SSC-I BIOLOGY
CHP#1 The Science of Biology
Knowledge Based Short Questions

1. Is Islam related to biology? Justify with an example.

- Yes, Islam is related to biology.
- The Quran describes the origin of life, stating, "We made every living thing from water" (Surah Al-Anbiya 21:30).
- It also explains human development stages, such as the formation of bones and flesh (Surah Al-Mu'minun 23:14).
- These verses align with scientific concepts like the importance of water for life and embryonic development.

2. Define branches and sub branches of biology with examples.

Biology has three main branches: Botany (study of plants), Zoology (study of animals), and Microbiology (study of microorganisms). Sub branches include Morphology (study of structure, e.g., leaf shape), Physiology (study of functions, e.g., digestion), and Genetics (study of heredity, e.g., eye color inheritance).

3. Describe the relation of biology with other branches of science.

Biology connects with other sciences:

- Biophysics: Applies physics principles (e.g., muscle movement).
- Biochemistry: Studies chemical reactions in cells (e.g., photosynthesis).
- Biotechnology: Uses organisms for products (e.g., insulin production).
- Biostatistics: Analyzes biological data (e.g., disease trends).

4. Identify careers in biology and explain its subset status.

Biology is a subset of life sciences (studies living organisms) and natural sciences (studies nature). Careers include medicine (doctors), agriculture (crop scientists), biotechnology (vaccine developers), and marine biology (study of ocean life).

5. Justify that science is collaborative with an example.

Science requires teamwork across disciplines. For example, COVID19 research combined biology (virus study), statistics (infection rates), and engineering (ventilator design). The International Space Station also involves collaboration among scientists worldwide.

6. Describe the steps of the scientific method.

1. Recognition: Identify a problem (e.g., "What causes malaria?").
2. Observation: Collect data (e.g., Plasmodium in blood).
3. Hypothesis: Propose an explanation (e.g., "Plasmodium causes malaria").
4. Deduction: Predict outcomes ("If true, all patients should have Plasmodium").
5. Experiments: Test the hypothesis (e.g., examine blood samples).
6. Results: Analyze data to confirm or reject the hypothesis.

7. Write the characteristics of a hypothesis.

A hypothesis must be:

- A general statement (e.g., "Mosquitoes spread malaria").
- Testable (can be proven true/false).
- Based on observations (e.g., malaria near marshes).
- Falsifiable (can be disproven by evidence).

8. Differentiate between qualitative and quantitative observations.

- Qualitative: Describes qualities (e.g., leaf color, bird song).
- Quantitative: Measures quantities (e.g., body temperature, blood volume).
- Quantitative data is more precise because it uses numbers.

9. Contributions of Ronald Ross, A.F.A King, and Laveran.

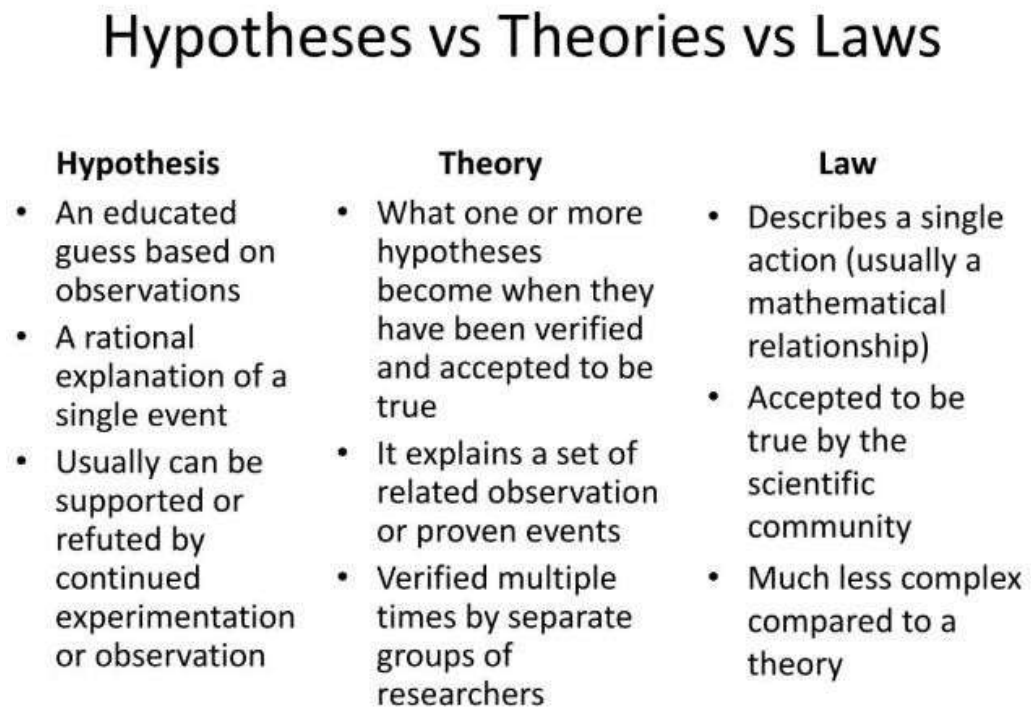
- Laveran (1882): Discovered Plasmodium as the cause of malaria.
- A.F.A King (1883): Linked mosquitoes to malaria spread.
- Ronald Ross (1897): Proved mosquitoes transmit Plasmodium.

10. What is the incubation period?

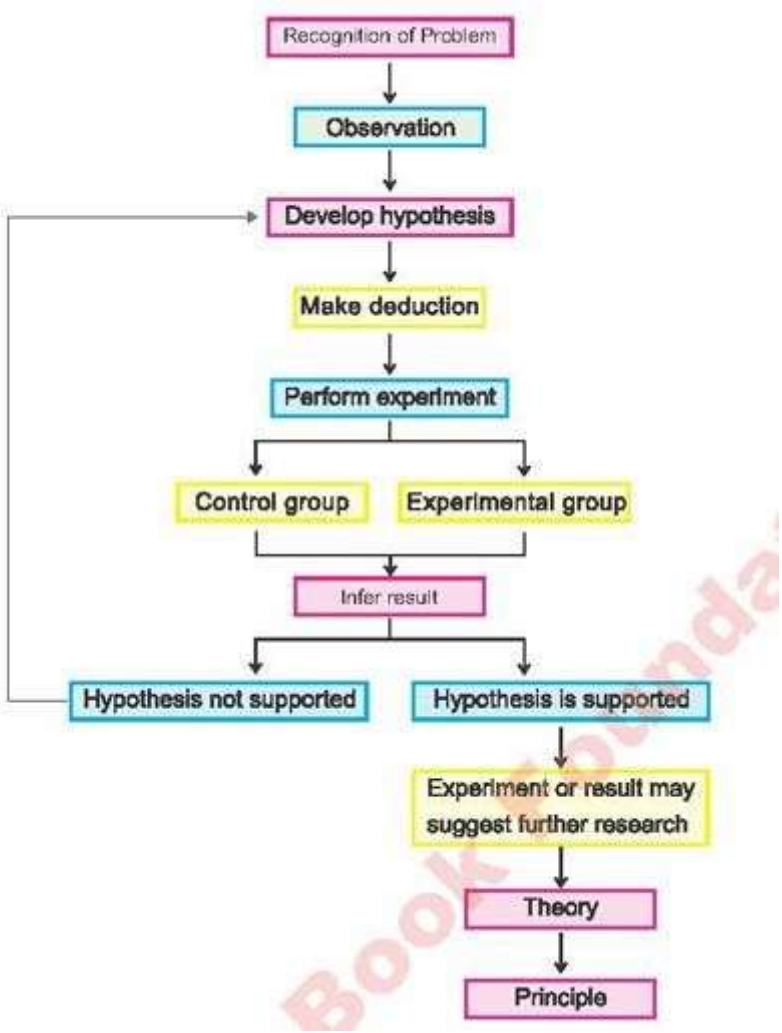
The time between pathogen entry and symptom appearance. For malaria, it varies (24–72 hours) depending on the Plasmodium species.

11. **Differentiate hypothesis, theory, and law.**

- Hypothesis: An untested idea (e.g., "Plasmodium causes malaria").
- Theory: Well supported explanation (e.g., Cell Theory).
- Law: Universal fact (e.g., Mendel's Laws of Inheritance).



12. Draw a flowchart of the biological method.



Understanding/Application Based Short Questions

1. Identify branches of biology for scenarios:

a) Ecology (desert adaptations of cacti).

b) Genetics (inheritance of disorders).

c) Ecology (wolf-deer population dynamics).

d) Molecular Biology (gene mutation effects).

2. Identify interdisciplinary sciences for scenarios:

A) Biochemistry (enzyme speeds up reactions).

b) Biophysics (X-ray protein structure).

c) Biostatistics (viral spread modeling).

3. Is biology an isolated branch of science?

No, biology integrates with other sciences. For example:

- Biophysics studies muscle movement.
- Biochemistry examines cellular reactions.
- Biotechnology combines biology with engineering.

4. Sort observations as qualitative or quantitative:

- Qualitative: Cat color, leaf shape, bird song, desert climate.
- Quantitative: Giraffe height, mango weight, body temperature, blood volume, tiger speed.

5. How did Ronald Ross prove Plasmodium is in mosquitoes?

Ronald Ross conducted experiments in 1897 to prove that mosquitoes transmit malaria. First, he allowed female Anopheles mosquitoes to bite malaria patients. After a few days, he dissected the mosquitoes and observed Plasmodium multiplying in their stomachs. To confirm transmission, he used sparrows instead of humans for ethical reasons. He allowed infected mosquitoes to bite healthy sparrows, which later developed malaria. This proved that mosquitoes act as vectors (carriers) of Plasmodium. His work earned him the Nobel Prize in 1902 and laid the foundation for malaria control strategies.

6. Why didn't Ross let infected mosquitoes bite healthy people?

Ross avoided human experiments due to ethical concerns. Deliberately infecting healthy people with malaria would have been unethical and dangerous. Instead, he used sparrows as model organisms because:
1. Similar Transmission: Sparrows could be infected with a bird specific Plasmodium strain (similar to human malaria).
2. Controlled Environment: Easier to observe and document results.
3. Safety: No risk to human lives.
This approach followed scientific rigor while adhering to moral principles.

7. First step for a salivary amylase experiment?

The first step in any scientific experiment is problem recognition. For a salivary amylase study:
1. Identify the Question:
   Example: "How does pH affect amylase activity?"
2. Background Research:
   Learn that amylase breaks down starch and works best at pH 6.7–7.0.
3. Form a Hypothesis:
   "If pH increases, amylase activity will decrease."
4. Design the Experiment:
   Test amylase activity at different pH levels using iodine (turns blue-black with starch).
This systematic approach ensures accurate and reproducible results.

8. Why did only 6 out of 10 people with Hepatitis B virus show symptoms?

- The four asymptomatic individuals were in the **incubation period:**
  - Definition: The time between virus entry and symptom appearance.
  - Hepatitis B Incubation: Ranges from 30–180 days.
  - Reason: The virus was replicating silently in their bodies, but the immune system had not yet reacted strongly enough to cause symptoms.
  - Carrier State: Some people never develop symptoms but can still transmit the virus (chronic carriers).

9. Can a Nobel winner's COVID19 vaccine hypothesis be wrong?

Yes, even a Nobel winning hypothesis can be disproven because:
1. Hypotheses Are Tentative: They are educated guesses, not absolute truths.
2. New Evidence: Future research might reveal flaws (e.g., vaccine side effects).
3. Example Deduction:
   Hypothesis: "COVID19 vaccines reduce severe complications."
   Deduction: "If vaccinated people get infected, they should have milder symptoms than unvaccinated people."
4. Scientific Process: Hypotheses are continually tested; Nobel prizes reward verified contributions, but science evolves.

10. Why is malaria eradication impossible?

Despite advances, malaria persists due to:
1. Mosquito Resistance:
   Anopheles mosquitoes develop resistance to insecticides (e.g., DDT).
2. Plasmodium Adaptations:
   The parasite mutates, becoming resistant to drugs (e.g., chloroquine).
3. Complex Life Cycle:
   Requires both humans and mosquitoes, making interruption difficult.
4. Environmental Factors:
   Climate change expands mosquito habitats.
5. No Universal Vaccine:
   Current vaccines (e.g., RTS, S) offer partial protection.

11. Why Only Female Mosquitoes Bite People

Female mosquitoes bite to obtain protein from blood needed for egg development. Males feed only on plant nectar since they don't produce eggs. The female's mouthparts are specially adapted for piercing skin and sucking blood. This biological difference makes females the dangerous disease carriers.

12. Write a note on Dengue Fever

Dengue is caused by Dengue virus transmitted by Aides mosquitoes (recognizable by black-white stripes). Symptoms include high fever, severe headache, and bleeding from nose/gums. Unlike malaria, there's no specific antiviral treatment. Prevention focuses on Mosquito control and avoiding bites. Second infections can be more severe.

13. What are Vectors in Biology?

A vector is an organism that transmits pathogens between hosts without getting sick itself. Mosquitoes are vectors for malaria (Plasmodium) and dengue. Other examples include ticks (Lyme disease) and fleas (plague). Vectors play crucial role in disease lifecycles.

14. Write Symptoms of Malaria

Malaria causes recurring cycles of:
- Intense chills and shivering
- High fever (up to 104°F)
- Profuse sweating as fever breaks
- Headache and nausea

These episodes repeat every 24-72 hours depending on Plasmodium species. Severe cases may lead to anemia or coma.

Extensive Questions

1. Describe the Cause of Malaria in Relation to the Biological Method

Introduction

Scientists used the biological method to discover that Plasmodium causes malaria and mosquitoes spread it.

Step 1: Recognition of the Problem

For centuries, people got sick with malaria, but no one knew why.

Step 2: Observations

- Malaria was common near swamps and stagnant water.
- Drinking swamp water didn't cause malaria, so scientists suspected mosquitoes.
- Under a microscope, Plasmodium was seen in patients' blood.

Step 3: Hypothesis

Laveran (1882) proposed: "Plasmodium causes malaria."

Step 4: Deduction

"If Plasmodium causes malaria, then all sick people should have it in their blood."

Step 5: Experimentation

Scientists checked blood samples:

- 100 malaria patients → All had Plasmodium.
- 100 healthy people → Only 7 had Plasmodium (later got sick).

Step 6: Results

The hypothesis was confirmed: Plasmodium causes malaria

2. The Spread of Malaria – Explained Through the Biological Method

The spread of malaria was discovered using the 6step biological method. Here's how scientists uncovered how this deadly disease transmits:

Step 1: Recognition of the Problem

For centuries, people noticed:

- Malaria was common near swamps/stagnant water
- But drinking swamp water didn't cause malaria
- Something else must be spreading it

Key Question:

"How does malaria spread from person to person?"

Step 2: Observations (Late 1800s)

Scientists collected crucial clues:

- ✓ Malaria patients had Plasmodium parasites in their blood **(Laveran, 1880)**
- ✓ Cases were higher among:
- People who slept outdoors
- Those without mosquito nets
- Populations near mosquito breeding sites

✓ A.F.A. King's 20 Observations (1883):

- Malaria occurred in warm climates
- Screened houses had fewer cases
- Smoke seemed to repel mosquitoes

Step 3: Hypothesis

Based on observations:

"Mosquitoes transmit the Plasmodium parasite"

Step 4: Deductions

If mosquitoes spread malaria, then:

1) Plasmodium should be found in mosquitoes

2) Mosquitoes that bite sick people can infect healthy ones

Step 5: Experimentation (Ronald Ross, 1897-1899)

Experiment 1:

1. Let mosquitoes bite malaria patients

2. Dissected mosquitoes days later

→ Found Plasmodium multiplying in mosquito guts

Experiment 2 (Ethical Alternative):

1. Infected mosquitoes bit healthy sparrows

2. Sparrows developed malaria

→ Proved transmission cycle

Step 6: Results & Conclusion

✓ Hypothesis Proven Correct:

Mosquitoes carry Plasmodium

Transfer it through bites

✓ **Cycle Discovered:**

Malarial Patient (Human) → Mosquito → Healthy Human

YouTube Videos for More Understanding and Concept Building

- https://youtu.be/ionF-moU0zU?si=abxduIs32Ly-pQyQ (The Cause of Malaria)
- https://youtu.be/WcFFRMQRZ10?si=EraPVe3T-rbr3WK5 (The Spread of Malaria)
- https://youtu.be/BVRnNbb9cLU?si=L4ZBH-bGg1pZBsKv (Malaria and Plasmodium's Life Cycle)