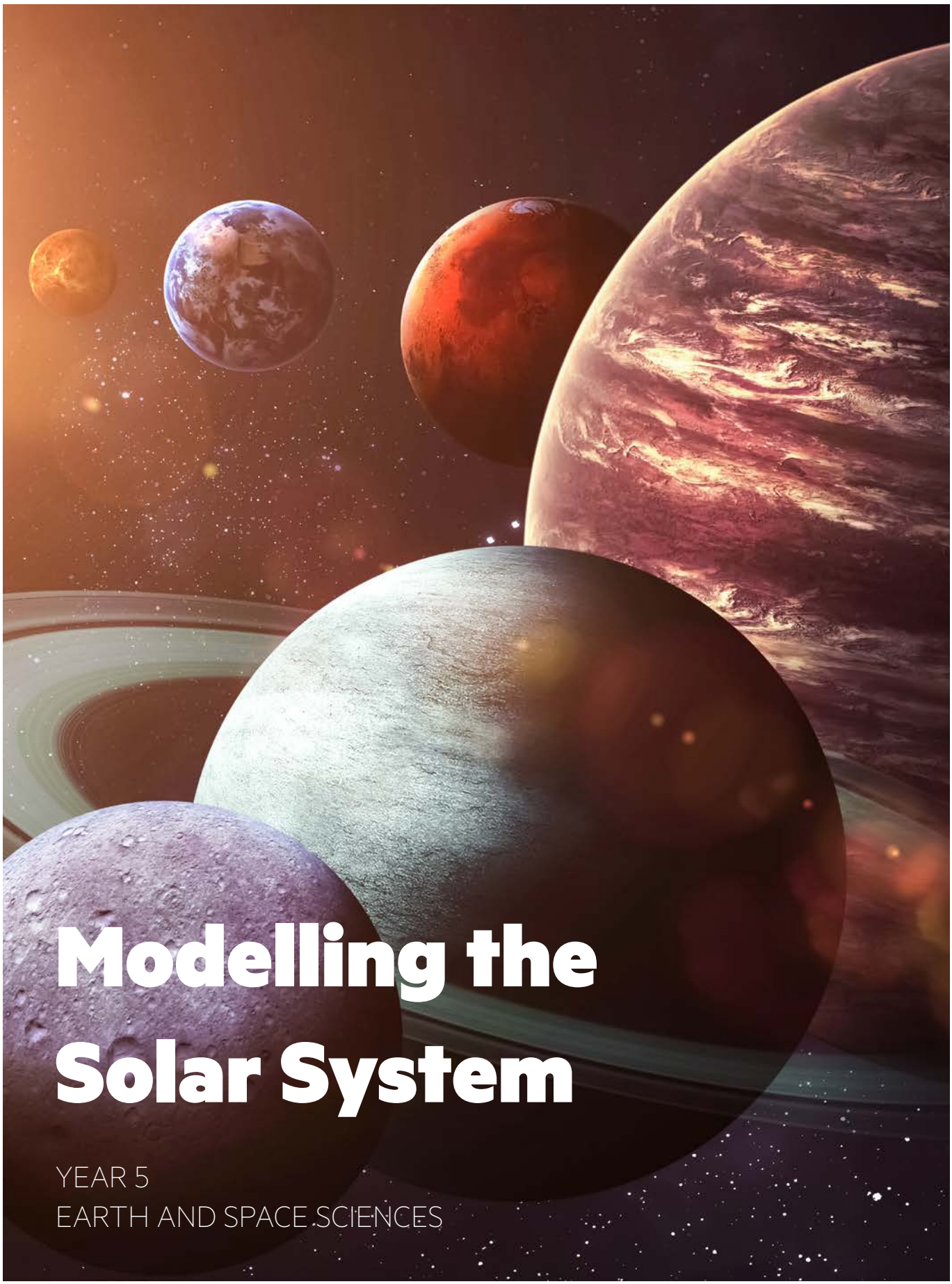

Modelling the Solar System

YEAR 5
EARTH AND SPACE SCIENCES

QGC | FUTUREMAKERS | QUEENSLAND MUSEUM NETWORK | Queensland Government

Future Makers

Future Makers is an innovative partnership between Queensland Museum Network and Shell's QGC business aiming to increase awareness and understanding of the value of science, technology, engineering and maths (STEM) education and skills in Queensland.

This partnership aims to engage and inspire people with the wonder of science, and increase the participation and performance of students in STEM-related subjects and careers — creating a highly capable workforce for the future.

QUEENSLAND MUSEUM NETWORK

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This teacher resource is produced by Future Makers, a partnership between Queensland Museum Network and Shell's QGC business, with support from the Australian Research Council and other parties to ARC Linkage Project LP160101374: The University of Queensland, Australian Catholic University Limited and Queensland Department of Education.

EXPLAIN - ELABORATE

Modelling the Solar System

Teacher Resource

In this activity, students use fractions to create scaled model planets. Before beginning the activity, students should predict how big each planet will look in comparison to Earth. Students can draw their predictions in their books.

Depending on student ability and mathematics focus at the time, this activity can be modified by changing fractions into decimals or percentages. To simplify the activity, you could change fractions into equivalent fractions or tenths as a class before students build the planets.

Different methods can be used to measure the diameter of the model planets. Students can either hold a ruler against their models to estimate the diameter, cut the model in half and measure the diameter, or record the circumference of the model using string then divide the circumference by pi ($C=\pi d$).

Pluto is not a planet!

Science is constantly evolving with improved observation and understanding. An example of this change in understanding is Pluto. Pluto is no longer classified as a planet; instead it has been reclassified as a *dwarf planet*. Why? As telescopes and our space visualisation systems improved, scientists started to identify many (thousands) of objects in orbit past Neptune. While most of these *transneptunian objects* were smaller than Pluto, there were objects in orbit that were significantly larger than Pluto. These discoveries prompted scientists to ask, 'How do we define a planet?'

After much deliberation and consultation, in 2006 the International Astronomical Union (IAU) defined a planet as:

A celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit.

This resolution means that our solar system officially has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. A new class of objects was also decided on – *dwarf planets* – which Pluto belongs to (along with others including Ceres and Eris).

Students may wish to research this decision further. For now, let's appreciate this definition because we only have to memorise 8 planets of our solar system, rather than thousands!

Teacher Answers

Teacher answers for this activity are provided below. There will be some variation in student answers due to inaccuracies while dividing the clay and measuring the size. This is to be expected and can be discussed with the class – students should know that they can be correct without getting the exact same answer.

Students may want to check their answers using the *Exploratorium's Build a Solar System* website. This allows students to input the size of the diameter of the Sun, and the corresponding planet sizes and distances are automatically calculated. This can also be used to help students decide on a more appropriate scale to show distances between the planets.

Curriculum Links

Science

YEAR 5

Science Understanding

The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)

Mathematics

YEAR 5

Number and Algebra

Compare and order common unit fractions and locate and represent them on a number line (ACMNA102)

Investigate strategies to solve problems involving addition and subtraction of fractions with the same denominator (ACMNA103)

Describe, continue and create patterns with fractions, decimals and whole numbers resulting from addition and subtraction (ACMNA107)

YEAR 6

Number and Algebra

Compare fractions with related denominators and locate and represent them on a number line (ACMNA125)

Solve problems involving addition and subtraction of fractions with the same or related denominators (ACMNA126)

Find a simple fraction of a quantity where the result is a whole number, with and without digital technologies (ACMNA127)

Make connections between equivalent fractions, decimals and percentages (ACMNA131)

General Capabilities

Numeracy

Using fractions, decimals, percentages, ratios and rates

Estimating and calculating with whole numbers

Modelling the Solar System

Teacher Answers

1. Measure the diameter of each planet and place in the table below.

Diameter of Planets in the Solar System

Planet	Real-life Diameter (km)	Model Diameter (mm)
Mercury	4879	2
Venus	12 104	5
Earth	12 756	6
Mars	6792	3
Jupiter	142 984	65
Saturn	120 536	53
Uranus	51 118	21
Neptune	49 528	21
*Pluto	2302	1

2. Calculate the scale of your solar system.

a. My planet: Jupiter

b. Divide the real life diameter by the model diameter to find the scale.

$$\frac{\text{real-life diameter}}{\text{model diameter}}$$

$$= \frac{142\ 984\ \text{km}}{65\ \text{mm}}$$

$$= \frac{2200\ \text{km}}{1\ \text{mm}}$$

$$= 1\ \text{mm} = 2200\ \text{km}$$

In the solar system, 1 mm represents 2200 km.

3. How big would the Sun be at this scale?

To find the size of the Sun in mm, divide the real-life diameter by the scale of 2200.

Diameter of the Sun: 1 392 000 km

$$= \frac{1\ 392\ 000}{2200}$$

$$= \frac{632.72}{1}$$

$$= 633\ \text{mm}$$

At this scale, the sun would be 633mm (or 63 cm) in diameter.

4. To create an accurate model the distances should be scaled in the same way as the model planets. Use the table below to determine the distance of each planet from the Sun at this scale.

Planet	Real distance from the sun (km)	Space for working out	Model Distance from Sun		
			mm	cm	m
Mercury	58 000 000	= $\frac{58\,000\,000}{2200}$ = 26 364	26 364	2636.4	26.36
Venus	108 000 000	= $\frac{108\,000\,000}{2200}$ = 49 091	49 091	4909.1	49.09
Earth	149 600 000	= $\frac{149\,600\,000}{2200}$ = 68 000	68 000	6800	68
Mars	227 900 000	= $\frac{227\,900\,000}{2200}$ = 103 591	103 591	10 359.1	103.59
Jupiter	778 600 000	= $\frac{778\,600\,000}{2200}$ = 353 909	353 909	35 390.9	353.91
Saturn	1 433 500 000	= $\frac{1\,433\,500\,000}{2200}$ = 651 591	651 591	65 159.1	651.59
Uranus	2 872 500 000	= $\frac{2\,872\,500\,000}{2200}$ = 1 305 682	1 305 682	130 568.2	1305.68
Neptune	4 495 100 000	= $\frac{4\,495\,100\,000}{2200}$ = 2 043 227	2 043 227	204 322.7	2043.23
*Pluto	5 900 000 000	= $\frac{5\,900\,000\,000}{2200}$ = 2 681 818	2 681 818	268 181.8	2681.81

5. Is this an effective scale to show the distance between planets? Why/why not?

Teacher discretion – it would be difficult to see a model over 2 km!

6. Why do you think Pluto is no longer classified as a planet?

Teacher discretion.

Modelling the Solar System

Student Activity

In this activity you will use fractions to make scale models of the planets of the solar system. Before you begin, predict which planet is the largest and which is the smallest.

*(*Note: Pluto is classified as a dwarf planet, rather than a planet. It has been included in this activity as a comparison to the eight planets in the solar system.)*

Materials

- 500 g modelling clay
- Plastic knife
- Electronic scale
- Paper plate
- Labels for the planets of solar system
- Ruler

Method

1. Divide the clay into tenths.
    a. Use $\frac{3}{5}$ to make Jupiter, and place on label (continue to place planets on labels while working through the activity)
    b. Use $\frac{3}{10}$ to make Saturn
    c. Use the remaining clay $\frac{1}{10}$ in step 2.
2. Divide the remaining clay into tenths.
    a. Add $\frac{1}{2}$ to Saturn
    b. Use $\frac{1}{5}$ to make Neptune
    c. Use $\frac{1}{5}$ to make Uranus
    d. Use the remaining clay $\frac{1}{10}$ in step 3
3. Divide the remaining clay into fourths
    a. Add $\frac{3}{4}$ to Saturn
    b. Use the remaining clay $\frac{1}{4}$ in step 4
4. Divide the remaining clay into tenths
    a. Use $\frac{1}{5}$ to make Earth
    b. Use $\frac{1}{5}$ to make Venus
    c. Add $\frac{2}{5}$ to Uranus
    d. Combine the remaining clay $\frac{1}{5}$ to use in step 5

5. Divide the remaining clay into tenths
    a. Use $\frac{1}{10}$ to make Mars
    b. Add $\frac{2}{5}$ to Neptune
    c. Add $\frac{2}{5}$ to Uranus
    d. Use the remaining clay $\frac{1}{10}$ in step 6
6. Divide the remaining clay into tenths
    a. Use $\frac{7}{10}$ to make Mercury
    b. Add $\frac{1}{5}$ to Uranus
    c. Use remaining clay $\frac{1}{10}$ in step 7
7. Divide the remaining clay into tenths
    a. Add $\frac{9}{10}$ to Mercury
    b. Use the remaining clay $\frac{1}{10}$ to make Pluto

Questions

1. Measure the diameter of each planet and place in the table below.

Diameter of Planets in the Solar System

Planet	Real-life Diameter (km)	Model Diameter (mm)
Mercury	4879	
Venus	12 104	
Earth	12 756	
Mars	6792	
Jupiter	142 984	
Saturn	120 536	
Uranus	51 118	
Neptune	49 528	
*Pluto	2302	

2. Calculate the scale of your solar system.

   a. My planet: ☐

   b. Divide the real life diameter by the model diameter to find the scale.

$$\frac{\text{real-life diameter}}{\text{model diameter}}$$

$$= \frac{\square}{\square}$$

$$= \frac{\square}{\square}$$

$$= \square$$

In the solar system model, ☐ represents ☐

3. How big would the Sun be at this scale?

To find the size of the Sun in mm, divide the real-life diameter by the scale of ☐

Diameter of the Sun: 1 392 000 km

$$= \frac{\square}{\square}$$

$$= \frac{\square}{\square}$$

$$= \square$$

At this scale, the Sun would be ☐ in diameter.

4. To create an accurate model the distances should be scaled in the same way as the planets. Use the table below to determine the distance of each planet from the Sun at this scale.

Planet	Real distance from the sun (km)	Space for working out	Model Distance from Sun		
			mm	cm	m
Mercury	58 000 000				
Venus	108 000 000				
Earth	149 600 000				
Mars	227 900 000				
Jupiter	778 600 000				
Saturn	1 433 500 000				
Uranus	2 872 500 000				
Neptune	4 495 100 000				
*Pluto	5 900 000 000				

5. Is this an effective scale to show the distance between planets? Why/why not?

6. Why do you think Pluto is no longer classified as a planet?