

Being safe at work

Introduction

In the Teaching and Learning Programme resource **Improving teaching and learning in construction** there is an activity called **Being safe at work**, which involves interpreting bar charts and pie charts.

Many vocational qualifications include units relating to health and safety. The Health and Safety Executive (www.hse.gov.uk) website contains many useful statistical data sets which can be used to support skills development work linking vocational areas and Mathematics.

Learning objectives and outcomes

When they have completed this session, learners should be able to:

- understand and interpret bar charts and pie charts
- understand the information that the charts portray
- select appropriate statistical diagrams to display patterns seen in sets of data
- work co-operatively to explore and resolve misconceptions
- learn from each other, clarifying their own understanding through engaging in activities that encourage discussion with their peers
- discuss the way that charts can misrepresent data.

Resources required

An overhead projector and **OHT 1: Statistical representations**, or data projector and the computer program **Statistics 2**.

For each small group of learners you will need:

- Health and safety quiz and Answers to health and safety quiz
- Card set A: Bar charts
- Card set B: Pie charts
- Card set C: Causes of accidents
- Accidents to employees reported in the construction industry.

Starting points

This session is intended to complement the activity **Being safe at work: what do the figures tell us?** in **Improving teaching and learning in construction**. Illustrative data is based on the statistics presented there.

This activity involves matching pie charts to bar charts and is intended to allow learners to be able to translate from one representation to the other. Learners will then be able to choose an appropriate chart to represent the data in **Being safe at work** and gain a deeper understanding of the data on accidents.

If computers are available, a spreadsheet may be used to complete some of the practical activities.

Planning learning in multiple environments

Draw on learners' own experiences during discussion. They may have seen accident reports or other health and safety documentation during their work experience.

Suggested approach

Stage 1

Introduce the session by linking to the activity **Being safe at work**.

“There are 13,000 reported accidents each year in construction. About 140 are fatal. This is almost three deaths a week across the industry. The Health and Safety Executive (HSE) reports that between October 2002 and May 2004, nine apprentice workers (all under the age of 23) have been killed on work placements.” (**Being safe at work**, page 8).

We are going to explore the way that data about accidents can be illustrated so that it has the greatest influence on readers and makes them careful workers.

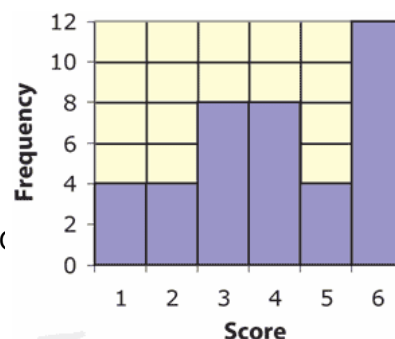
Stage 2

Divide the learners into pairs and give each pair a copy of the **Health and safety quiz**. Instruct the pairs to discuss the questions and select the answer they think is correct. Emphasise that the importance of the exercise lies in justifying the selection to their partner.

Display the **Answers to the health and safety quiz**. Ask the pairs to compare their answers to the correct ones and consider which ones are surprising.

Stage 3

Display the bar chart shown here.



If a data projector is used, display the bar chart using the program Statistics 2 and hide everything except the frequency table and bar chart (see Screen shot 1) or use OHT 1: Statistical representations.

Note: in the program Statistics 2 you will need to enter the data into the frequency table first, then hide everything except the bar chart. You will not be able to change the labels on the axes. You will need to explain to your learners That a company asked its workforce to complete the Health and safety quiz and the bar chart represents the scores they obtained.

Questions for discussion with the group might include these.

- How many workers got one question right?
- How many people made up the workforce? How can you tell?
- What proportion of the workforce scored one? What is this as a percentage?
- What proportion of the workforce scored three?
- What proportion scored six?
- What would the bar chart look like if the workforce had a poor score on the Health and Safety Quiz?
- What would the bar chart look like if the group were made up of a mixture of new recruits to the workforce and very knowledgeable health and safety experts?
- Bar charts allow you to show the total number in each category. They retain information about the frequencies involved. Can you think of any other type of statistical diagram that can be used to show proportions? (Learners could suggest percentage bar charts as well as pie charts.)

Expand on the idea of a pie chart. Ask learners to one if they can. Listen carefully for misunderstandings about the number of degrees and how to calculate the proportions for each then show them how this can be done. (A general thumb is enough at this stage, reinforced by the correct pie chart for the bar chart above.)



sketch
in a circle
category,
rule of
revealing

(See Screen shot 2 for software settings.)

Focus attention on the pie chart through careful questioning. Here are some suggestions.

- From the pie chart, can you tell how many people took part in the quiz? No? So what does it tell you?
- Can you estimate the percentage of workers who scored six?
- In the original data, if only four workers had scored six, what would the pie chart have looked like?
- If I half the heights of all the bars in the bar chart, what will happen to the pie chart?
- If I double the heights of all the bars in the bar chart, what will happen to the pie chart?

D S5 Interpreting bar charts, pie charts, box and whisker plots

Learning Mathematics in context

Try to draw out from learners the relative advantages and different uses of bar charts and pie charts. For example, bar charts help you to see the shape of the distribution and give you more data, including the numbers involved. Pie charts help you to see the proportions (or fractions) of the total in each category.

It may be worth discussing how difficult it is to distinguish the differences between the size of sectors when they are close to each other and the repercussions of this when you want to emphasise differences between the data they represent. This is also an opportunity to point out the difficulties of distinguishing between the sectors if a computer is used.

Stage 4

Organise the learners to work in pairs.

Distribute one set of each of **Card set A: Bar charts** and **Card set B: Pie charts** to each pair of learners. Ask them to match the cards from each set. As they work on this task, encourage learners to explain how they know that particular cards match. If they get stuck, ask questions that might help them to develop a strategy.

- Which bar charts have the smallest range?
- How is the range shown on the pie chart?
- What is the modal score on the bar chart?
- Which pie charts have the same mode?

Differentiation to meet individual needs

Learners who complete the matching task quickly can be given some blank cards and asked to devise sets of cards of their own.

Stage 5

Divide the learners into groups of three or four.

Give each group **Card set C: Causes of accidents**. Explain that the HSE classifies the causes of accidents using seven categories, but the HSE's 'other' category is not precise enough for this exercise.

Ask learners to put the causes in an order that shows the proportion of fatal accidents caused by this category. For example, if they think that 'fire and explosions' cause the greatest proportion of fatal accidents, this should be first.

Hand out the table of statistics **Accidents to employees reported in the construction industry**. Ask learners to highlight where their order of importance differs from the official statistics.

Facilitate a discussion for the whole group. Ask the group which statistics in the table are particularly surprising. Ask learners for possible explanations for this.

Stage 6

Working in pairs, ask learners to illustrate the data in the table using a pie chart or a bar chart.

You could divide the pairs into three sets at this point. One set could be directed to illustrate the statistics on 'fatal accidents', a second set could work the 'serious accidents' and a third set could work with 'accidents that lost more than three working days'.

Learners could create a poster that displays the official statistics and their illustrations.

If computers are available, learners could use a spreadsheet to produce the results.

Stage 7

Reviewing learning

Ask learners to summarise what they have learned about the use of bar charts and pie charts to represent different types of information.

Then ask them to summarise:

- how they learned
- what went well – and why?
- what went less well and why?
- where they could use the approach again.

Challenges – what learners might do next

If the internet is available, learners could be asked to find more recent data about accidents and illustrate this using one of the charts.

Learners could offer a commentary to accompany their illustrations that suggests reasons for the data, for example, the low number of minor accidents caused by 'fire and explosions' may reflect the regulations that surround these activities.

Learners may like to try to illustrate the three sets of data in a single representation, for example, by using a percentage component bar chart.

Health and safety quiz

Test your knowledge of health and safety statistics in the UK. You may be in for a surprise. (Figures are approximate and apply to all UK industries.)

1. How many working days are lost every year as a result of work-related accidents and ill health?
 - a. 500,000
 - b. 10 million
 - c. 20 million
 - d. 25 million

2. Which of the following might carry out a workplace inspection?
 - a. Supervisors and/or trade union representatives
 - b. Independent experts
 - c. Managers
 - d. All of the above

3. Approximately how many people are killed in accidents caused by work activities every year?
 - a. 70
 - b. 120
 - c. 400
 - d. 560

4. How many people are forced to give up work every year as a result of work-related accidents and ill health caused by work?
 - a. 500
 - b. 5,000
 - c. 10,000
 - d. 25,000

5. How many workers are injured every year in this country?
 - a. 10,000+
 - b. 100,000+
 - c. 600,000+
 - d. 1,000,000+

6. What is the estimated cost of work-related accidents and illness suffered by employees each year?
 - a. Between £500 million and £800 million
 - b. Between £1,500 million and £2,500 million
 - c. Between £2,900 million and £3,700 million
 - d. Between £3,500 million and £7,300 million

Source: www.leedstrinity.ac.uk/health

Answers to the Health and safety quiz

Question number	Answer
1	d
2	d
3	c
4	d
5	d
6	d

Screen shot 1

Change the frequency table and watch what happens

Frequency Table							Hide [F]
Score	1	2	3	4	5	6	
Frequency	4	4	8	8	4	12	

Statistics

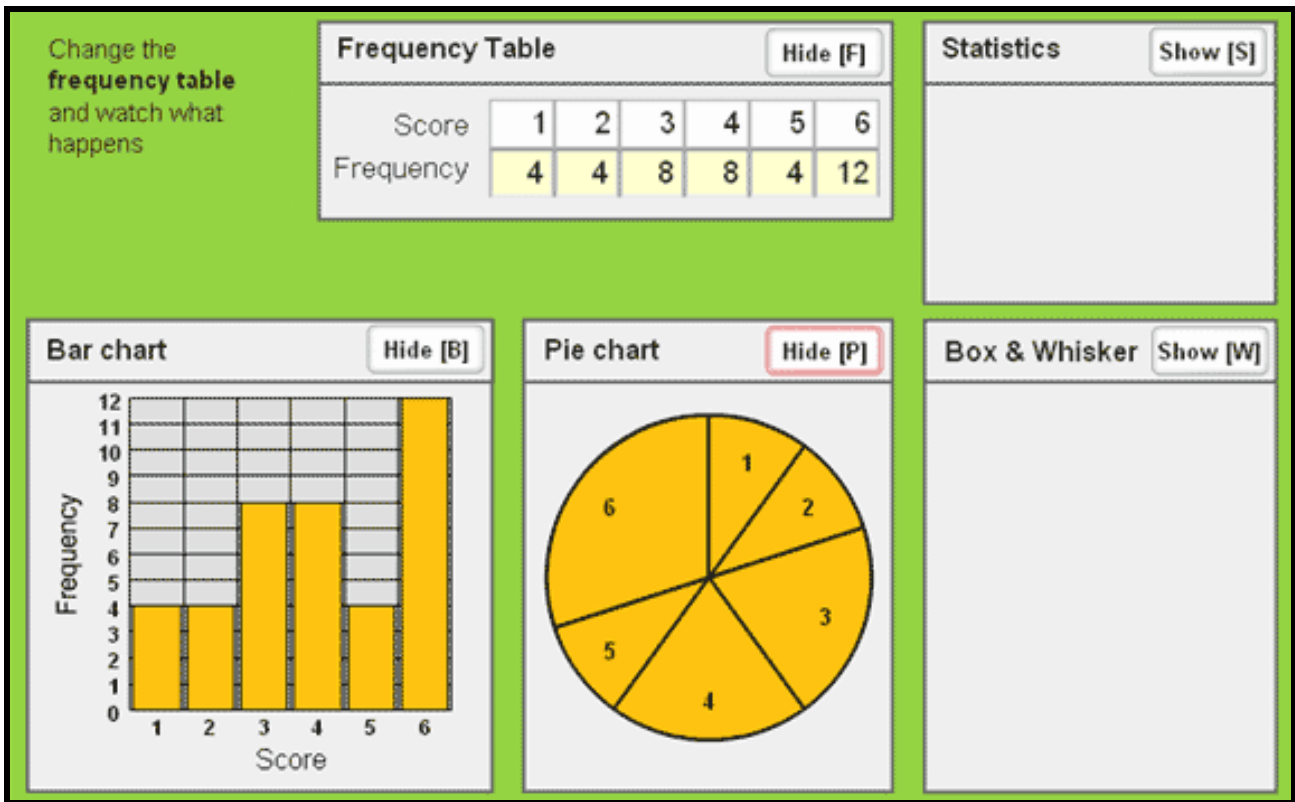
Bar chart

Score	Frequency
1	4
2	4
3	8
4	8
5	4
6	12

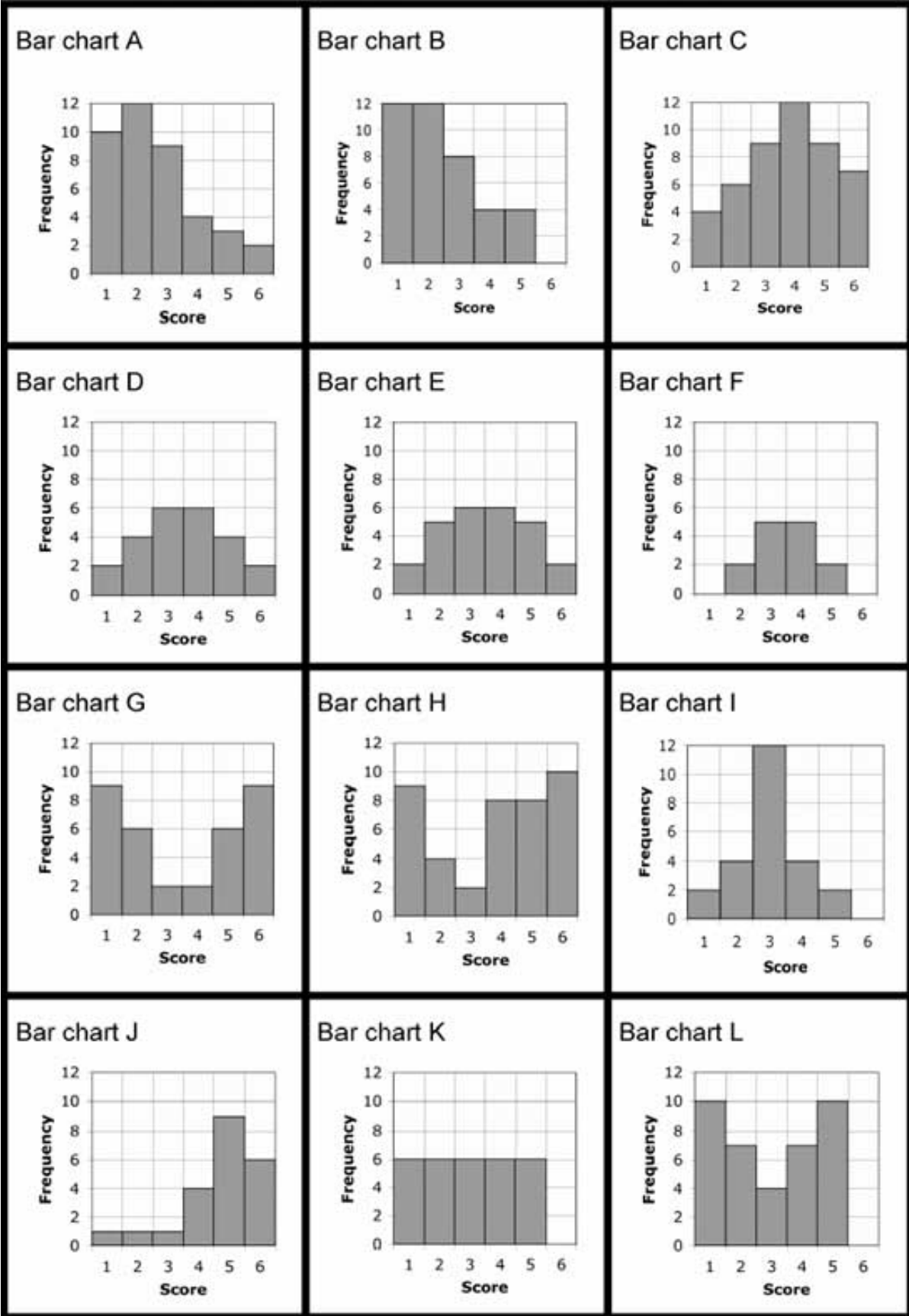
Pie chart

Box & Whisker

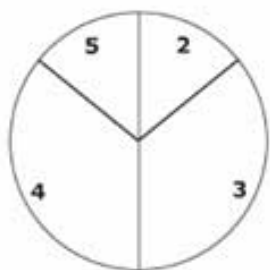
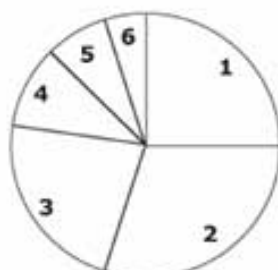


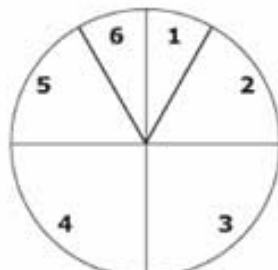

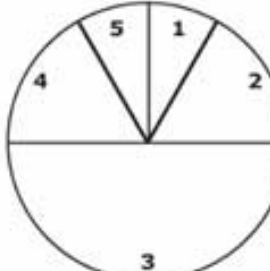
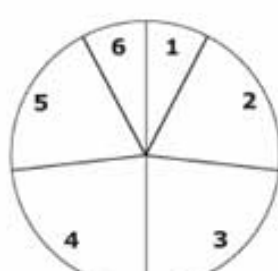

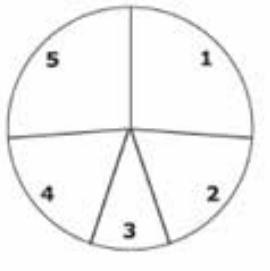
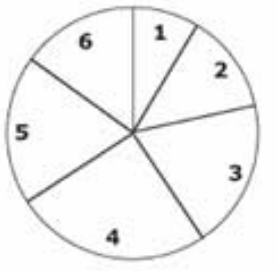

Screen shot 2



Card set A: Bar charts



Card set B: Pie charts

<p>Pie chart A</p> 	<p>Pie chart B</p> 	<p>Pie chart C</p> 
<p>Pie chart D</p> 	<p>Pie chart E</p> 	<p>Pie chart F</p> 
<p>Pie chart G</p> 	<p>Pie chart H</p> 	<p>Pie chart I</p> 
<p>Pie chart J</p> 	<p>Pie chart K</p> 	<p>Pie chart L (complete this yourself)</p> 

Card set C: Causes of accidents

People hurt by moving vehicles, flying objects, machinery, trapped by something collapsing or overturning.
People slipping, tripping, handling, lifting, carrying, striking against something.
Falls from a height
Harmful substance
Fire and explosion
Electricity

Source: Health and Safety Executive 2002/03

Accidents to employees reported in the construction industry

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Accidents to employees reported in the construction industry

Cause of accident	Fatal accidents	Non-fatal major accidents	Over three-day absence
People hurt by moving vehicles, flying objects, machinery, trapped by something collapsing or overturning	35%	23%	19%
People slipping, tripping, handling, lifting, carrying, striking against something	2%	40%	63%
Falls from a height	40%	30%	9%
Harmful substance	4%	1%	2%
Fire and explosion	5%	1%	1%
Electricity	11%	1%	1%
Other	3%	4%	5%

Source: Health and Safety Executive (HSE) 2002/03