SCIENCE

Lesson 8

Year 8

Topic: Understanding the nature of the cell

Evaluating cell theory

Today you will:

- evaluate the validity of original cell theory using key historical findings
- outline scientific work that has helped to shape the development of cell theory.

Resources

Digital

Slideshow — The history of the microscope and its impact on cell biology

Find and prepare

Sheet 5 — Cell theory

Sheet 6 — The work of Remak, Virchow and Pasteur

Sheet 7 — Studying cells: Microscopy

Exercise book

Key terms

cell theory, evidence, validity

For definitions and explanations of terms, please see the Glossary.

Science start-up

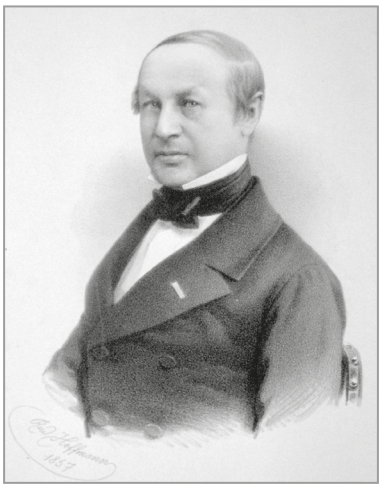
Reflect on the views of scientists

Historical scientists who first observed cells under the microscope used their observations to devise theories about the nature of the cell. Two of those scientists were Matthias Schleiden (1804–1881) and Theodor Schwann (1810–1882). Because of their ground-breaking work in cell biology, modern science recognises them as instrumental in the development of **cell theory**. **Cell theory** outlines the fundamental role of the cell as the structural unit of organisms. Schleiden was the first scientist to formalise cell theory into three main tenets or principles:

1. All living things are composed of cells.
2. The cell is the basic unit of life.
3. Cells form from free-cell formation, similar to the formation of crystals (that is, by spontaneous generation).



Matthias Jacob Schleiden, 1855 https://commons.wikimedia.org/wiki/File:Matthias_Jacob_Schleiden.jpg



Geymayer, P, *Theodor Schwann (1810–1882), Lithographie von Rudolf Hoffmann, 1857*, https://commons.wikimedia.org/wiki/File:Theodor_Schwann_Litho.jpg

1. Open the **Slideshow — The history of the microscope and its impact on cell biology** and review the work of these two scientists.



Slideshow

   a. What part/s of historical cell theory did Schleiden and Schwann agree on?

   b. What part/s of historical cell theory did Schleiden and Schwann disagree on?

   c. Both scientists used microscopic investigation to make and record observations and develop their ideas about cells, so why didn't they agree with each other on every aspect of cell theory?

In this lesson, you will consider the validity of the claims made by Schwann and Schleiden based on their own research, later research and your own observations. You will also reflect on how modern microscopy is helping to further our understanding of cell theory.

Lesson

Evaluate the scientific work of historical figures

2. Think about the observations you have made in your study of microscopic organisms and cells so far. What ideas about the nature of the cell have you developed from your observations?

You are now going to use your own observations, plus the observations made by Schwann and Schleiden to evaluate the validity of their ideas about the nature of the cell. Recall from previous lessons that **validity** refers to the extent to which data, inferences and actions produced from tests and other processes are accurate.

Test results, data and inferences have greater validity if repeated scientific investigation consistently results in the same outcomes.

3. Complete the following table, providing observational evidence from your own experience and from the research of Schwann and/or Schleiden in support of each tenet, wherever possible.

Tenet of historical cell theory	Schleiden's evidence	Schwann's evidence	My evidence
All living things are composed of cells.			

Tenet of historical cell theory	Schleiden's evidence	Schwann's evidence	My evidence
The cell is the basic unit of life.			
Cells form from free-cell formation (spontaneous generation).			
Cells form from materials inside pre-existing cells.			

4. Given the evidence you've provided in the table above, which tenets (principle or belief) of historical cell theory do you consider to be the least valid? Justify your choice.

Examine historical evidence of cell formation

The belief that organisms and cells formed from non-living molecules through 'spontaneous generation' had a long history. It aligned with people's religious beliefs and general understanding of their everyday experiences without being tested scientifically for its validity. For example, in the cities, where rats were a problem, people thought the garbage and sewage thrown in the streets turned into the rats. This led to some interesting 'recipes', such as one for mice: wheat husks and sweaty clothes placed in an open-mouthed jar for 21 days will develop into mice as a result of the sweat penetrating the husks. It also answered the question of how the very first living cell formed; a question that modern biologists are still grappling with.

If you're interested in reading more of these historical ideas and you have internet access, go to the **Website — Spontaneous generation** (DB Frankhauser and J Stein Carter) http://faculty.sdmiramar.edu/dtrubovitz/micro/history/Spontaneousgen.html#background

Scientists at the time were reluctant to challenge this belief, despite growing evidence. Schwann himself is reported to have written that new cells formed from the crystallisation of non-living material inside a cell, despite his observations of cell development from embryo stages to adult tissues and his experiments with sterilised broth.

It was not until the mid- to late-1800s that evidence from scientific investigation of cell formation was finally accepted as validation for the theory that new cells originate from pre-existing cells.

5. You are now going to examine the work of historical scientists responsible for collecting this evidence in the further development of cell theory.
6. Open and read through **Sheet 5 —** Cell theory.
7. Open **Sheet 6 —** The work of Remak, Virchow and Pasteur and **Sheet 7 —** Studying cells: Microscopy. These sheets will help you answer the questions on **Sheet 5**. Keep these sheets open to use in the last section of the lesson.
8. Complete and keep **Sheet 5**. Your teacher may ask you to send it in for marking.

Build on historical ideas about cells

From the moment scientists first asked questions about the microscopic world they have strived to invent technologies capable of magnifying smaller and smaller objects. It is incredible to think that early scientists hypothesised and modelled, often accurately, the function of cell organelles long before they had access to the technology and techniques that would provide them with the evidence they needed. With the technologies available to modern scientists, the theories put forward by these early scientists can finally be validated. Currently, the world's most powerful microscopes are capable of viewing structures as small as the components of single atoms. This means there is virtually no cellular structure that can't be observed.

9. **Sheet 7** lists a number of investigable questions that the microscopic study of cells has helped answer over the last 200+ years. Use the information provided on **Sheet 7** to answer the following questions.

   a. Identify one question that requires an investigation into the relationship between cell structure and function.

   b. Explain how investigating an answer to the question would lead to a greater understanding of cell structure and function.

   c. How might scientists have gone about investigating this question?
   (**Hint:** Refer to techniques described on **Sheet 7**.)