

**Read the descriptions of beliefs about and experiments on spontaneous generation, then answer the analysis questions that follow.**

- The invention of the microscope in the sixteenth century allows people to see single-celled organisms (microorganisms). The discovery of micro-organisms leads supporters of the spontaneous generation hypothesis to modify their original assumptions. They argue that small organisms, such as snakes, frogs, and flies, are too complex to be created through spontaneous generation. However, simpler living things, such as the recently discovered micro-organisms, arise spontaneously.
- In 1748, an English naturalist and priest, John Needham (1713–1781), designs an experiment to support the idea of spontaneous generation. He brings meat broth to a boil for a short time to kill off micro-organisms in it and then transfers it to a sealed flask. He leaves a second flask with boiled broth open. Within days, the broth in both flasks is teeming with micro-organisms. Needham reports his findings as evidence in favour of spontaneous generation.
- An Italian biologist, Lazzaro Spallanzani (1729–1799), learns of Needham’s experiment and is skeptical of his results and conclusions. Spallanzani repeats the experiment in 1753, but boils the broth for a longer time. No life appears in the sealed flask. Supporters of the spontaneous generation hypothesis claim that boiling killed a vital principle contained in air. This vital principle, they argue, is what is responsible for life arising from non-living matter.
- Pasteur uses heat to kill off micro-organisms in a flask in 1862. He then conducts an experiment with S-necked flasks to show that, even in the presence of air, micro-organisms do not arise in heat-treated broth.
- In 1953, scientists Harold Urey and Stanley Miller mix water, methane, hydrogen, and ammonia and subject the mixture of non-living matter to electric discharges to simulate lightning. This experiment results in the spontaneous production of organic chemicals that are components of all living cells.

**1.** Draw a flowchart to show how each piece of evidence *against* spontaneous generation was put into question by supporters of the idea of spontaneous generation.

**2.** Identify any flaws in Needham’s experiment that would have influenced his results.

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**3.** How did Pasteur’s experiment address claims that Spallanzani destroyed a vital force required for life when he sealed his experimental container?

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**4.** In what way do Urey and Miller’s experimental results affect the biogenesis-abiogenesis controversy?

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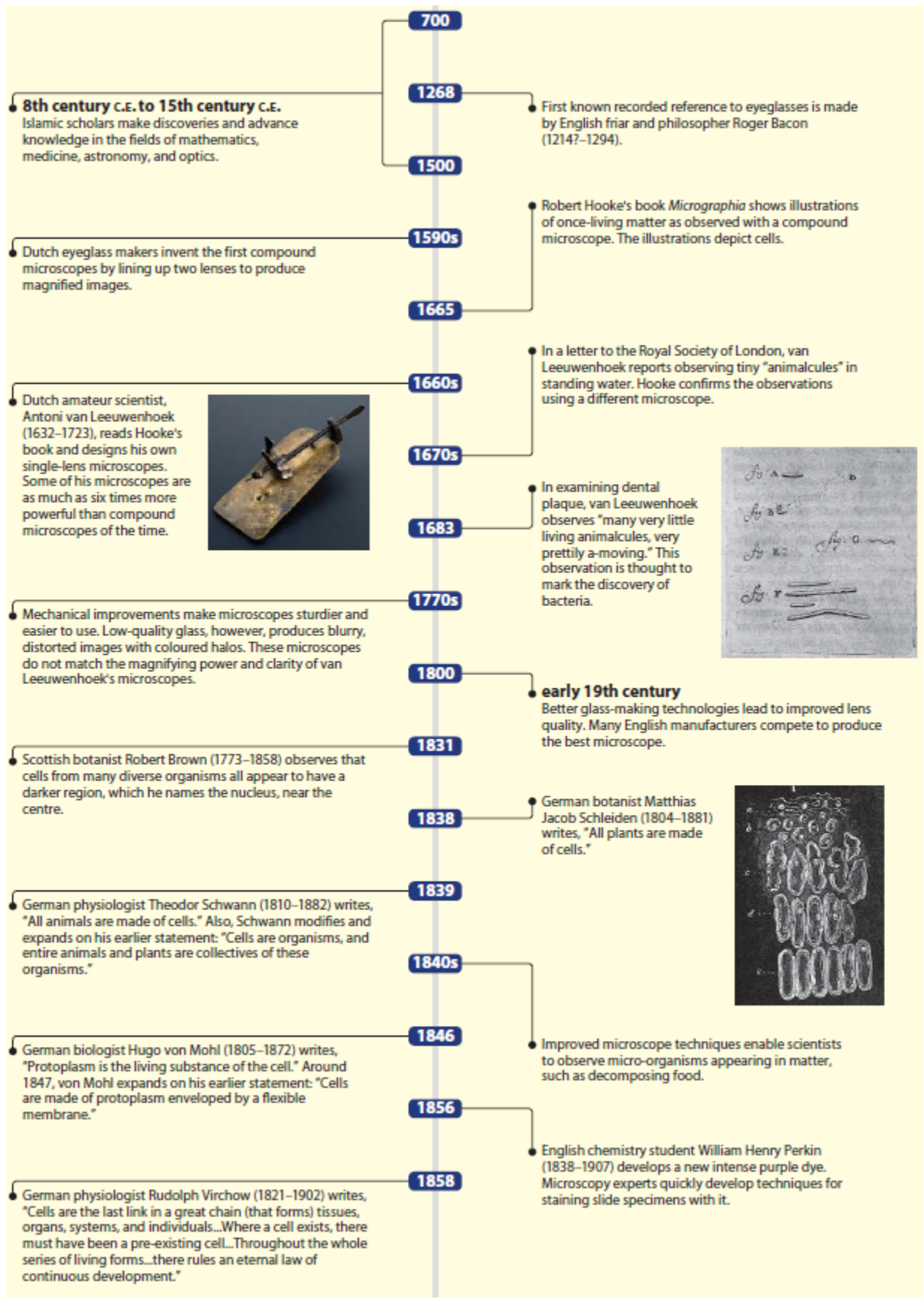
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Each time there was advancement in \_\_\_\_\_ a new discovery was made with regards to cells.