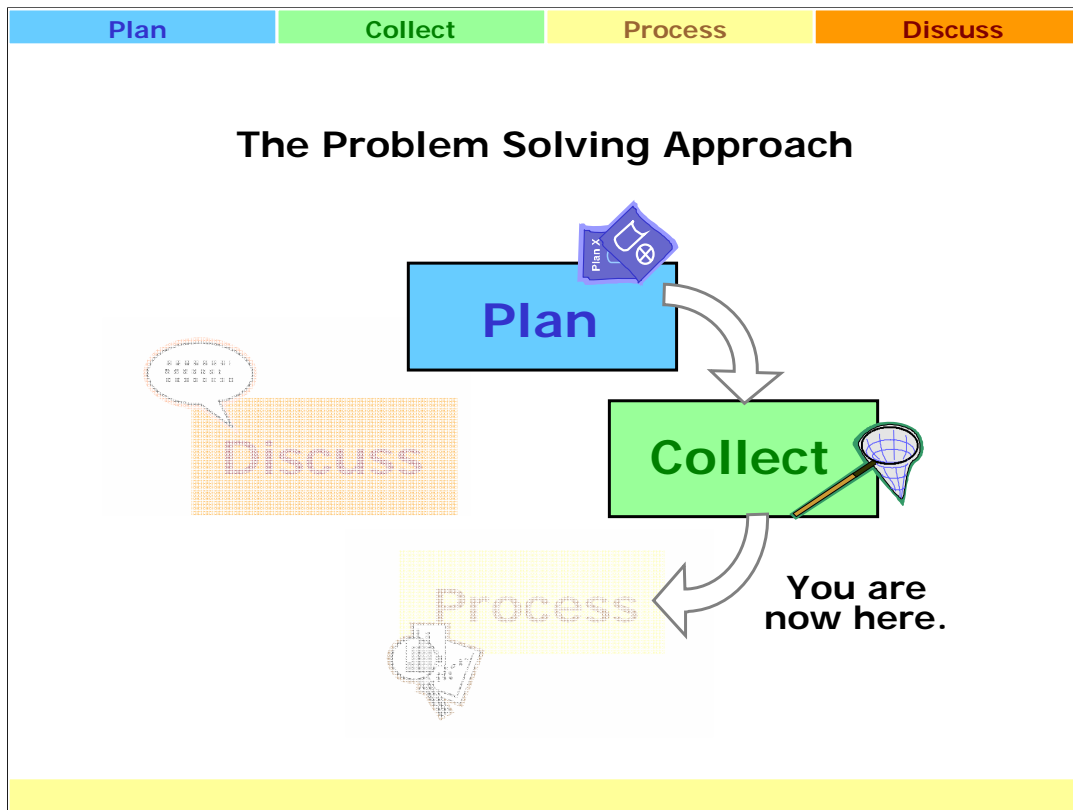
Discuss

Time to get some data!



Activities

Data collection!



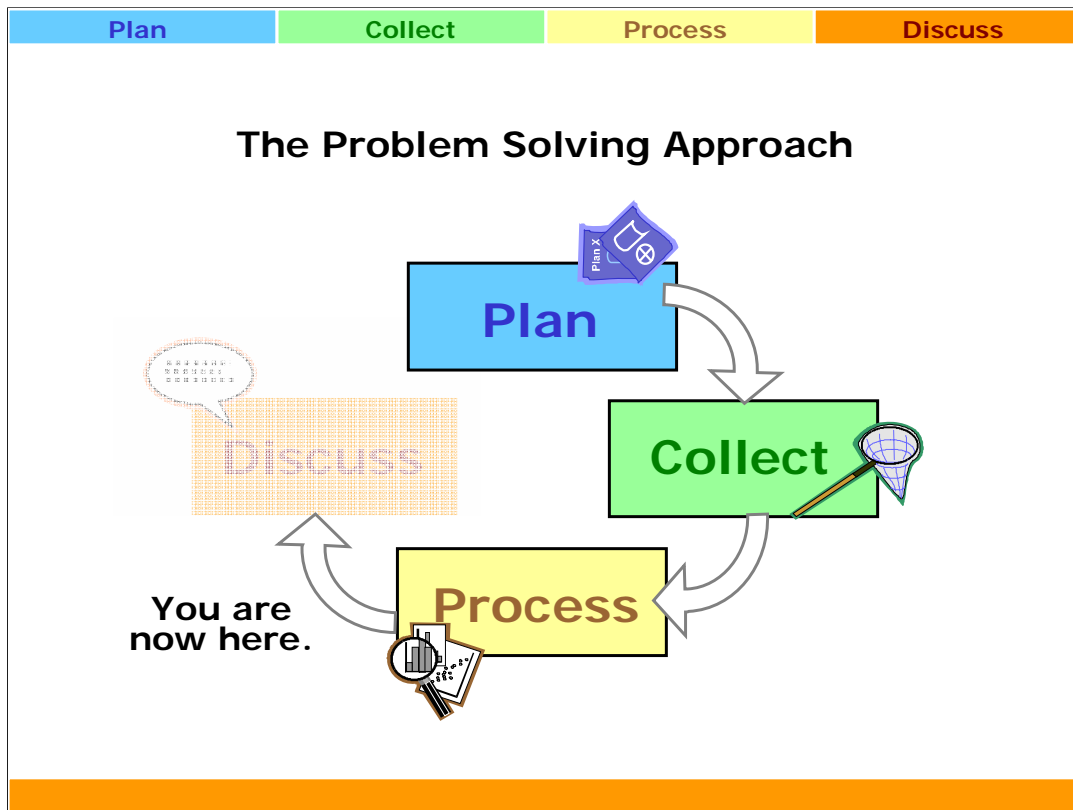
Objectives

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.



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 **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.

Plan

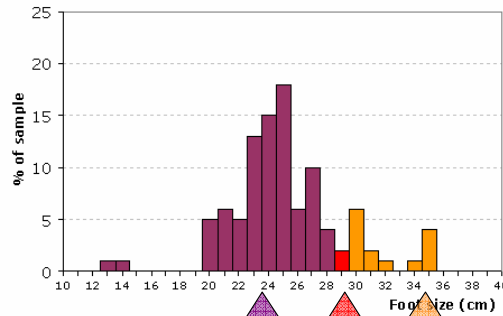
Collect

Process

Discuss

From our samples, let's look at how common different foot lengths are for **girls** aged 11-15.

Age 11
Age 12
Age 13
Age 14
Age 15



How common is a foot length of 29cm?
What age is most likely to have a foot length of 29cm?
What happens to the distribution of foot lengths?

Objectives

Children should learn:

- To interpret histograms and relate the presented information to the problem under investigation

Activities

The slide shows 5 histograms showing the distribution of girls foot lengths.

- Discussion: How likely is it that a girl aged x has a foot length of 29cm?
What is the modal foot length for girls aged x?
What is the median?
What is the mean?

Following the discussion of the girls' charts, the group could then interpret the graphs for the boys and come up with a likely age for the suspect.

Plan

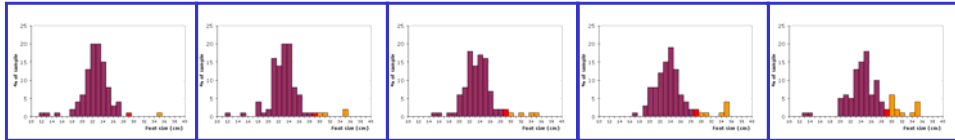
Collect

Process



Discuss

The suspected thief has a foot length of 29cm.
We want to find out how common this is amongst
young people.



How common is a foot length of 29cm for girls who are 11
years old?

Does this foot length become more or less common as
age increases?

If the thief was a girl, what age(s) would you suggest?
Why?

Objectives

Children should learn:

- To interpret their charts and graphs in the light of the problem they are investigating

Activities

The same questions as displayed on the slide, for boys.

Plan

Collect

Process



Discuss

Crime Scene Evidence

How common is a foot length of 29cm in young people (11-15yr)?

Is there a particular age and/or gender more likely than others to have a foot 29cm long?

Is there a strong link is there between foot length and a person's age/gender?

Is the foot length useful for identifying a suspect?

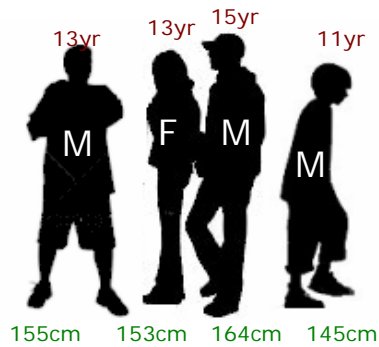
Were the police right or wrong to ignore the footprint?

Objectives

Children should learn:

- To draw conclusions from data
- To think analytically around a problem

A group of four teenagers were caught trying to sell the MP3 player to a pawnbrokers.



From your investigation can you suggest who is most likely to be the thief with 29 cm long feet?

Objectives

Children should learn:

- That statistics can help us draw conclusions, but usually these conclusions have a degree of uncertainty attached.

Plan

Collect

Process



Discuss

Crime Scene Evidence

Who do you suspect? What can you say about the other members of the group?

How *confident* are you be that this is the actual thief from your results?

Are there any features you have *noticed* or *wondered* about during the investigation?

Is there more or different data that we could collect to aid this investigation?

Objectives

Children should learn:

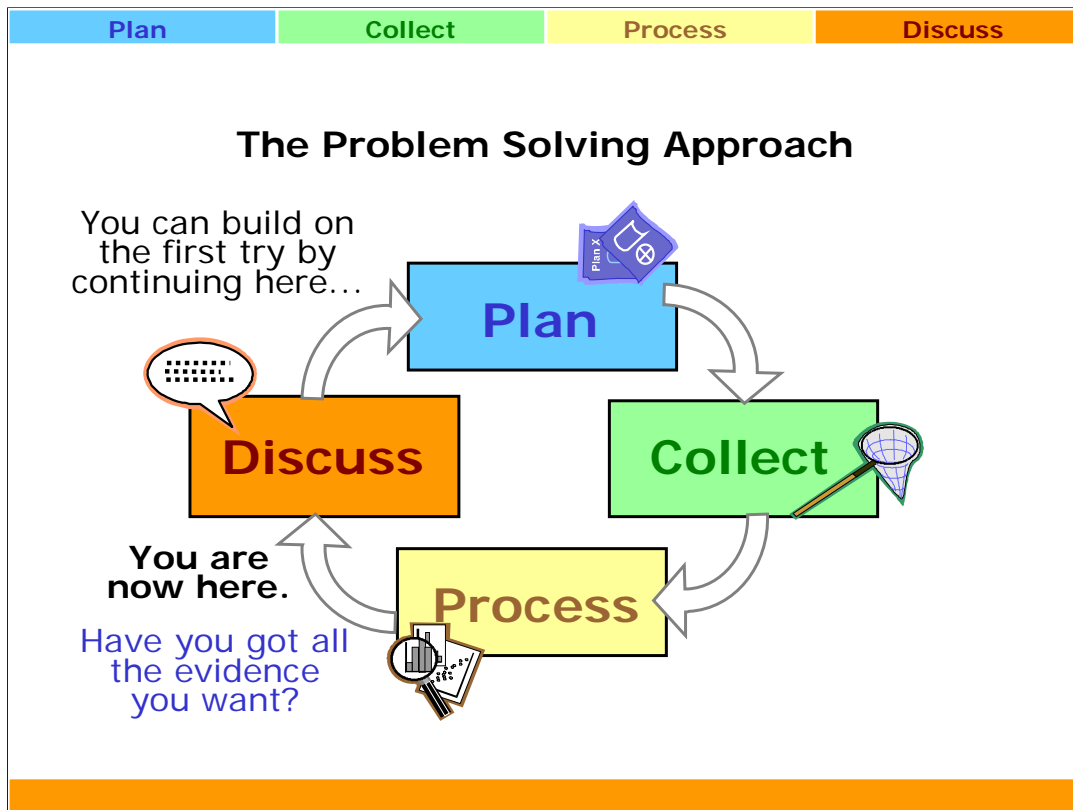
- To draw conclusions from data and relate these to the original problem.

Points to note:

It is likely that the pupils will choose the 15 year old as the most likely suspect.

They are also likely to conclude that a foot length of 29cm is 'above average'. They might suspect that since the thief has larger than average feet, they are also likely to be taller than average – and – perhaps heavier than average.

It would also be interesting to see if there is a relationship between foot length and height. The pupils can now investigate correlation using scatter diagrams.



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.

Possible further work could be drawing scatter diagrams of age or height and shoe size.

Plan	Collect	Process	Discuss
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Scene of Crime Evidence

I am going to use the thief's **foot length** to work out their likely ...

I will use measurements from other people to see if there is a strong link between **foot length** and ...

Students should choose here what they would like to investigate. You could edit and alter these questions - this will mean making similar edits to later slides.

You may wish the whole group to do the same thing, or you may like to give them the option of choosing individually or in small groups.

There are **two options** covered by the remaining slides:

Either investigating the relationship between height and foot length using scatter diagrams,

or finding as many people as possible with a foot length of 25cm and determining the average values for this population.

Plan	Collect	Process	Discuss
<p data-bbox="475 367 1134 416" style="text-align: center;">Scene of Crime Evidence</p> <p data-bbox="355 506 754 544">I expect to see that...</p> <p data-bbox="355 622 611 660">I wonder if....</p> <p data-bbox="355 725 1233 808">I have noticed that...I wonder if I can show it is true...</p>			

Encourage the students to describe what they **expect** will happen. Try to use phrases like:

I wonder....

I noticed...

I expect....

They may also like to discuss why they think this might be the case.

Plan Collect Process Discuss

Scene of Crime Evidence

What data should we collect?

How big a sample should we take?

What data is needed to investigate the students' question?

What is the best way to collect the data?

Efficiency?

Sampling?


How are we going to record the data?

This is an opportunity for students to plan **how** they will collect the data, think of an appropriate way of recording the data and discuss measurement.

You could discuss what size sample should be taken and could also think about different ways of taking random samples.

You have a choice of pupils collecting their own **primary** data or being supplied with **secondary** data; random samples have been collected from the CensusAtSchool web site and made into **PDF** files to print off. Alternatively you can use the web link on the RSSCSE site to obtain your own spreadsheet of up to 200 random samples. - this is discussed on the next slide.

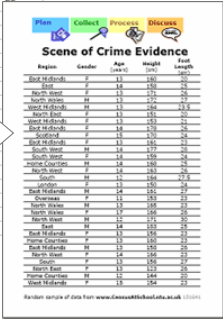
Plan
Collect
Process
Discuss



If we use this data, can we select a particular range of people to look at?

Some **real** data already exists at this website.

	A	B	C	D	E	F
	gender	age	height	footLength	wristCirc	thumbCirc
1						
2	F	11	149	20.5	130	40
3	F	11	146	21	145	55
4	F	11	155	22	150	50
5	F	11	160	26	152	
6	F	11	169	24	140	
7	F	12	148	23	160	
8	F	12	150	22	120	
9	F	12	134	18.5	150	
10	F	12	162	20.5	160	
11	F	12	163	25	146	
12	F	12	160	27	170	
13	F	12	154	20	150	
14	F	12	151	22	140	
15	F	12	164	25	140	
16	F	12	141	24	140	
17	F	12	155	23	169	
18	F	12	152	25	150	
19	F	12	148	18	130	
20	F	13	170	25	125	
21	F	13	160	24	150	



This provides an opportunity to discuss primary and secondary data sources. Since we know that it was teenagers on the beach, school children are an appropriate population to consider. Possible discussion points are:

When would it be better to use a secondary data source?

When it is data which has already been collected and would be very difficult for 'us' to get (e.g. the national census)

What are the problems with using a secondary data source?

Since you have not done the data collection yourself it is often difficult to judge how well it was collected and recorded – students probably have examples of when people have surveyed them in the past, you could discuss whether you would trust the information the people collected

What are the advantages?

Often secondary data sources are much bigger than we could practically collect ourselves. If someone else has already done it, why do it again?

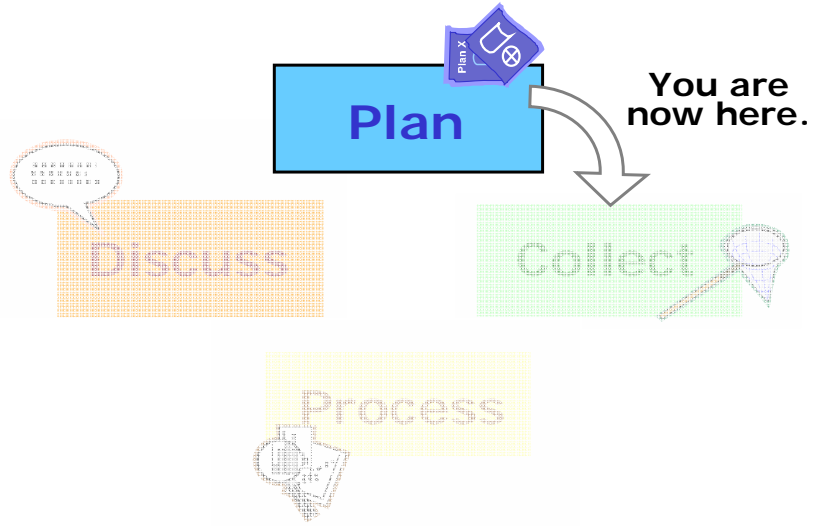
Plan

Collect

Process

Discuss

The Problem Solving Approach



Plan

Collect

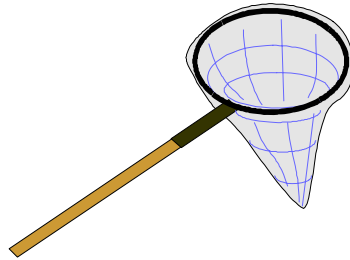


Process

Discuss

Time to get some data!

100
5.6 Not sure
1.244 7.6
12 Yes 123



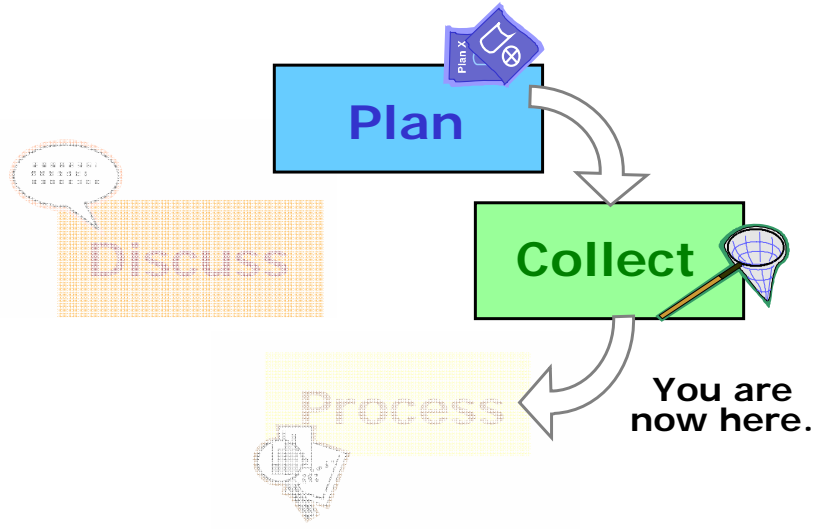
Plan

Collect

Process

Discuss

The Problem Solving Approach





Scene of Crime Evidence

Once we have collected our data, how can we use it to solve our *problem*?

What can we suggest about the thief from the 29cm footprint?
For example their height?



	A	B	C	D	E	F
1	gender	age	height	footLength	wristCirc	thumbCirc
2	F	11	149	20.5	130	40
3	F	11	146	21	145	55
4	F	11	155	22	150	50
5	F	11	160	26	152	50
6	F	11	169	24	140	60
7	F	12	148	23	160	60
8	F	12	150	22	120	30
9	F	12	134	18.5	150	60
10	F	12	162	20.5	160	65
11	F	12	163	25	146	61
12	F	12	160	27	170	60
13	F	12	154	20	150	55
14	F	12	151	22	135	50
15	F	12	164	25	143	50
16	F	12	141	24	140	60
17	F	12	155	23	169	68
18	F	12	152	25	150	62
19	F	12	148	18	130	49
20	F	13	170	25	125	25
21	F	13	160	24	150	60

It is important at this stage, that things get related back to the problem. There are different approaches that could be taken in getting the students to draw charts to represent the data.

You could let the students get on and draw graphs of their choice and then analyse them as a group or tell them which ones to do!

The best for exploring the relationships here, are scatter graphs.

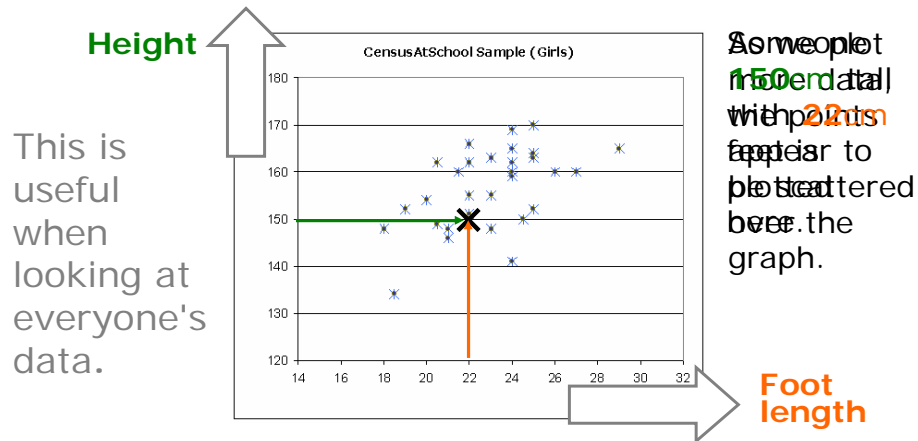
Students could also draw stem and leaf diagrams for the distributions of heights and weights at the particular foot length.

The buttons in the bottom right of the screen will take you through either of the 2 routes and will skip the unrelated slides.



Process

To see if there is a link between **foot length** and **height**, a useful chart is a **scatter graph**.



This slide animates the plotting of one point on a scatter graph.

You could show how to plot more than one point or ask pupils to point on the whiteboard/projection where additional points would go for foot lengths and heights you generate.

The slide then shows an actual sample of points from the CensusAtSchool project.

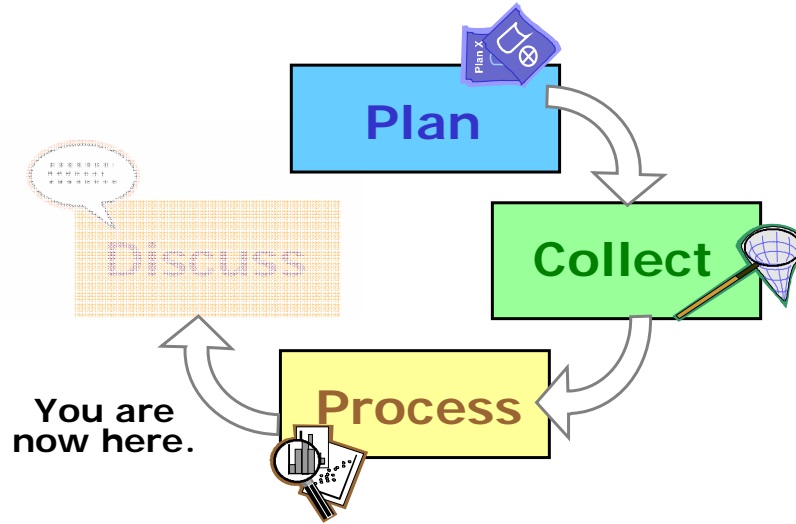
Plan

Collect

Process

Discuss

The Problem Solving Approach



Plan

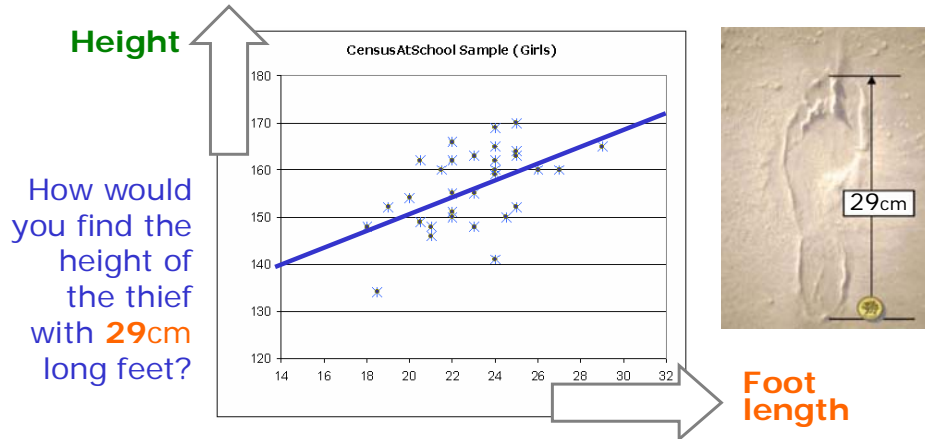
Collect

Process



Discuss

Does there appear to be a pattern or link between foot length and height? Is there a **relationship**?



Encourage students to discuss the relationship – not simply to spot the (positive/negative) correlation.

You could use a prompt – I notice that as..... increases increases.

They may be looking at different hypotheses. Make sure they relate their graphs to their statement from their plan.

Plan

Collect

Process

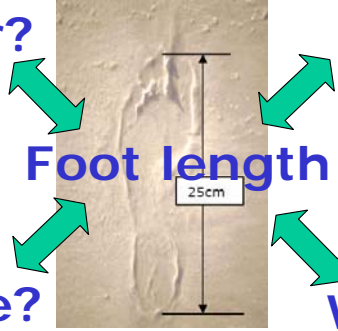


Discuss

What did you hope the footprint would tell us about the thief?

Gender?

Height?




Foot length

Age?

Weight?

What patterns have you found during this investigation? Remember to use statistical language!

Restate the problem – give examples of the statistical language we want them to use - see suggested vocabulary from teachers sheet?

Plan	Collect	Process	Discuss
			 Discuss
<p>What can the footprint tell us about the thief?</p> <p>If you were to give the police some suggestions about the thief, how <i>confident</i> would you be that these were right?</p> <p>Are there any features you have <i>noticed</i> or <i>wondered</i> about during the investigation?</p> <p>Is there more or different data that we could collect to aid this investigation?</p>			

This is an opportunity to discuss the limits of what has been done. Possible points to bring out are:

Quality of the random sample – discuss whether the methods used were truly random

Size of the sample – what would happen if we took a larger sample?

How reliable are the inferences we make?

They involve probabilities – there may of course be an outlier, so in fact we would need other evidence (it may help us narrow down the person, but not convict them!)

What other information could support the enquiry?

Why are finger prints used? (unique, reliable)

Try to encourage the students to engage with these and perhaps even start to plan a new investigation with justified changes. This part is notoriously done badly – a list of bullet points – my sample wasn't big enough etc

Plan

Collect

Process

Discuss

The Problem Solving Approach

You can build on the first try by continuing here...

