QCA-RSS Centre Review

Statistics and Handling Data Project

World Population

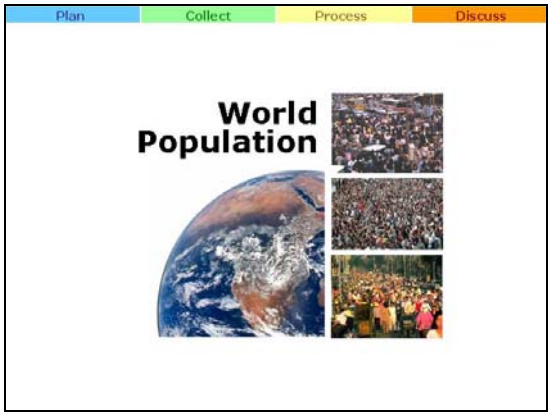
Notes for PowerPoint Presentation

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;
- to know that mathematical models are used to help understand situations;
- general population knowledge.

Slide 1



The PowerPoint presentation contains 29 slides. A number of these are either optional or used for transitions between the different sections (a map of the problem solving approach is used for this).

The presentation requires Microsoft PowerPoint version 2002 and above. If you have an earlier version you can download software to view (but not edit) our files. The viewer can be obtained for free from www.microsoft.com/powerpoint/ (search with the key word “viewer”).

Context

In 1999 the World’s Population broke the 6 billion barrier. Scientists have used various models, including bacteria, to simulate world population growth – many suggest we are in a time of exponential growth and that the world will reach a stationary period at 10 billion – after this it is expected that the population size will remain static or decline. This unit focuses on issues surrounding population – how figures are reported, what factors affect population growth and comparing the growth in different countries.

Activities (Approx 30 minutes)

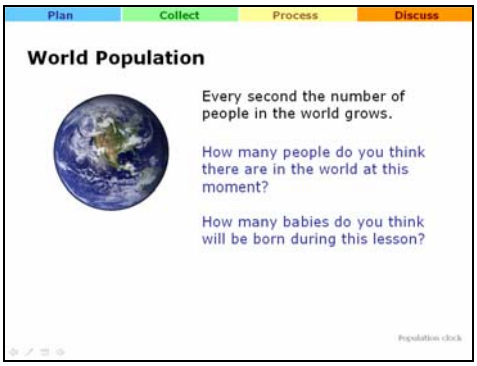
Worksheet 1 could be used here to help engage students with the problem. It involves students:

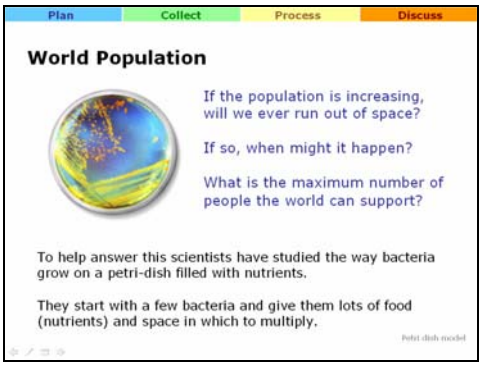
1. Estimating populations (of school through to country)
2. Ordering countries in order of size of population
3. Researching population figures using the internet
4. Sensibly rounding population values

World Population

Objectives
Children should learn:
- the context of the problem;
- to ask questions about presented information;
- to know that mathematical models are used to help understand situations;

Slides 2 & 3





How do you think these figures are calculated?
What factors affect population growth?
Is the population growing faster or slower than you expected?
How fast do you think the population in the UK is growing?
Can you read the World's Population as a number?

The underlined link to the population calculator works using Internet Explorer (or other browser). You need Macromedia Flash player installed for it to display correctly – if you are having problems viewing it you made need to update your flash viewer. This can be done through the site:

http://www.adobe.com/shockwave/download/download.cgi?P1_Prod_Version=ShockwaveFlash

Activities

Discussion based on questions posed.

Optional activity: (15-20 mins approx) using M&M's to model population growth and decay. This resource is adapted from www.pbs.org and provides an interactive introduction to mathematical modelling which can be used to introduce the bacterial model.

Points to note:

Scientists formulated the **natural growth model** for biological populations with an unlimited supply of food - suggesting that the growth rate is proportional to the population, ie double the population and the birth rate doubles (or $\mathbf{dP/dt = kP}$)

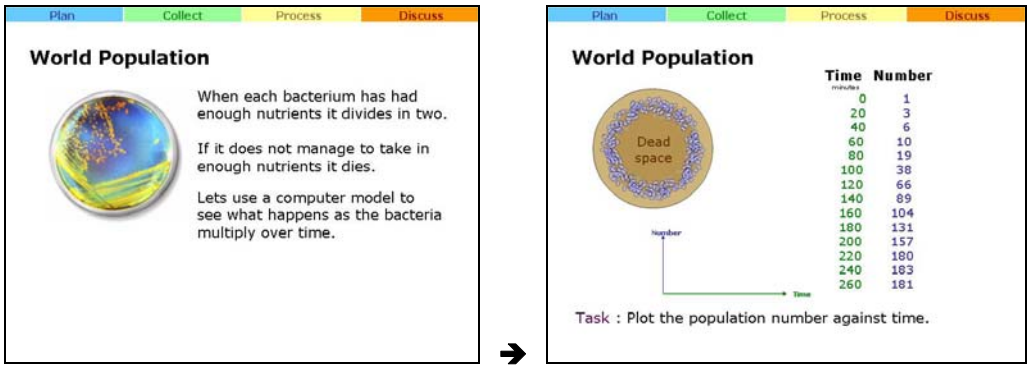
For the model of bacteria in a petri dish the food is limited and the population soon reaches a maximum and then declines.

As far back as 1798 Thomas Malthus concluded that left unchecked, it would only be a matter of time before the World's Population would be too large to feed itself.

World Population

Objectives
Children should learn:
- to plot a line graph
- to look at a simple model as a representation of a more complicated situation;
- to make predictions about what might happen next.

Slide 4



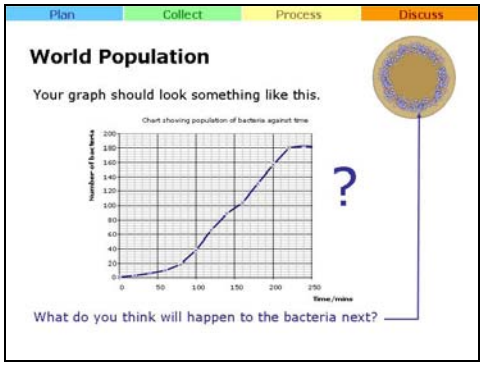
Activities

Students plot the graph on the pupils' worksheet – the numbers have been simplified (under ideal conditions bacterial numbers can reach millions in a few hours, in this model space is limited).

Why is TIME on the x axis?

This fits the standard of the independent variable (time) on the x axis and observed variable (population number) on the y-axis.

Slide 5



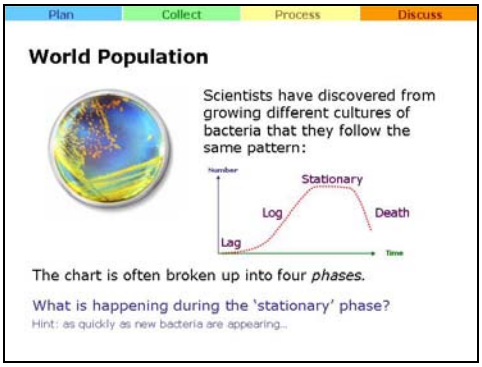
This screen shows the completed graph for comparison.

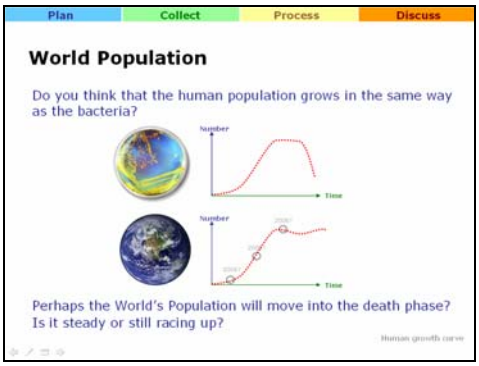
The question is given here to allow discussion of what will happen to the numbers next – the image is repeated to show that the bacteria are reaching the limits of the petri dish – their numbers should soon drop/decline.

World Population

Objectives
Children should learn:
- to interpret graphical information;
- to look at a simple model as a representation of a more complicated situation;
- about the four stages of growth - it is not important to know the exact meaning of each term.

Slides 6 & 7





Under good conditions bacteria adhere to the basic Natural Growth Curve which has form stages:

> The lag phase is so-called as the population growth is small and so growth rate is small – hence lagging. During the log phase the growth is 'explosive' (exponential) – new bacteria are appearing at a faster rate than the older bacteria are dying. In the Stationary phase, the death rate = the growth rate. This occurs as space becomes limited and food supply is insufficient. The Death phase occurs as food is no longer available and no new bacteria are appearing.

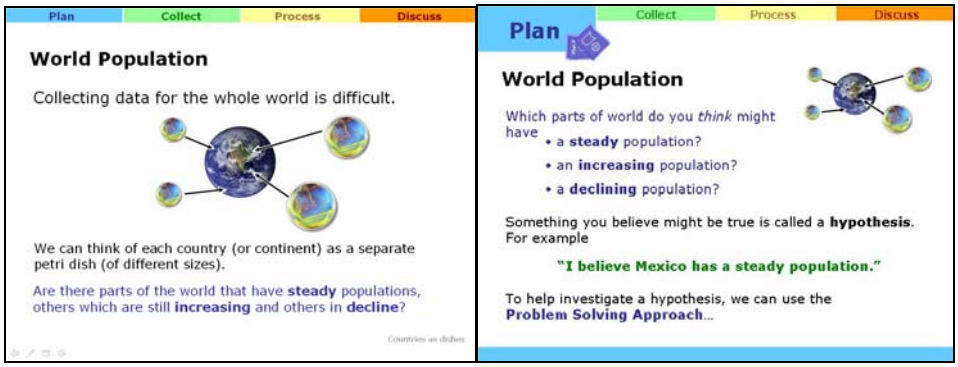
Is the actual world population curve likely to be:
1. as smooth?
2. the same shape?

In the model the bacteria run out of food and space – provided humans are able to replace the food their numbers will not fall. It is likely to have an extended 'stationary' period and hopefully not go into full decline.

World Population

Objectives
Children should learn
- that individual countries have different growth patterns;
- estimation of the World's Population comes from country-by-country data;
- to form and investigate hypotheses.

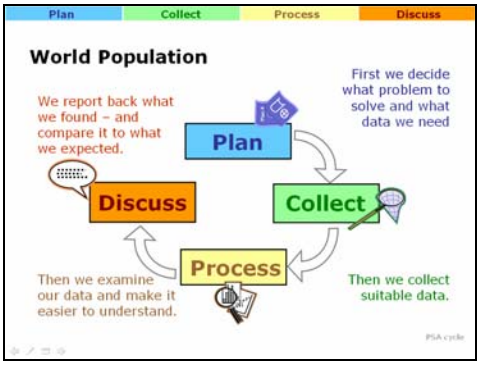
Slide 8 & 9



These two slides are used to get pupils to consider how growth around the world could be in different stages of the growth curve.

Depending on the ability of the group you might want to give them an open choice of country or direct them to particular examples. European countriestend to show slow growth becoming almost steady eg Sweden, Germany) whereas IndoAsia (Pakistan, India) are still rapid. Other good examples which show changing growth rates include South Africa and Zimbabwe.

Slide 10



This slide introduces the Problem Solving Approach that will be used during this investigation. It is repeated several times during the investigation to show the progress being made.

These materials have been designed so that students can see how individual elements relate to a whole problem solving approach.

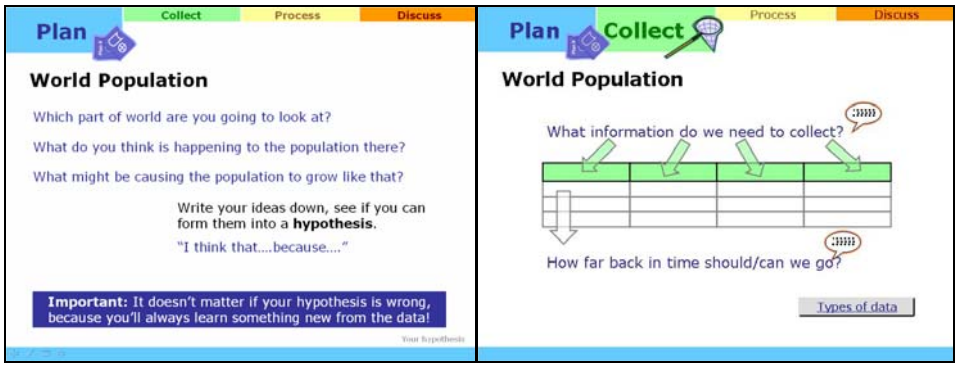
World Population

Objectives

Children should learn

- to make and justify predictions relating to data
- to plan what data they will need to address their question;
- to think about where they can get relevant data from;
- that data can be obtained from primary and secondary sources.
- how hypothesis writing fits into problem solving
- to make and justify predictions relating to data

Slide 11



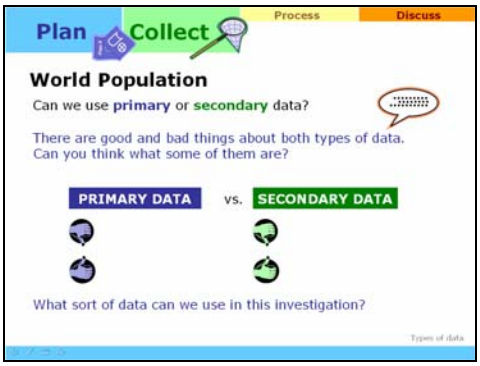
Pupils could be given an area to look at or select themselves – if groups are directed to study particular parts of the world their results can be shared and compared with other groups' results in the later stages. In planning what to collect pupils could be asked:

What data is needed to investigate the pupils' questions?
What is the best way to collect the data?
Where can you get the most reliable data from?
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.

Note: The next slide contains a discussion of primary and secondary data sources – this can be accessed using the button in the bottom right. If this is not clicked, the next slide is ignored.

Slide 13 Optional



Which is appropriate in this case? (SEE SLIDE 15 TOO)

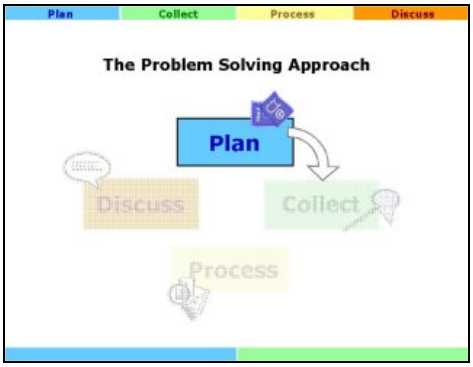
It may be possible to divide the class into groups and get them to collect data from different sources enabling comparison at the end, and a discussion about reliability.

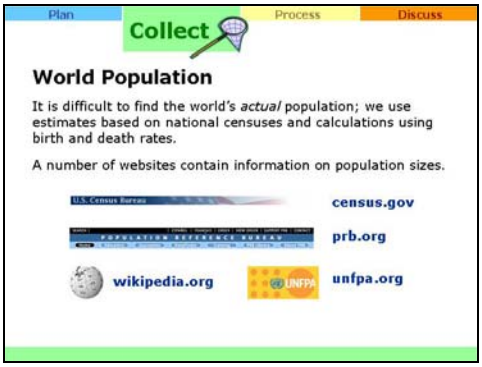
If possible, it is advantageous to allow the students to explore the data on their own – studies have shown that they engage with a problem best when they collect the data themselves.

World Population

Objectives
Children should learn:
•to think about where they can get relevant data from;
•that data can be obtained from primary and secondary sources.
•how their current task fits within the whole 'problem solving approach'.

Slides 14 & 15



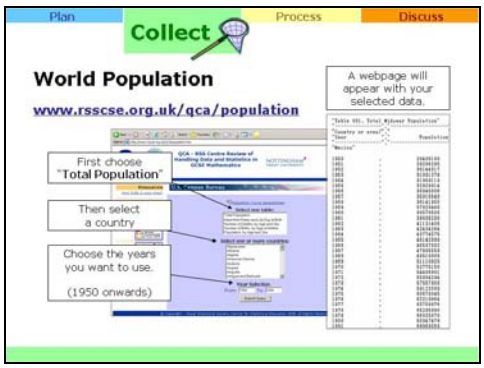


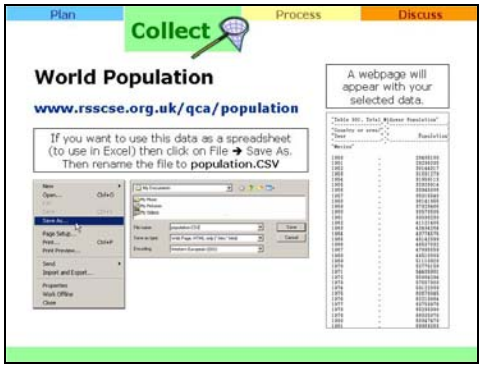
Slide 14 highlights our position in the problem solving approach; we have decided what to collect.

Slide 15 shows some websites which contain fairly reliable population estimates. Individual countries take censuses once every ten years (on average); in between years are therefore estimated. Flagging this as a problem now helps with discussion later on once they have collected the data.

Wikipedia could also be used as an additional source which itself has links to other online resources. In addition it contains pictorial representations of the distribution of the World's Population. See en.wikipedia.org/wiki/World_population

Slide 16 & 17





If Internet access is available to pupils they can be shown how to use the simplified request form that is hosted on the QCA site – this is linked to the US Census world database.

The URL shown is an active hyperlink to the website which has estimated population numbers – based on birth rates, death rates and census data for individual countries. The data runs from 1950 onward – dates beyond 2006 can be used and estimated numbers will be provided (up to and including 2050).

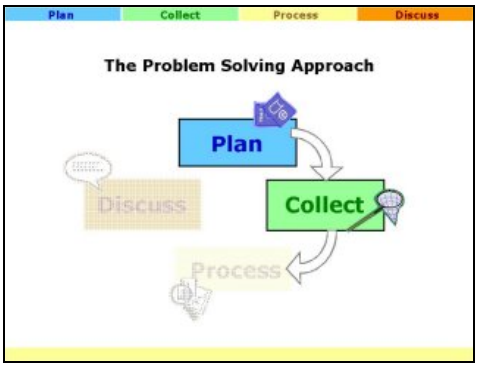
Copying the data directly from the webpage and pasting it into Excel can cause problems – the two columns when pasted default as one column! Instead save the webpage onto the Desktop or My Documents as "population**.CSV**" – it is important to use the ".CSV" ending.

Double clicking on this file will open it up in Excel – it may require a little tidying up but the data will be stored in two separate columns!

World Population

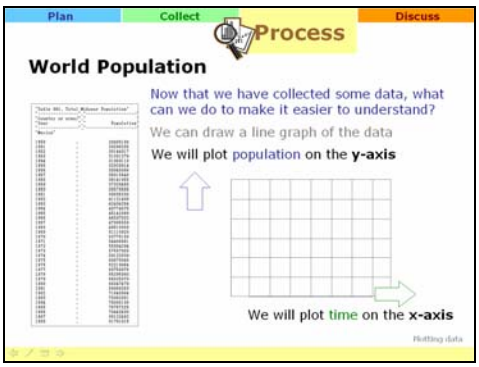
Objectives
Children should learn:
•to think about variables and the best way to process them;
•that graphs and charts can be used to gain additional information;
•how the current task fits within the whole 'problem solving approach '.

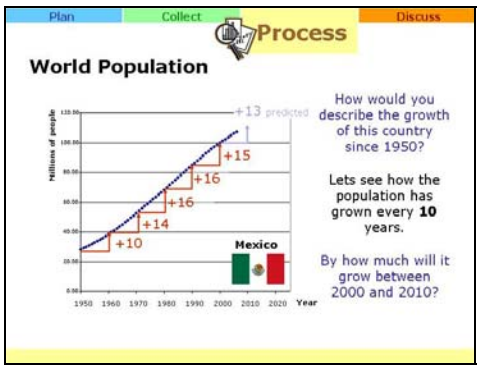
Slide 18



This slide shows which stage in the Problem Solving Approach we have reached having specified our key questions and collected some data – we are now ready to process the data. We need to get it into a form that is easier to manage by drawing some graphs and charts and doing some calculations.

Slides 19 & 20





Pupils could plot their results now or wait until after both slides have been discussed.

An additional discussion could be about why **time** is plotted on the x-axis and **population** on the y-axis; this is the expected standard for an independent or selected variable (time) against dependent or measured variable (population).

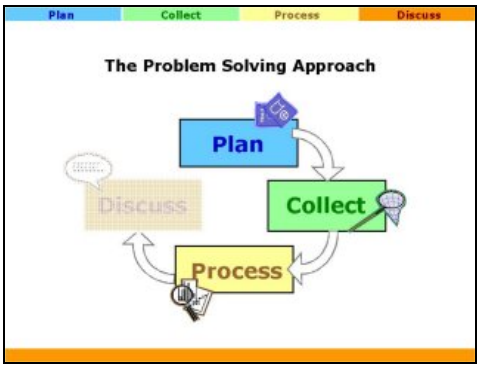
Data for Mexico is plotted for each year from 1950 to 2006. The population is increasing at a reasonable pace, but beginning to slow down.

To help investigate the growth curve steps are plotted for every 10 years. Pupils should suggest an estimate for the final step (2000-2010) before it is revealed.

World Population

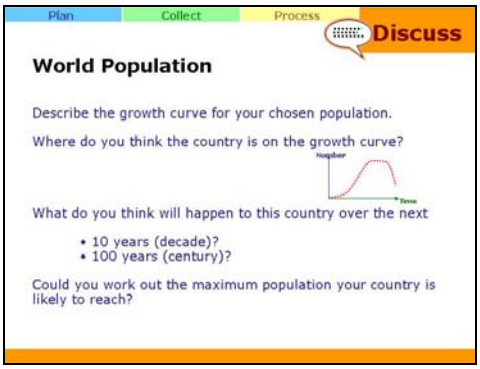
Objectives
Children should learn:
•to relate their investigation back to the original problem;
•that investigating a problem often leads to new questions being asked.
•how their current task fits within the whole 'problem solving approach'.

Slide 21



This slide shows which stage in the Problem Solving Approach we have reached having processed some data – we are now ready to discuss what we have found from the data.

Slide 22



This slide is used to remind us of the initial questions asked during the planning stage:

Where on the simple growth curve is the World's Population?
What will happen to the population over time?

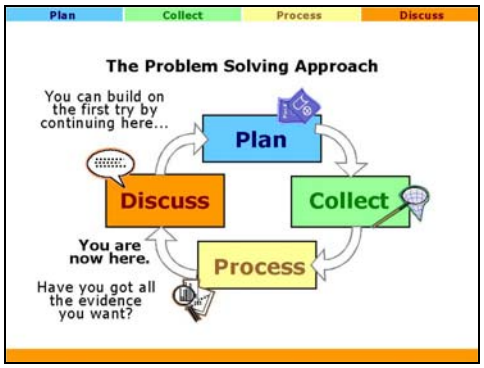
These can be edited or other questions could be added.

Depending on the ability of the group they could be asked to comment on the accuracy of the figures. For example, in the UK the census is taken only once every ten years. Population figures for the next nine are then based on calculations. For the country they are investigating they could try and find out when the last full census was taken.

World Population

Objectives
Children should learn:
•to relate their investigation back to the original problem;
•that investigating a problem often leads to new questions being asked.
•how the current task fits within the whole 'problem solving approach'.

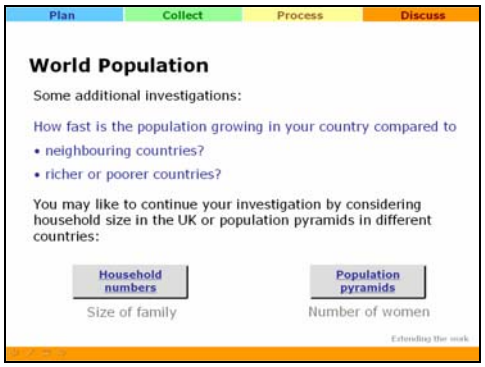
Slide 23



This is the final screen, from a series of similar screens, showing which stage in the Problem Solving Approach we have reached.

Having discussed our findings we could now start the whole cycle again. Some additional ideas are introduced on the next slide.

Slide 24



This slide is used to extend the investigation and takes us into a new planning stage:

What impact is does household size have on population growth?
OR How do factors such as a country's age profile influence its growth?

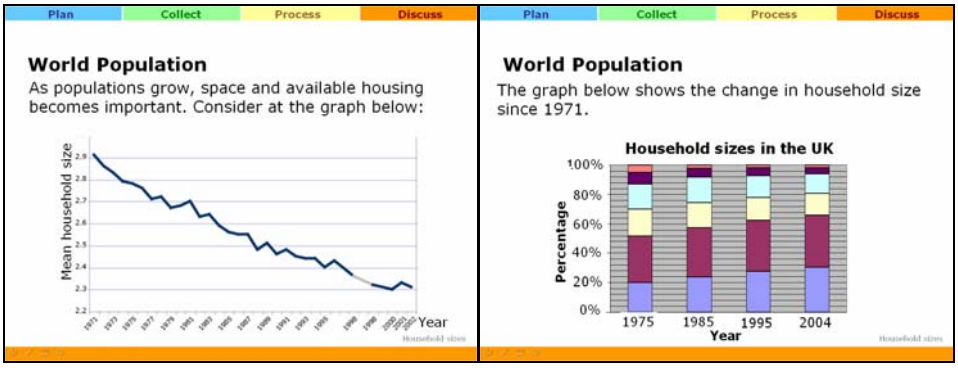
These can be edited or other questions could be added.

World Population

Objectives
Children should learn:
•how their current task fits within the whole 'problem solving approach';
•that investigating a problem often leads to new questions being asked.

Investigating Household numbers

Slides 25 & 26



Points to note
This is the last slide in this section. Further investigation should be carried out independently.

There is the chance here to extend or improve the investigation. Discussion can centre on the questions on the slide

Students could collect household size data for their group and plot the average on this graph. It is likely that their average is significantly higher than 2.32 – why is this? Is there bias involved? What is problematic about the sample group? Ext: Which average is best?

Decreasing household size is a matter of concern in the UK. There are various reasons that it is happening – some are more sensitive than others: family breakdown, more people choosing to delay having children, people living longer. As a result of decreasing household size, more space is needed to house the population. This leads to concern about whether and when we may run out of space.

[The mean is best for roughly normally distributed data, and the median is best for skewed data – by plotting data from a single year you can see the data is positively skewed. For higher ability children this is something worth exploring. Why has the mean been chosen? What difference would choosing the median make?]

The General Household survey is carried out annually and is available online: http://www.statistics.gov.uk/ghs/ all the presented data is taken from this survey. It is a difficult site to navigate but there is a lot of information available.

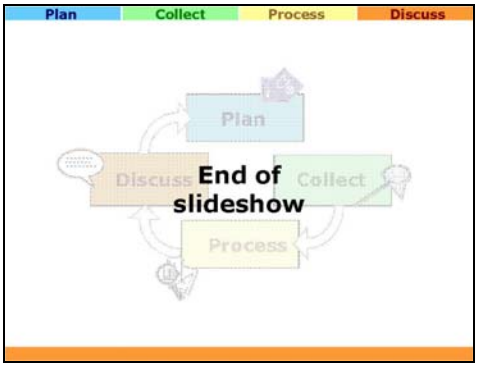
Alternatively, investigation could be into household size around the world (data and an interactive map available at http://www.sasi.group.shef.ac.uk/worldmapper/display.php?selected=191#) and the possible links between household size and birth/death rates.
Students can create a stacked bar to represent their class data.

The site www.sasi.group.shef.ac.uk/worldmapper could be used to investigate birth rates and other factors relating to population growth and decline.

World Population

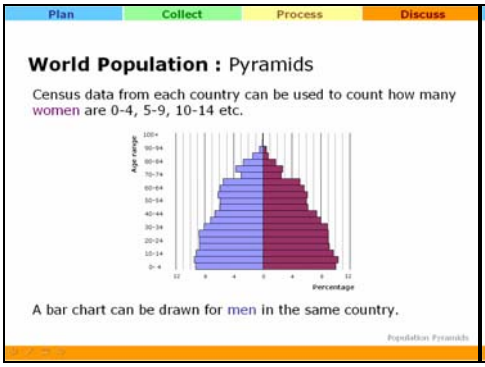
Objectives
Children should learn:
•how their current task fits within the whole 'problem solving approach';
•that investigating a problem often leads to new questions being asked.

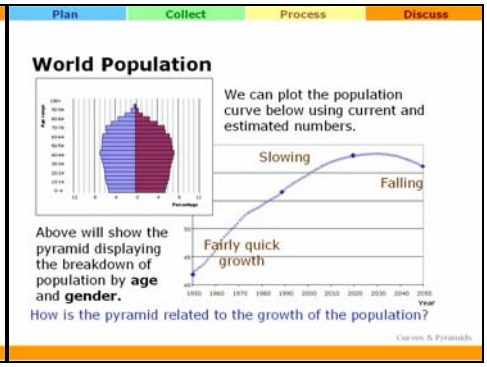
Slide 27



Investigating Population Pyramids

Slides 28 & 29





The birth rate of a country is closely linked to the number of number of women of childbearing age; CBA is difficult to define, as there are often older and younger exceptions. A suitable choice might be 15-44 since the datasets available group by the ages 10-14, 15-19, 20-24 etc.

A population pyramid is shown on the first slide by creating two bar charts side by side.

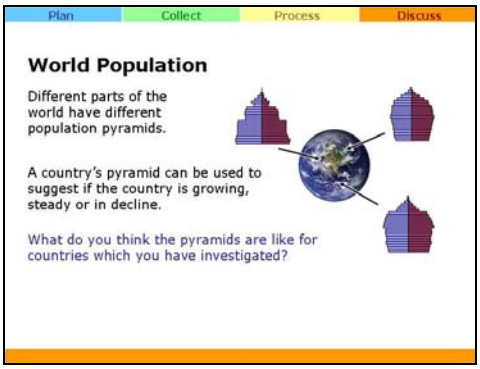
The second slide then shows (for France) how population growth has slowed and is likely to go into decline. This is revealed at the same time as several snapshots of population pyramids.

Pupils hopefully will see that once a population pyramid becomes top heavy the country will go into decline – too many older people not being replaced by enough young.

World Population

Objectives
Children should learn:
•how their current task fits within the whole 'problem solving approach';
•that investigating a problem often leads to new questions being asked.

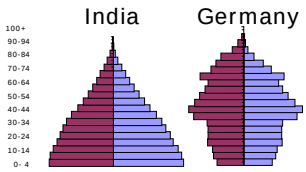
Slide 30



This slide links this new factor back into their previous work looking at countries around the world. If they have found a rapidly growing country and a steady country are there differences in the pyramids?

You could discuss the pyramids on the slide and whether the countries are likely to be growing quickly or not. Students could also predict which countries they might represent and look for similar pyramids.

Data on population pyramids can be found at the website below. Choose "**Population, by Age and Sex**" in the top option box and repeat as instructions given earlier (see slide 16).



www.rsscse.org.uk/qca/population.htm

If you are interested in looking at regions of the UK, the census 2001 part of the ONS site has population pyramids for different regions of the UK. See http://www.statistics.gov.uk/census2001/pop2001/Nottingham_UA.asp for an example and links to others.

Slide 31