Investigating the History of Biotechnology
Stations and Questions

Station 1: 1920s (Penicillin)

Commentary: In the 1920s Alexander Fleming accidently discovered penicillin, a powerful antibiotic that is used to treat bacterial infections. Penicillin is derived from fungi. Prior to the 1920s, even minor bacterial infections were deadly. While penicillin was instrumental in treating diseases, such as strep throat, by end of the 1940s bacteria resistance to the drug began to occur.

Questions:

1. What is an antibiotic?
2. Which organism can antibiotics be used to kill?
3. How does an antibiotic differ from a vaccine?

Station 2: 1950s (Eradicating Polio)

Commentary: Poliomyelitis is an infectious crippling disease that is caused by a virus. In the early 1900s, many people, especially children, were left paralyzed as a result of being infected. Some even ended up spending their life in an iron lung. In the 1950s Dr. Jonas Salk developed the polio vaccine, which has nearly eradicated polio in the US.

Questions:

1. What is a vaccine?
2. What role do vaccines play in preventing and treating diseases?
3. Name three diseases that have vaccines.
4. How have vaccines improved human health?

Station 3: 1950s (Discovering DNA's function)

Commentary: Prior to the 1950s, little was known about structure and function DNA. Many experts hypothesized that proteins were the genetic material for organisms. In 1952, Alfred Hershey and Martha Chase conducted their famous experiment to confirm that DNA was the genetic material.

Questions:

1. What is the central dogma in biology?
2. Why were proteins first considered to the first genetic material?
3. How did scientist determine DNA was the first genetic material?

Station 4: 1960s (Discovering DNA's Structure)

Commentary: While Hershey-Chase determined the function of DNA, Crick, Watson, and Rosalind Franklin determined the structure of DNA. DNA is double helix composed of nucleotide bases, a phosphate group, and a sugar. Crick and Watson won the Nobel Prize in 1963.

Questions:

1. What does DNA stand for?
2. What are the nucleotide bases and how are they paired?
3. If DNA has 20% As, how many Cs does it have?
4. If there so few bases, why are people so different?

Station 5: 1970s (Recombinant technology)

Commentary: Pharmaceuticals: Prior to the 1900s, diabetes was a certain death sentence. Doctors often used crude methods for treatment since little was known about the role of insulin in regulating blood glucose. Insulin was first discovered in the 1920s as an effective treatment for diabetes. Early formulations were extracted from animal sources and were impure, which often caused adverse reactions. In the 1970s, E coli were used to make synthetic insulin, which resulted in larger quantities that could be purified and safely injected.

Questions:

1. What are some examples of biological pharmaceuticals?
2. Which organisms are used to make medications?
3. What is the name of the process used to make biological pharmaceuticals?
4. How can you tell if a biological was made using E coli or another organism?

Station 6: 1980s (PCR)

Commentary: Polymerase Chain Reaction (PCR) is a process in which DNA is rapidly replicated using primers, enzymes, and temperature cycles. It was invented by Kary Mullis in 1983. PCR is used to amplify gene sequences and rapidly replicate small samples. Before PCR, small DNA samples were difficult, if not impossible to analyze. It is used for forensic and genetic analysis.

Questions:

1. How does PCR compare to DNA replication?
2. What mathematical function describes the amount of DNA produced during PCR?
3. After 30 rounds of PCR, how much DNA would be produced?

Station 7: 1996-2005 (GMOs-plants)

Commentary: Genetically Modified Organism (GMOs): GMOs, which were first introduced in 1996, are organisms that have foreign DNA inserted into their genome. Expression of the foreign DNA allows the organism to be more nutritious and disease resistant. GMOs have also increased the size and yield of organisms. Many commonly consumed GMOs are corn, papaya, and soybeans.

Questions:

1. Why would some farmers not want to plant genetically modified crops?
2. How would a neighboring farmer who is planting genetically modified plants impact a farmer who is not?
3. What are the ethical concerns of creating and eating GMOs?

Station 8: (GMOs-animals)

Commentary: GMO animals: Currently, the only types of GMOs that are approved for human consumption are plants. However, animals are being genetically modified for desired properties such as less feathers, increased nutrition, faster growth, and disease resistance.

Questions:

1. How can a chicken be born without feathers?
2. Why would you want to raise featherless chickens?
3. Are there any issues associated with this organism?

Station 9: Enter CRISPR

Commentary- Clustered regularly interspaced short palindromic repeats, CRISPR, were discovered independently in three parts of the world beginning in 1987 with the acronym being proposed in 2001. CRISPR allows the alteration of DNA sequences and modification of gene function. The process has many potential applications including correcting genetic defects, treating and preventing the spread of diseases and improving crops.

Questions:

1. How was CRISPR discovered?
2. What did the researchers discover about the “stolen” genes?
3. Why is CRISPR so important?

Station 10: Present Day (Who Owns the Genome)

Commentary- In 2013, the US Supreme Court ruled that naturally occurring DNA cannot be patented. Several companies have created and manipulated DNA sequences for agriculture and pharmaceutical purposes. The court ruled that manipulated DNA can be patented.

Questions:

1. What defines natural DNA?
2. Do companies have the right to patent DNA?
3. How do patents impact scientific progress?
4. What are the concerns with creating synthetic DNA? T