

# FANCY FEET ACTIVITY

## OVERVIEW OF ACTIVITY

This activity comprises two parts addressing mathematics, statistics, science, technology and engineering: (1) undertaking within-class investigations of feet dimensions, shoe sizes, shoes for different activities, shoe popularity, and shoe design including material use; and (2) designing a shoe of students' choice.

Part 1 of the activity focuses on question posing, data collection, analysis and concludes with students reporting on their conclusion/s.

Part 2 will engage the students in engineering practices including further exploring shoe materials, shoe designs, and their manufacture. They will consider how a manufacturer would determine what shoes to make in what sizes for various age groups, what materials they might use (based on their properties and purpose as well as on what most people like), and latest and predicted fashion trends (collectively, these aspects will link back to the statistical practices of researching, collecting, and analysing statistical data, and to the notions of variation, typical, mode, prediction, and certainty). Cost factors (optimising product outcome on a given budget), planning, designing, constructing, testing, assessing, retesting and improving outcomes will comprise the major part of the activity.

## OBJECTIVES

The activity will involve students in:

1. Exploring and identifying similarities and differences (variation) in characteristics of their feet and shoes (shoe size, length of foot, favourite type of shoe, materials shoes are made from);
2. The statistical practices of data collection including observing, measuring, posing questions, researching facts, and conducting a survey;
3. Posing and refining statistical questions, and developing an appreciation of the characteristics of questions that can be answered statistically;
4. Identifying data required to answer questions posed;
5. Analysing and representing data gathered from a survey;
6. Predicting and comparing outcomes of their statistical investigation;
7. Developing a facility with core notions of variation, typical, range, and mode;

8. Preparing a statistical report on their investigation and results, including acknowledging uncertainty involved in drawing conclusions from their data analysis; and
9. Consolidating foundational skills in engaging in the practice of statistics.

## **THE AUSTRALIAN CURRICULUM CONTENT DESCRIPTORS YEAR 4 VERSION 8.2**

### **PART 1**

#### **MATHEMATICS CURRICULUM**

- Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (ACMMG084)
- Select and trial methods for data collection, including survey questions and recording sheets (ACMSP095)
- Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values (ACMSP096)
- Evaluate the effectiveness of different displays in illustrating data features including variability (ACMSP097)

### **MATERIALS LIST**

#### **PART 1**

- <https://www.youtube.com/watch?v=51iW9-HAq2Q> (4mins 35 secs)
- <https://seaworld.org/en/animal-info/animal-infobooks/penguin/physical-characteristics>
- Student Workbooks
- envelopes for data sheets x 3 per question
- small pieces of paper x 12 per student for data copying
- blank A4 paper

## **PART 1: FEET AND SHOES**

**TIMING: 3hrs 40mins**

### **Penguin Introduction**

Start the activity by showing the videoclip from the Happy Feet Two movie. Most students would be familiar with the movie.

<https://www.youtube.com/watch?v=51iW9-HAq2Q> (4mins 35 secs)

Ask students if they know what type of penguin Mumble is. Mumble and the majority of penguins in Happy Feet are Emperor Penguins. Inform students that Emperor Penguins live in the Antarctic, not in Australia but that we do have penguin populations in Australia.

Ask students if they have visited any of the penguin colonies. The largest colonies are located off Perth on Penguin Island, off the South Australian coast on Kangaroo Island, off the Mornington Peninsula in Victoria on Phillip Island, and on King Island in the Bass Strait. Tasmania has smaller penguin colonies and the type of penguins in Tasmania are “Little Penguins” commonly known as “Fairy Penguins”.

Show picture of Emperor Penguins and a Fairy Penguin.



<https://seaworld.org/en/animal-info/animal-infobooks/penguin/physical-characteristics>

## **Our feet and shoes**

Ask students if our feet look like Mumble's feet. (No, penguins' feet are made of tough, scaled keratin [the same material as our finger nails and skin], they are webbed and have visible claws on their three "toes".)

Ask students to remove one shoe/sock and to closely observe what human's feet look like.

Ask students to identify similarities and differences between penguin feet and their own foot. Ensure skin and shape are discussed.

Ask students to particularly note the shape of their foot when viewed from the side. (Rounded heel, 5 rounded toes, arched sole).

Ask students what purpose our feet serve. (They keep us upright and balanced, they bear our weight, they enable us to walk, run, skip, jump and swim.)

Inform students that our feet are very complicated, with lots of bones (26), joints and muscles, and they do many things. There are specially trained people who look after our feet. Ask students if they know what they are called (podiatrists) and if anyone has been to one.

Steer the conversation to humans' need to wear shoes by asking students what purpose shoes serve. (Protection, support, fashion, warmth, etc.)

## **Introduce the activity**

Inform students that our next activity will be all about feet and shoes.

Handout Student Workbooks and ask students to record their name, partner's name, class and group number on the cover.



<https://lastocean.wordpress.com/2011/07/18/the-real-happy-feet/>

# **FANCY FEET DESIGN ACTIVITY – PART 1**

Name: \_\_\_\_\_

Other group members: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Group Number: \_\_\_\_\_

Class: \_\_\_\_\_

Advise students that the activity we are going to undertake will be in two parts. **Part 1 today**, will be an investigation where we collect data about our feet and shoes. **Part 2 will be undertaken next term** during which students will get the opportunity to design a model/prototype of a shoe that they create themselves.

Remind students that we are going to gather some data about our feet and shoes. Ask students how we could go about this. (Observation, measuring, asking questions, researching facts, conducting a survey.) Record “survey” on the whiteboard.

Ask students what we could collect data on. List bullet points on whiteboard ensuring “shoe size, length of foot, favourite type of shoe, materials shoes are made out of” are recorded. If any are not suggested by students, simply add them to the list. Underline these 4 main investigation topics as listed above.

Ask students to reflect back on the “Life in Hobart” Activity and ask why we needed to think carefully about how to word survey questions. (So the other students could understand exactly what we meant; so we could get the data that we needed to compare life in Hobart to life in Brisbane.) Congratulate students on their efforts and success in writing well-worded questions.

Ask students to turn to page 2 of their Student Workbook and to independently record one question for each of the 4 main investigation topics that will enable us to gather data. Inform students we are looking for some “really interesting” questions for each of the 4 main investigation topics.

Note: Questions posed may be very broad and/or non-answerable by the data that will be collected later. This is okay as it will give students the opportunity to refine their questions once they have recorded/collected data.

## PART 1: FEET AND SHOES



What are some really interesting questions you could ask to gather data about our feet and shoes?

**Shoe size**

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**Foot length**

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**Favourite type of shoe**

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**Material it is made out of**

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Ask students what they know about the shoes they wear (any shoes). (Fit is important otherwise you can damage your feet, get blisters, etc. Shoes come in different widths and lengths. Shoes can be made out of various materials such as leather, plastic, fabric, rubber. Shoes are made for different purposes, school wear, wet weather, fashion, sports, warmth, coolness etc.)

Ask students if they think there will be any/some/a lot of “variation” in the shoe sizes of our class. (Check students’ understanding of “variation”.) Record “variation” on whiteboard.

Ask students what “predict” means. (Estimate, guess, etc.) Record “predict” on whiteboard. Ask a student or two to predict the range of ages for the students in their class. (Don’t spend time reaching a consensus on the prediction at this point, we are aiming for students to think about the term range.) Ask the students what we mean by “range”. Record “range” on whiteboard.

Ask a student or two to predict the most common age for students in their class. Ask students if they know what “mode” means. Inform students that “mode” can have several meanings - common uses such as; a) a way of doing something for example mode of transport, car, bus, train, walk; b) a style or fashion; c) a setting on a machine or computer such as sleep mode; and d) a mathematical term for the value that occurs the most often. Record “mode” on whiteboard.

Advise students that mode is often used to describe the most popular/most common item or most common category of something. Record “most” on the whiteboard next to “mode”. Ask students if they can think of another term to describe “most/mode”. If not raised, inform students that “mode” is one term that can be used to describe “typical”. (Mean and Median are also terms that can be used to describe typical but unless raised by students we will leave these terms to a future activity.) Record “typical” on whiteboard next to “mode” and “most”.

Giving an example from the classroom that students will be able to relate to such as the most common age of students in the class is helpful. Ask for a show of hands for students who are 8, then 9, then 10, then 11 need be and emphasise most hands went up for 9 years of age. Ask students to use the word “typical” in a sentence to describe the typical age of students in the class. (The typical age of students in our class is 9 years old.) Repeat for the term “mode”. (9 is the mode for the age of students in our class.)

Ask students to predict if the typical age of the students in the other grade 4 class would be “similar”. Record “similar” on whiteboard. Ask about the Grade 4 students in Hobart. Ask if this would be the same for other countries. (We don’t want to spend too much time on this).



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## Data collection

Inform students that we are going to begin to collect our data so we can reach a conclusion about our 4 main investigation topics. The data collection method we are using is a survey.

Inform students that we will first make a prediction for each of the 4 main investigation topics; a prediction for what we expect students in our class might answer.

Ask students to turn to the data collection/survey table on page 3 of the Student Workbook. Read the survey prompts to students to ensure they understand.

Shoe size	
Foot length	to the nearest whole centimetre
Favourite type of shoe	record a category such as sandals, runners, thongs, etc
Material	the “material” that the favourite shoe is mainly made out of such as leather, plastic, fabric, rubber, etc.

*Remind students that a prediction is an estimate and that there is no right or wrong answer. But that a prediction is not a “wild guess.” We need to think about what the data might be like for our class.*

Ask students to record a prediction for their class for each of the 4 topics in the first column.

Note: Students are to record one “answer” only to each prompt.

Once predictions are recorded, request students to proceed to answer for themselves by recording an answer to each of the 4 topics in the “Me” column. Students will now need to locate their shoe size (by looking on the tongue/inside/bottom of your shoe) and measure their foot (by standing on the ruler provided and recording the measurement to the nearest whole centimetre).

Note: Request students not to erase or change their predictions.



	<b>Prediction for my class</b>	<b>My data</b>
<b>Shoe size</b>		
<b>Foot length (nearest cm)</b>		
<b>Favourite type of shoe</b>		
<b>Material of favourite shoe</b>		



As students finish recording their data, each answer is to be copied to a separate small piece of paper which will be provided. These do not need to be named. The pieces of paper will be placed in an envelope marked with the survey prompt, that is, all “material” answers will go in the envelope marked “material”, all the “shoe size” answers will go in the envelope marked “shoe size”, and so on for “favourite type of shoe” and “foot length”.

The contents of the envelopes will be the raw data students will need to use for their analysis. As we will have only four questions but eight/nine groups, at least two groups will analyse the same investigation question. Therefore, students will need to repeat the above “copying of answers” process placing their second copy in the second envelope marked “material”, “shoe size”, “favourite type of shoe”, or “foot length” and their third copy in the appropriate third envelopes.

Once all data have been collected, recorded and copied thrice, the investigation topic and envelopes are to be allocated to groups. It is up to you to decide how this process should occur; you can ask groups to select a topic or you can give each group a topic. No more than three groups are to analyse each topic and all members of the one group must analyse the same topic.

## **Analysis**

Once investigation topics have been allocated/chosen, ask students to turn to page 4 of the Student Workbook and circle the topic their group will analyse. Ask students what “analyse” means (think about, investigate, sort data, summarise, represent, etc). Record “analyse” on whiteboard.

At this point each student has recorded a question on pg 2 of the Student Workbook for each of the 4 topic areas. Each group now needs to agree upon and record a final question that they would like to analyse with the data they will be provided. Students need to reflect on the type of data they provided in the table on page 3 in order to create their “group question”. Each student is to record their “group question” in the space provided on pg 4 of the Student Workbook.



**Which topic will we investigate?**

(circle your topic)

**Shoe size**

**Foot length**

**Favourite type of shoe**

**Material**

**Record your group's investigation question below.**

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**You can now analyse and represent your data any way you like.  
Use the blank A4 paper provided.**

**When you are finished, turn over and answer the questions.**

Hand out the appropriate envelope to each group. Allow students time to open the envelope and gain an appreciation of the number of and variety of responses they are to use in their analysis.

Inform students they will need to “show the rest of the class their findings” and “report on any conclusions”. Ask students for suggestions on ways this could be done (tally the responses, represent/graph the data, make a summary statement or two based on the data they have been given). Each group can analyse and represent their data any way they like. Inform students they are to use blank A4 pages for their representations/tallies/graphs etc. Each group can complete a combined representation or each member of the group can complete their own representation if they’d prefer.

Ask students to turn to page 5 of the Student Workbook. Ask students to note the questions on pages 5, 6 and 7 that they will need to answer once they have represented and analysed their data.

Once all instructions have been given, students can begin to analyse their data.



**When you've finished representing your data, answer the following questions.**

- 1. What steps did you take when you opened your envelope of data?**

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- 2. Were all the data the same? Describe any variation you found.**

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**3. How did your representation help you to analyse your data?**

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**4. What conclusion/s have you reached?**

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**5. How certain are you of your conclusion/s? Why?**

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- 6. Would your conclusion be true for all Grade 4 students in Hobart and Brisbane? Why/why not?**

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- 7. What factors should you consider in Part 2 of the activity when you get to design and create your own shoe?**

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Once students have finished their analysis and representation and reached a conclusion, recording their answers to questions 1 to 7 on pgs 5, 6 and 7 of their Student Workbook, QUT staff and teachers are to check each group's work. If students have not used the mathematical terms on the whiteboard such as mode, typical, range, variation, etc, ask students to turn to pg 8 and record a further summary paragraph using these terms. Likewise, if students haven't referred to their initial predictions and the actual data, ask students to record a sentence or two comparing their prediction to the data analysed.

Note: We do not want to initially prompt students to use these terms, rather if not done we would like them to attempt to use them in a sentence.



## Reporting to the class

When all groups have completed their task, students can report back to the class. They will use the answers on pgs 5 to 8 and their representations to justify their conclusions/findings.

## Wrap Up

The lesson can be concluded by asking students summary questions such as:

What is the **most popular** favourite type of shoe for students in our class? What terms could we use to describe “most popular”?

What is the **typical** material our favourite shoes are made from?

What is the **mode** for the shoe sizes in our class?

What is the **range** of foot length for students in our class?

Ask students to reflect on their group’s investigation question and consider whether it could have been improved given the data they were provided. Students should be encouraged to reword their question providing reasons for the change or to justify why they felt it was satisfactory as it was.

If time permits, pose the following questions and ask students to justify/explain their responses:

Do you think there is any relationship (link) between a person’s shoe size and their height?

Do taller people have larger shoe sizes?

Can you tell a child’s age by their shoe size? An adult’s age?

Remind students that Part 2 of the activity will be undertaken next term. Inform students that they will use today’s findings to design and make their own shoes.

## End of Part 1

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