



# Volume: Counting Stars

## Key Learning Content

This film tackles the question of how many stars there are in the universe, by first asking how many grains of sand there are on a beach. The total volume of a beach is calculated using length  $\times$  width  $\times$  depth. Then the number of grains of sand in a small sample is counted, and the answer scaled up for the beach as a whole. For stars, the sample is a galaxy. The number of stars in our galaxy is counted, and then the number scaled up for the total number of galaxies, to arrive at a truly remarkable answer.



Knowledge of standard form would be useful prior to watching the film.

### Core Outcomes

#### Learning Points

- Be able to make sensible estimates of a range of measures.
- Be able to find the surface area of simple shapes using the area formulae for triangles and rectangles.
- Be able to find the volume of right prisms, including cuboids and cylinders, using an appropriate formula.

#### Suggested Activities

- Estimate the number of grains of rice in a 1kg packet of rice.
- Estimate the number of grains of salt in a 500g packet of salt.
- Estimate the number of grains of sugar in a 1kg packet of flour.

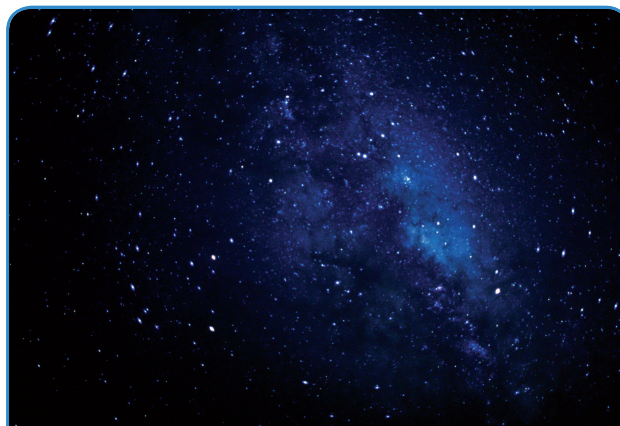
### Extension Outcomes

#### Learning Points

- Be able to use index notation and index laws for multiplication and division of positive integer powers.
- Be able to express numbers in the form  $a \times 10^n$  where  $n$  is an integer and  $1 \leq a < 10$ .
- Be able to solve problems involving standard form.

#### Suggested Activities

- Imagine you had your own observatory in the form of a 10m diameter glass hemisphere. Work out how many stars lay behind a  $1\text{cm}^2$  box on the surface of the hemisphere.
- Point at the night sky with a stick with a  $1\text{mm}^2$  tip. How many stars are you pointing to?



It is thought that the Universe holds up to 400 billion galaxies.

**Related Films**



To use before the lesson plan:

**The Emperor's Chess Board**

This film introduces exponentials, or powers, using the story of the Chinese emperor who wanted to reward the inventor of the game of chess.

**Counting Crowds**

This film explains how it is possible to work out how many people are present when there are too many to count.

To use after the lesson plan:

**Speed of the Earth**

This film shows how to calculate the average speed with which the Earth moves round the Sun by simplifying assumptions about its motion.

**Measuring the Earth**

This film tells the story of how an 11th century Persian scholar calculated the circumference of the Earth by using a mountain and trigonometry.

**What Does the Internet Weigh?**

This film shows how standard form can be used to establish the 'weight' of the internet.

**Guide Lesson Plan**

**Introduction**

In the previous lesson set a homework task to count the number of stars visible in the night sky. At the beginning of this lesson, collect and compare answers, then ask if anyone looked up how many stars there are in total?

**Show Film**



**Volume: Counting Stars**

**Main Activity**

**Foundation**

Provide, or get students to bring in, uniformly shaped packets of rice, salt, sugar, flour or similar granular foodstuffs. Using stiff card and sticky tape, get students to cut out and make open-topped,  $1\text{cm}^3$  containers. Measure out  $1\text{cm}^3$  of each foodstuff and count it as carefully as possible. Then calculate the volume of the container in  $\text{cm}^3$  and scale up answers to arrive at an estimated number of grains in the packet. Compare estimates for the same packets.

**Main Activity cont ...**

**Advanced**

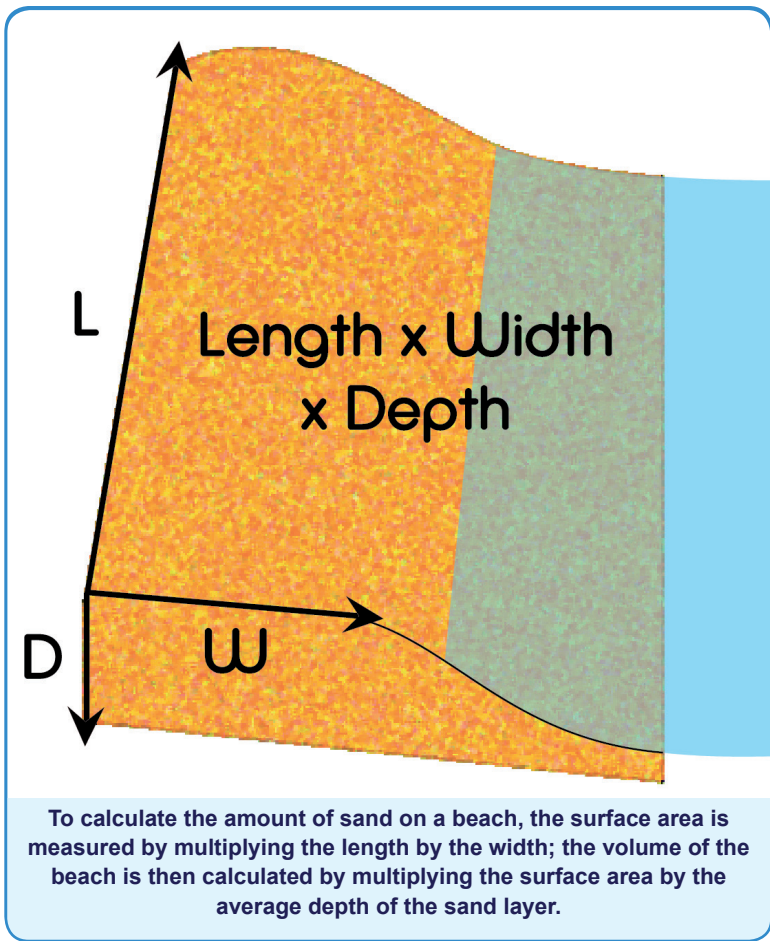
Use the estimate in the film for the number of stars in the universe to work out how many stars lie within a certain area of the night sky. Imagine standing inside a glass hemisphere and looking out to the stars. Work out the surface area of the hemisphere using the standard formula. Divide the appropriate number of stars by the surface area to get the number of stars per unit area. How small an area would you have to restrict your viewing to, to expect to see just a single star?

**Extension Activity**

The 'counting grains' approach to estimation is intuitive but may not always be the most sensible way to approach a problem, particularly if, as with flour, the grains are very small. Explore alternative ways of making the estimate, for example by using a microscope to work out the dimensions of a single grain, or by looking up the manufacturer's specification for the product. Award a prize for the most ingenious method of counting grains of flour.

**Optional Extra**

Get students to estimate how many cells there are in the human body. (Award marks for method, not the answer.)



To calculate the amount of sand on a beach, the surface area is measured by multiplying the length by the width; the volume of the beach is then calculated by multiplying the surface area by the average depth of the sand layer.