



MATHEMATICS IN CAREERS

Investigation - Cell sizes

Key career focus for this investigation: Biologist, zoologist, environmental scientist

Related career areas: Health and biological sciences



THINKING ABOUT CAREERS

- Brainstorm biological sciences professions you can think of where maths is frequently used. Use <https://joboutlook.gov.au> to explore biological sciences related career pathways that include use of mathematics. *How is maths used in these scenarios? What maths is used in these scenarios?*
- This task focuses on how maths is used in biology through investigating cell size.
- The tasks specifically looks the surface area of cells and how this impacts on passive diffusion of materials through the cell wall.
- Explore careers such as biologists, zoologist, research scientists to discover how maths is used in these. For a more extensive list of careers related to this task, with a maths/science focus, refer to the table at the end of the task and explore the maths used in these jobs.

MATHEMATICS IN EVERYDAY LIFE AND CAREERS

Mathematical focus for this investigation

- Using formulas to solve problems.
- Re-arranging expressions to make a specified variable the subject.
- Using authentic situations to apply knowledge and understanding of surface area and volume

Scientists including health professionals use various measurement formulas. They apply their knowledge and understanding of surface area and volume to see the relationship between volume and surface area, in various situations. In this case specifically looking at size of cells and the effect on surface area if volume increases.

- Many people use various measurement formulae every day. For example, they do the area calculations in their head to calculate carpeting or tiling floor surface.
- Brainstorm and share scenarios where this mathematics may be used in health and biological sciences to solve problems.

MATHEMATICAL INVESTIGATION

CELL SIZES

INVESTIGATION BACKGROUND

There is a physical limitation to the maximum size of cells. This is due to the surface area of the cell to allow for passive diffusion of materials through the cell wall. What is the relationship between volume and surface area that may limit this? Given,

- A cell has a spherical volume, and that it generates waste at a rate of a molecules per cubic micron per second.
- It removes the waste through its surface by passive diffusion at a rate of b molecules per square micron per second, where 1 micron is 0.000001 metres.

YOUR INVESTIGATION

You will need to create a model: recognising that there is a stable relationship between surface area and volume.

Note:

- The cell has spherical volume.
- The cell removes waste through its surface.

PART 1

Find the equation that defines the rate, R , at which the organism changes the amount of its net waste products.

PART 2

Derive the equation to describe a relationship where the value for the cell's radius will have a net change of zero, meaning that the cell is in equilibrium. (hint: $R = 0$)

PART 3

What is the relationship between volume increase and surface area of a sphere?



MATHEMATICAL INVESTIGATION

CELL SIZES

CAREERS RELATED TO THIS INVESTIGATION

BIOMEDICAL SCIENCE

Career description	Key skills required	More information
<p>Biomedical science is the study of physiology, pathology and pharmacology. It is a wide area of study with careers that vary from a sales representative for a pharmaceutical company to a toxicologist helping investigate a crime. Some examples:</p> <ul style="list-style-type: none"> • Biotechnologist • Biomedical lab technician • Biomedical researcher • Clinical scientist <p>Research scientist - plans and conducts experiments in order to gain new data. They then analyse and interpret this data and present it to research staff. A research scientist with a biomedical degree will specialise in topics such as stem cells or pharmacology.</p>	<ul style="list-style-type: none"> • Analysis and representation of data • Reasoning and problem solving • Scientific method • Teamwork and communication • Biological and chemical knowledge 	<p>https://careerswithstem.com.au/science-careers-list/</p> <p>https://www.open.edu.au/advice/careers/science/biologist</p>

BIOLOGIST AND BIOLOGY RESEARCHER

Career description	Key skills required	More information
<ul style="list-style-type: none"> • Investigates the biochemistry, anatomy and physiology of living organisms such as humans, animals and plants and their relationship with the environment. • Examines the effects of environmental factors on plants. • Liaises with other industry professional to apply the research results and develop new products or practices. • Observes the development of micro-organisms and the effects they have on living organisms. • Plans and conducts experiments and process and analyse results and data. • Writes up scientific reports and present to the scientific community at conferences or via published papers in scientific journals. 	<ul style="list-style-type: none"> • Teamwork and communication • Biological and chemical knowledge 	<p>https://careerswithstem.com.au/profiles/phd-preacher/</p>

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CAREERS RELATED TO THIS INVESTIGATION

ZOOLOGIST

Career description	Key skills required	More information
<p>A zoologist studies the origins, genetics, diseases, life progression, and behaviors of animals. A zoologist works on preserving natural habitats, protecting endangered species, and managing wildlife's adjustment to our ever-changing climate.</p> <ul style="list-style-type: none"> • Designs and conducts experiments to gather information on living organisms • Examine bacteria, fungi, cells, and other microscopic organisms, for information on larger plants and animals • Observe animals and humans in natural habitats and record their findings • Teach classes on zoology or other forms of science • Provide advice to locations where animals are kept in captivity, such as zoos 	<ul style="list-style-type: none"> • Scientific method • Communication 	<p>https://www.careerexplorer.com/careers/zoologist/</p>

ENVIRONMENTAL SCIENTIST

Career description	Key skills required	More information
<ul style="list-style-type: none"> • Develop and implement suggestions and advice to ensure an environmentally sustainable future. • Educate others about the need for conservation and environmentally sound practices and policies. • Take inventory of plants and animals to inform environmental policy. • Study and evaluate current environmental problems. • Work on conservation and sustainability to ensure a healthy and robust environment. 	<ul style="list-style-type: none"> • Scientific method • Communication 	<p>https://careerswithstem.com.au/profiles/mikaela-jade/</p>

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OTHER RELATED CAREERS TO EXPLORE

- | | |
|--|---|
| <ul style="list-style-type: none"> • Biochemist • Botanist • Cell biologist • Marine biologist | <ul style="list-style-type: none"> • Microbiologist • Physiologist • Pathologist |
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CAREERS ACTIVITIES

THE 10 BEST RATED JOBS OF 2021

Rank	Career	Median salary	Projected growth
1	Data Scientist	\$98 230	33%
2	Genetic Counsellor	\$85 700	21%
3	Statistician	\$92 270	35%
4	Medical Services Manager	\$104 280	32%
5	Mathematician	\$110 860	33%
6	University Professor	\$80 790	9%
7	Operations Research Analyst	\$86 200	25%
8	Information Security Analyst	\$99 730	31%
9	Actuary	\$111 030	18%
10	Software Engineer	\$110 140	22%

Data from [Careercast.com](https://www.careercast.com).

Select one of the careers, from either of the tables above, that interests you and find out:

- What are the tasks involved in this career? What may a typical day look like?
- What level of education or qualifications do you need to do this career?
- What are some other similar or related careers?
- What mathematics skills would be used in this career?
- Where does the career you have selected, to investigate, rank according to careercast.com?
- How many people in Australia are currently employed in this career (or field)?

INDUSTRY PARTNERS

This project was produced collaboratively between [The Mathematical Association of Victoria \(MAV\)](https://www.maths.vic.edu.au) and the [Victorian Space Science Centre \(VSSEC\)](https://www.vic.gov.au/vssec).

The Victorian Space Science Education Centre (VSSEC) is a specialist STEM learning facility, one of six established by the Victorian State Government. Since its official opening in 2006, VSSEC has used the context of space to enhance the learning experiences in Mathematics, Science, Technology and Engineering for both teachers and students. VSSEC is located in the grounds of Strathmore Secondary College. The spiral galaxy shaped building provides a stimulating environment which encourages students to be fully engaged in problem-solving and scenario-based learning. www.vssec.vic.edu.au

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FURTHER CAREER REFERENCES

Australian Jobs Report 2021

www.nationalskillscommission.gov.au/australian-jobs-report

An overview of trends in the Australian labour market to support job seekers and employment service providers, career advisers, those considering future training and people interested in labour market issues.

Business Victoria Future Industries

<https://business.vic.gov.au/grants-and-programs/future-industries>

Future Industries is about supporting investment in high-growth industries through industry excellence and development projects, including establishing collaborative networks and building supply chain readiness capabilities.

Career Education

www.education.vic.gov.au/school/teachers/teachingresources/careers/Pages/default.aspx

Career Education teaching resources to help teach students to make informed career decisions and equip themselves for the world of work.

CEAV Online Learning Resources

<https://ceav.vic.edu.au/media/250615/careers-in-the-construction-technology-industries-student-resource.pdf>

Designed to enable students to attend a virtual Industry Immersion Experience, these online resources will help students discover more about Victoria's priority growth industries and give them the opportunity to reflect on their skills, interests and undertake career planning and exploration.

Jobs Victoria

www.jobs.vic.gov.au

JobOutlook

www.joboutlook.gov.au

Relevant and current labour market trends and career information.

MyFuture

www.myfuture.edu.au

A database of over 600 careers.

National Careers Institute

www.dese.gov.au/nci

The National Careers Institute (NCI) ensures Australians have access to reliable and accurate careers information, resources, and support.