ADAPTATIONS IN BACTERIA

The breaking down of food to release energy is cellular respiration. Many bacteria require oxygen for respiration. These bacteria are called obligate aerobes. *Mycobacterium tuberculosis* cases tuberculosis, a lung disease, and is an obligate aerobe. There are other bacteria that are killed by oxygen, obligate anaerobes. *Clostridium botulinum*, an obligate anaerobe, causes food poisoning known as botulism. There are other bacteria that can live either with or without oxygen, releasing the energy in food aerobically by cellular respiration or anaerobically by fermentation. Consider those bacteria that are obligate anaerobes.

Some bacteria produce endospores under unfavorable environmental conditions. An endospore is a tiny structure that contains the DNA and small amount of the bacterium’s cytoplasm. It is encased by a tough outer covering that resists drying out, temperature extremes, and harsh chemicals. The bacterium rests and does not reproduce while in the form of an endospore. The endospore germinates when conditions improve. The cell will begin to grow and reproduce. Some endospores have survived thousands of years in the resting state.

Endospores are useful to bacteria, but can cause problems for people. Endospores can survive a temperature of 100 °C, the boiling point of water. Items must be sterilized or heated under high pressure in either a pressure cooker or an autoclave. Under pressure, water will boil at a higher temperature than its usual 100 °C, which kills endospores.

Canned foods must be sterilized and acidified. Endospores of the bacterium, *Clostridium botulinum*, easily get into foods being canned. These bacteria belong to the group clostridia, all obligate anaerobic bacteria that form endospores. They can germinate in improperly sterilized canned food. The can provides an anaerobic environment and the bacteria produce a powerful and deadly poison, toxin. This deadly toxin saturates the food and when eaten, causes the disease called botulism. It can results in respiratory failure if ingested by humans. It can be fatal, although boiling the food for 5-10 minutes will destroy the bacteria.
Clostridium botulinum spores on the skin of a potato can survive in a foil-wrapped baked potato. If the potato is eaten immediately, the spores can’t germinate. If the still-wrapped potato cools at room temperature, the spores can germinate in the anaerobic environment of the foil, and the bacteria will produce their deadly toxin. Don’t eat the room-cooled potato, or make sure it is unwrapped before cooling.

Clostridium tetani, produces a powerful nerve toxin the causes tetanus, which is often fatal. Endospores of Clostridium tetani can be found almost everywhere. They enter wounds. Since deep wounds and puncture wounds are hard to clean, they provide an environment for the growth of anaerobes. The endospores germinate and the bacteria grow and produce a toxin. The blood carries the toxin to verve cells in the spinal cord. There is an immunization for tetanus that you received as a child. Booster shots are given very ten years or immediately after receiving a puncture wound or are seriously injured.

Define the following terms.
(Use Chapter 18 in your book for help.)

Obligate anaerobe

Endospore

Anaerobic conditions

Germinate

Toxin
Hypothesizing
Can you get food poisoning from eating home-canned foods?

Analysis
*Clostridium botulinum* is a bacterial species that causes food poisoning. It is an obligate anaerobic soil bacterium, and it easily spreads onto plants. It forms endospores that are highly heat-resistant and germinate only in anaerobic conditions. The bacterium produces a heat-resistant toxin that can kill humans. Commercially canned food is heated to 121 °C for a minimum of 20 minutes to ensure that all spores are killed.

Thinking Critically
1. Hypothesize why you don’t get food poisoning if you eat fresh vegetables that are contaminated with endospores of *Clostridium botulinum*.

2. Hypothesize how the endospores of *Clostridium botulinum* get into home-canned vegetables.

3. Hypothesize how *Clostridium botulinum* endospores can survive inadequate home-canning procedures.

4. Explain why endospores of *Clostridium botulinum* germinate inside canning jars.