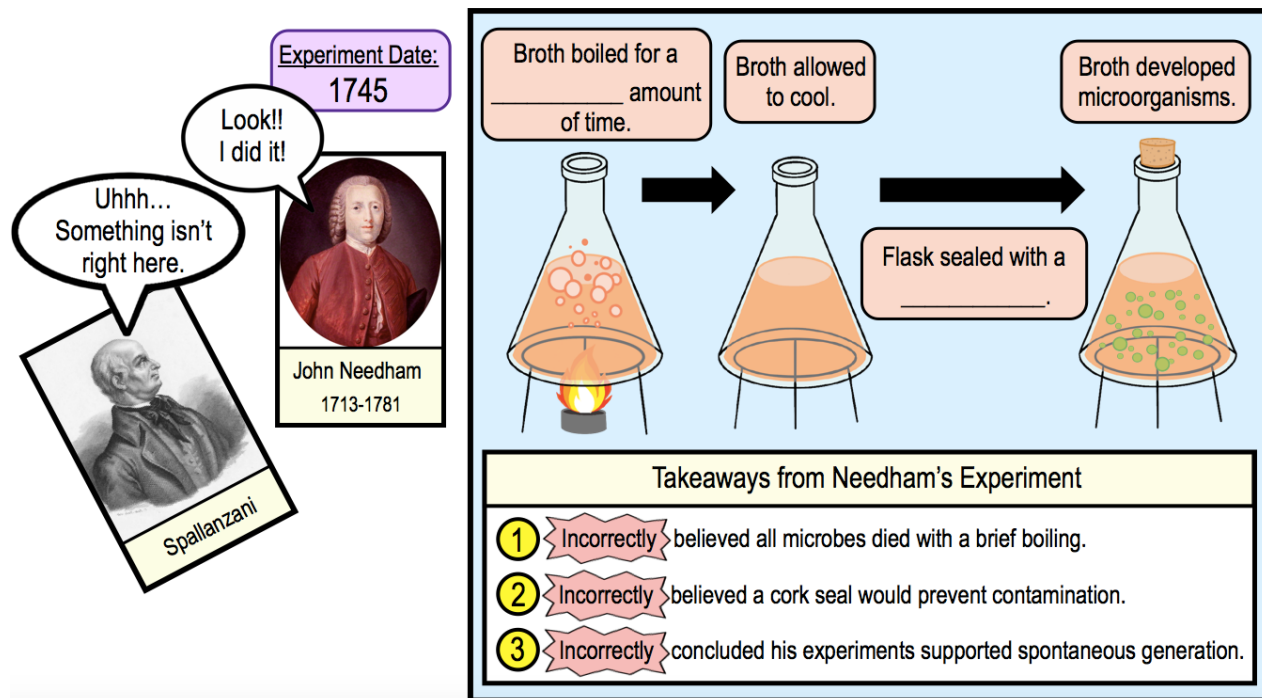


CONCEPT: NEEDHAM VS. SPALLANZANI

Needham's Results Incorrectly Supported Spontaneous Generation

- John _____: scientist & priest who tried to experimentally _____ *spontaneous generation*.
 - Had *poor* experimental setup & *incorrectly* believed that _____ *boiling* a *broth* would **sterilize** it.
 - **Sterilization**: process of killing _____ microbes in a sample.
- **Results**: after *briefly* boiling a flask of broth, allowing it to cool & sealing it with a cork, Needham saw *microbial growth*.
- **Conclusion**: Needham _____ concluded that his “sterile” flask of broth spontaneously generated microbes.

EXAMPLE: Poor Experimental Setup Led Needham to Incorrectly Support Spontaneous Generation of Microbes.



- It was not until 1776 that the scientist, Lazzaro Spallanzani, performed a set of experiments to *contradict* these findings.

PRACTICE: Which of the following cannot be an explanation of the microorganisms present in Needham's flasks?

- The microorganisms could have entered his flask after it was boiled and before it was sealed properly.
- Microorganisms had developed spontaneously from the molecules in the broth when it was cooled.
- He did not boil his broth for a long enough time to completely kill all of the microorganisms.
- The cork that he used was porous and allowed microorganisms to enter the sealed flask.

PRACTICE: Which of the following individuals argued in favor of the theory of spontaneous generation?

- Francesco Redi.
- John Needham.
- Isaac Newton.
- Louis Pasteur.
- Lazzaro Spallanzani.

CONCEPT: NEEDHAM VS. SPALLANZANI

Spallanzani's Results Disproved Spontaneous Generation

● **Lazzaro** _____: Italian physiologist who performed experiments that *contradicted* Needham's results.

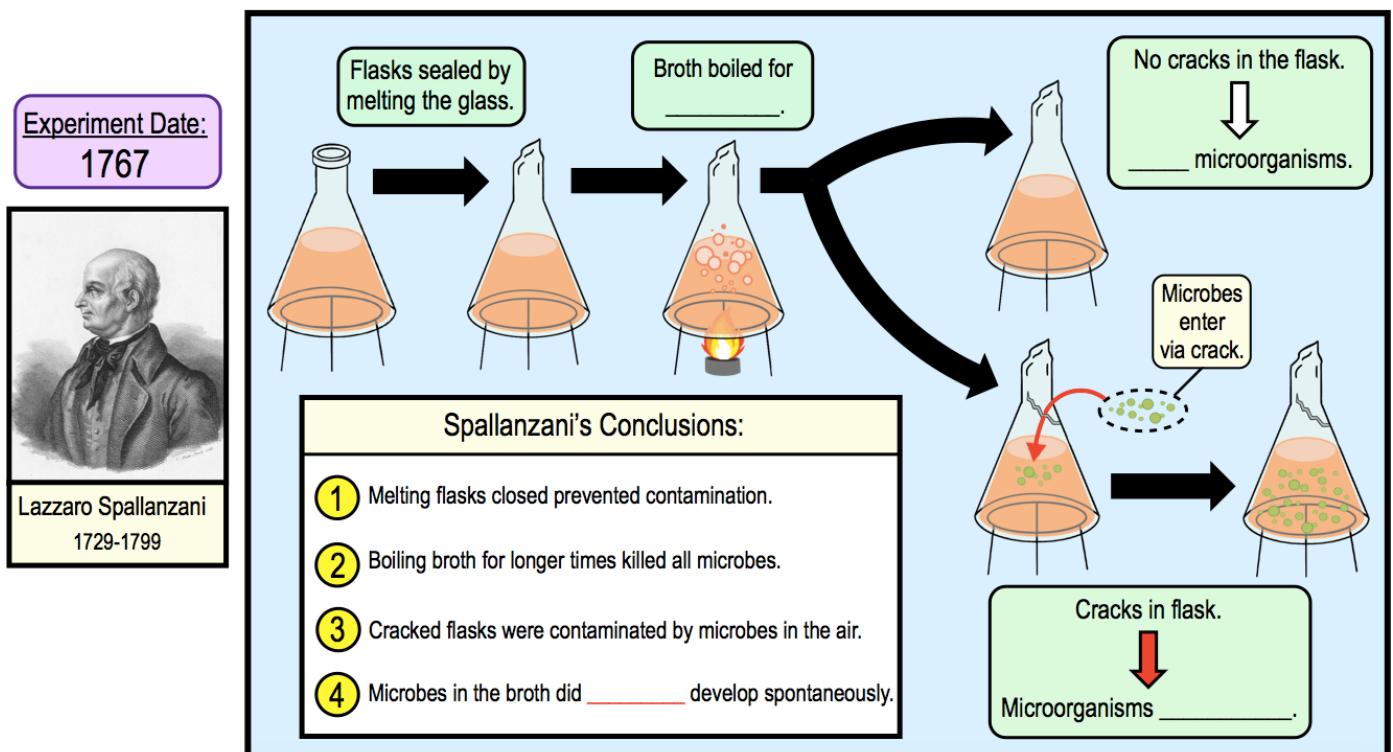
□ Proposed that Needham's experiment was *flawed* & that organisms do _____ *spontaneously generate*.

● Spallanzani _____ flask by *melting it closed* & then boiled broth for a _____ period of time.

● **Results:** Spallanzani _____ saw microbial growth in sealed flasks; only saw growth in flasks that were *cracked*.

● **Conclusion:** microbes do _____ *spontaneously generate*; *cracked* flasks allowed microbes to enter from the air.

EXAMPLE: Spallanzani's Experiment Disproved Spontaneous Generation of Microbes.



● Opposers claimed Spallanzani's sealed flasks excluded a "vital source" that was needed for spontaneous generation.

PRACTICE: Spallanzani set out to disprove spontaneous generation by, however his findings were not accepted by all.

Why did some scientists disprove his findings?

- He did not boil the broth for long enough.
- He boiled the broth too long, killing the "vital source" that some believed was needed for spontaneous generation.
- He used the wrong type of flask and cork to seal his flask.
- He did not allow air in the flask which some believed was needed for spontaneous generation.
- A and C.
- B and D.

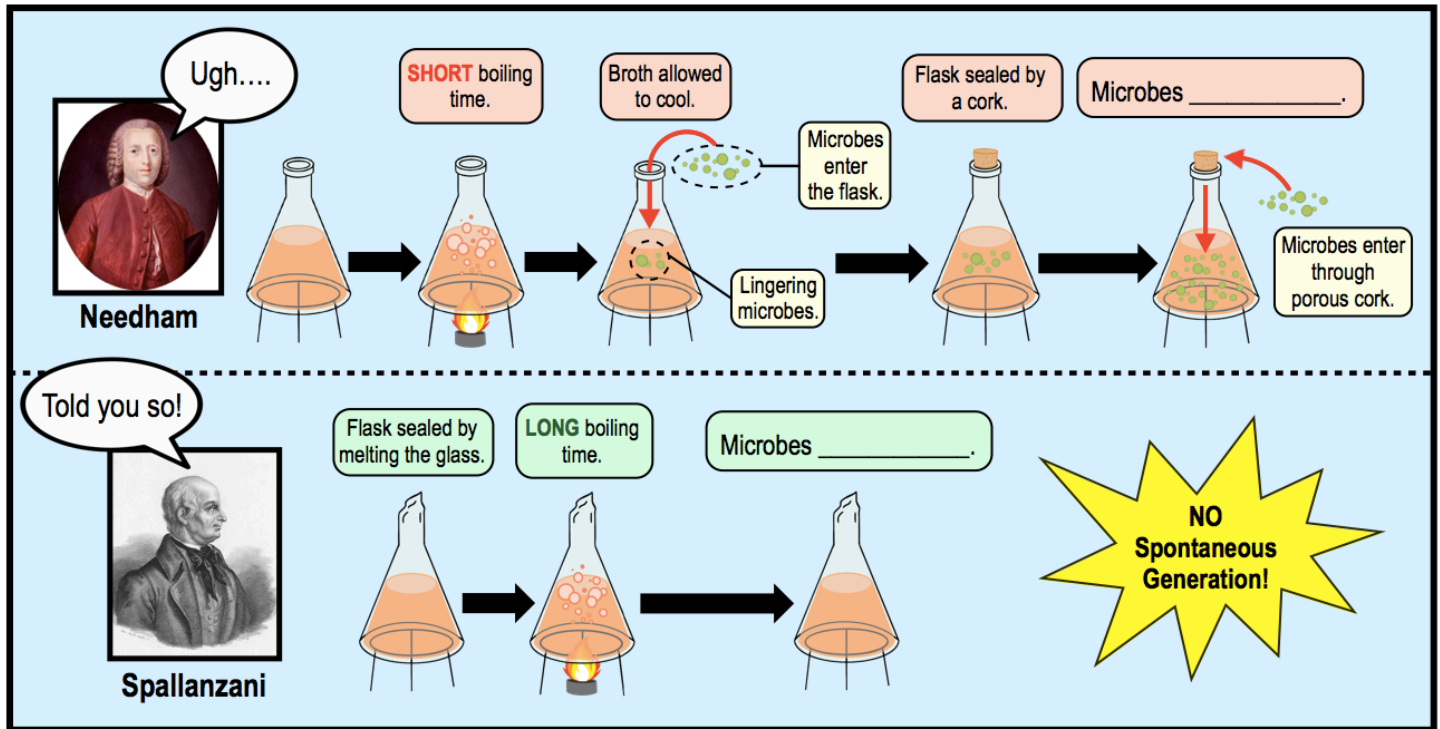
CONCEPT: NEEDHAM VS. SPALLANZANI

Needham vs. Spallanzani Experimental Design

- Spallanzani's experiments differed from Needham's in 2 *significant* ways:

- 1) *Completely* sealed flasks by _____ them before boiling (ensured no microbes entered *after* boiling).
- 2) Boiled the *broths* for a _____ period of time (ensured that ALL microbes were killed by heat).

EXAMPLE: Needham's vs. Spallanzani's Experiments.



- Some people still remained *skeptical* of biogenesis, even after Spallanzani's experiment.
- Almost 100 years later, Louis Pasteur confirmed Spallanzani's findings using a simple experiment with a custom flask.

PRACTICE: Needham performed an experiment by boiling chicken broth, placing it in a sterile flask, and then sealing the flask. After a few days, he observed microorganism growth in the flask. What was the major flaw of his experiment?

- a) Boiling the broth activated dormant microorganisms that were not present before boiling.
- b) Melting the flasks closed did not allow fresh air to interact with the broth, stopping microorganisms from developing.
- c) Needham boiled the broth too long, killing the "vital source" needed to develop microorganisms.
- d) He did not boil the broth long enough to kill all microorganisms and he did not seal the flask properly.

The flasks he used were cracked, and microorganisms from the air contaminated the broth.