

## Teacher's Notes: Are you a masterpiece?

**Please Note: Scatterplots are currently level 6 of the curriculum and may prove challenging to students.**

Allow at least two lessons for this activity. Students may either complete for homework or continue on with it the following day. Spend about 5 minutes discussing the context with the students.

You might want the students to work in small groups so they can discuss their work with each other. Most questions are discussion questions with a summary statement required at the end of each section.

The purpose of this activity is to carry out a statistical investigation in the same way a statistician would. The activity may also strengthen students' measurement skills. If students collect their own data then the activity may take slightly longer.

**Introduction:** You could introduce the activity by talking about Leonardo da Vinci.

Here are some interesting facts you may like to use:

Leonardo was so secretive that he never published his ideas and he wrote backwards to disguise them.

Leonardo was the greatest painters of the Italian Renaissance, yet he left only a handful of completed paintings. One of these is the Mona Lisa. She is regarded as the most beautiful woman; possibly because she was painted using his theories of body proportions (she doesn't have any eyebrows though).

The picture is called the Vitruvian Man. Vitruvius was a roman Engineer of the first century B.C. It was his model of ideal proportions of man that influenced Leonardo da Vinci.

To find more information on Leonardo and his investigations into body proportion try using the search words 'vitruvian man'.

### Problem



Discuss the question so that the students understand what they are investigating.  
- Students may have missed Leonardo's concept of a 'masterpiece' had height = arm span

### Plan



Students learn more effectively if they are encouraged to make predictions and then to test them and reflect on the difference between their prediction and the result.

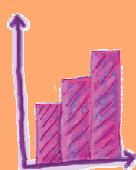
**How would you answer the question now, before you gather the data? Remember to justify your answer** – Students may remember their measurements from CensusAtSchool and use this to Justify their answer along with any class discussions that have taken place.

### Data



Students may either use data from CensusAtSchool or from their own class. Should you wish to use data from students in your own class you will need to take measurements

### Analysis



**Have a look at the table of data. What do you notice?** When students look at the data table they should notice features like largest or smallest measurements, the most frequent (mode).

**What does a row stand for?** A row stands for the measurements of one person.

**Who is the most like a masterpiece?** Student name

**What helped you decide who is most like a masterpiece?** The student who has height = arm span

#### GRAPH 1

Students should be encouraged to create their own graph initially rather than being told which graph to use so that they have ownership of the discovery process

**What is the shape of the plotted data?** younger students clumps/bumps older: Normal/skewed, it may also depend on the type of graph they have drawn.

**What is the spread of the plotted data?** bunched or evenly spaced etc.

**Is there anything interesting you notice about the graph (middle range, outliers, clusters)?** Students will need to look at their graphs and comment on interesting features.

#### GRAPHS 2 and 3

These two graphs have been preset. This is to get students to look at the relationship between height and arm span. The data is to be divided in genders. If you are using your own class data and teach at a single sex school, this section will not be appropriate. Students can simple fill in GRAPH 4 and answer appropriate questions.

**Draw a line of best fit:** Refer to teacher Help notes if required.

**What is the shape of the plotted data?** It will form a diagonal clump with a gradient of about 1.

**What is the spread of the plotted data?** This will depend on data used. Year 5 ~ Year 10 will be fairly

#### Resources checklist

For each group:

- Ruler and string or a tape measure
- Graph paper or access to computer or calculator

## Analysis



evenly spaced. Data from a single class of student with similar ages will have a grouping around the middle and less points at the extremes.

**Is there anything interesting you notice about the graph (outliers, clusters)?** This will depend on the sample, Any data points that are a long way from the rest of the data is interesting. Are the data clustered close together or evenly spaced.

### Graph 4

**Draw a line of best fit:** Refer to teacher Help notes if required.

**What is the shape of the plotted data?** It should be similar to the other scattergraphs

**What is the spread of the plotted data?** It should be similar to the other scattergraphs

**Is there anything interesting you notice about the graph (outliers, clusters)?** Once again it should be similar to other graphs. You may like to suggest that the student plot females in one colour and males in a different colour.

Final Analysis

**Compare the distribution shape, middle range and spread for males and females.** Students should be able to notice slight differences between the graphs

**Are males different from females?** Teenage boys may have slightly different proportions as their bodies rapidly change during puberty. Younger students should not notice any significant differences.

**What evidence do you have to support your claim?** Student should use evidence from their graphs to support their claims.

**Not everybody has an Arm span/ Height ratio equal to 1.**

**Why do you think this is?** They will find that most of the students' heights are not exactly the same as their arm spans. This is because the students are real and so vary slightly. Students may also have stretched their arms more than others or stood taller rather than slouched (although extreme cases where for example students stood on tippy toes may have already been cleaned or at least flagged). One of the key aims of statistics is to deal with the variation in data and to say whether it is natural or random or whether it is caused by something else.

**Do you think the results would be the same for other groups of people?**

**Babies Yes/No Why?** Babies may not have the same arm span to height ratio as they are still growing. Other nationalities may have slightly different ratios too.

**All Blacks Yes/No Why?** Most adults should have measurements that give a ratio that will be close to one.

## Conclusion



**Is Leonardo's theory that a person's height is equal to their arm span true for New Zealand students in 2005?**

Student's conclusions should relate back to their original question. They should also mention any features they had noticed or wondered about and investigated. Introduce probabilistic thinking – what is the likelihood of a student in another class being as tall as their arm span is wide?

A list of statistical language has been provided to help students construct a conclusion.

If all your body measurements were related to each other then you could draw someone from just one measurement. This is the basics of forensic science – just one foot print will provide all the other body measurements of the thief. Fashion designers could also design clothes for you from just one measurement.

**Complete the following sentences**

Encourage students to make more notice/wonder

I notice... what did they notice from their data/graphs/analysis or conclusion that they found interesting. Try to avoid the obvious.

I wonder why... if... What did this activity make them want to know more about?

**Who would be interested in your conclusion?** Media, school uniform/clothing manufacturer, School employed architects, businesses involved in manufacturing school desks/chairs... etc.

