

Dr. Bbosa Science

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Patterns of reproduction

1. Asexual reproduction

This is a type of reproduction that does not involve fusion of gametes or combination of genetic materials from different individual.

Types of asexual reproduction

- (a) **Fission:** The organism divides into two or more **equal** sized parts, e.g. binary fission in amoeba
- (b) **Spore formation:** Spores are unicellular bodies formed by cell division in a parent organism. Having become detached from the parent, they develop directly or indirectly into a new individual, provided environment conditions are suitable.

Generally, spores are very small which enables them to be distributed by animals.

- (c) **Budding:** this is a method of reproduction where an organism develops an outgrowth which when detached from a parent become self-supporting e.g. yeast and hydra
- (d) **Fragmentation:** this is where an organism is broken into two or more pieces, each of which grows into a new individual. As a means of reproduction, fragmentation depends on organism having good power if regeneration. E.g. spirogyra.
- (e) **Vegetative reproduction:** is a form of asexual reproduction in plants where part of the body become detached and develop into a new self-supporting individual
- (f) **Parthenogenesis:** This is the development of a new offspring from unfertilised egg. Haploid parthenogenesis (e.g. in pineapple, the egg is produced by meiosis whereas in diploid parthenogenesis the egg is produced by mitosis; e.g. production of wingless aphids.

Advantages of asexual reproduction

- producing more offspring than sexual reproduction mode in a given time
- good qualities are retained in the offspring

Disadvantage of Asexual reproduction

- may lead to accumulation of recessive genes in a population

- no genetic variability

2. Sexual reproduction

In its broadest sense, sexual reproduction is any process in which genetic materials is transferred from one cell to another. It generally involves fusion of gametes.

Cross fertilization and self-fertilization

- Cross fertilization- gametes come from two separate individuals.
- Self-fertilization – both gametes come from the same individual.

Advantage of sexual reproduction

- allows for mixing of genetic material (genetic variability).

Evolution of reproductive methods

Fundamental to sexual reproduction is the method by which gametes are brought together. In external fertilization, union of gametes occur outside the body whereas in internal fertilization, union of gametes occurs inside the body. Generally, internal fertilization, necessitates the use of some kind of intromittent organ (e.g. penis) to introduce the sperms into female body.

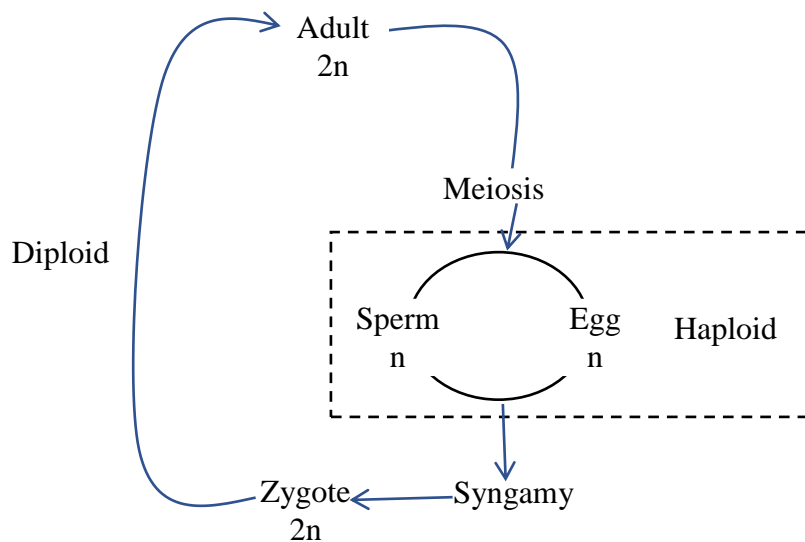
Internal fertilization has two advantages over external fertilization

- It is a surer method: there is less chances of gametes being wasted
- A fertilized egg can be enclosed with a protective covering before it leaves the female body (Oviparity) e.g. egg shells or develop within the female (Vivi parity)

Many organisms desert their off springs as soon as they have been produced as fertilized eggs. Other provided some sort of parental care. E.g. man. By and large the more parental care, the fewer the number off spring produced.

The life cycle

An organism's life cycle is the sequence of events from fertilization in one generation to fertilization in the next generation. The life cycle of human and most animals follow the plant below:



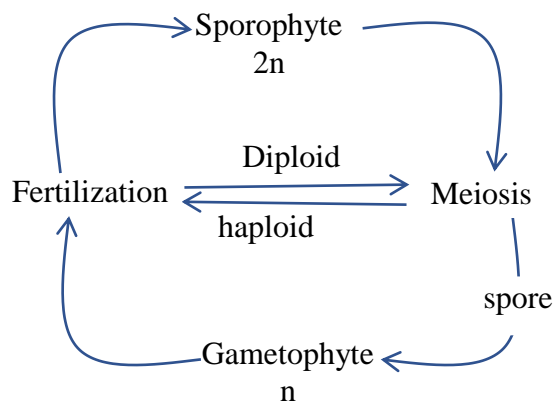
Alternative generations

Alternative generation is a life cycle the diploid and haploid generation follow one another and the two generation are dissimilar or the alternation of a sexual phase and an asexual phase in the life cycle of an organism. However, diploid generation is better adapted due to two pairs of gene that harmful gene due to mutation may be masked and there is greater opportunity for variation whereas the haploid has one gene

Advantage of alternative generation

Each generation occupies a different niche reducing intraspecific competition.

Plants and some algae have a two generation of life cycle called alternative generation that involves meiosis.



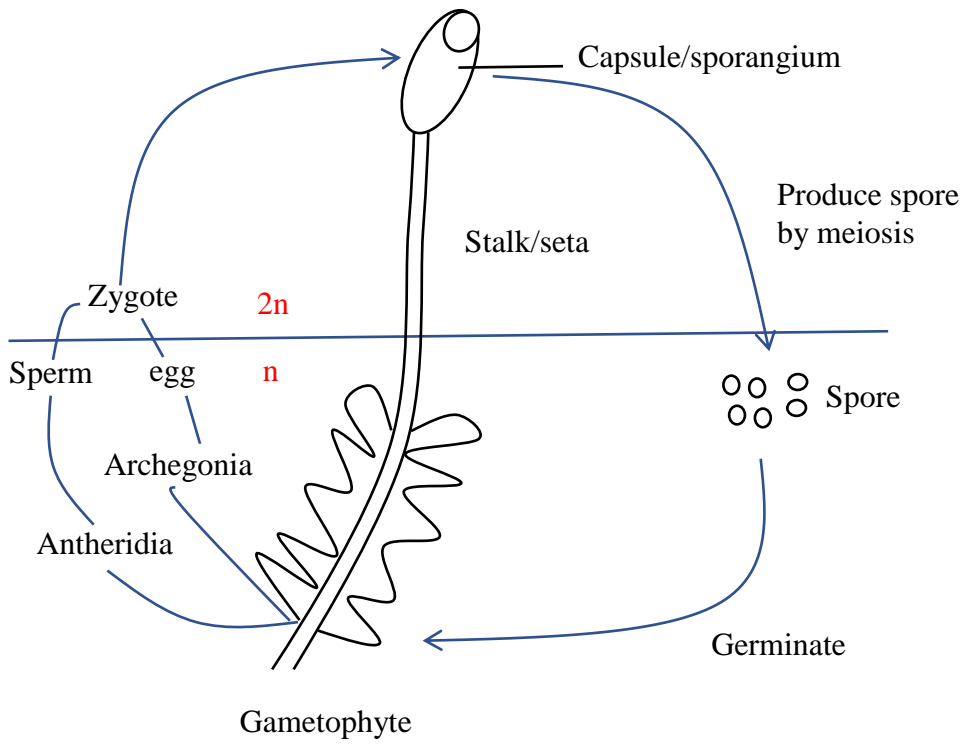
1. The sporophyte, the diploid generation, produced spores by meiosis. Spore develops into haploid generation.
2. The gametophytes, the haploid generations produce gametes by mitosis that unite to form a diploid organism

The two generations are dissimilar and one is dominant over the other. The dominant generation is larger and exists for a long period of time.

Life cycle of a moss

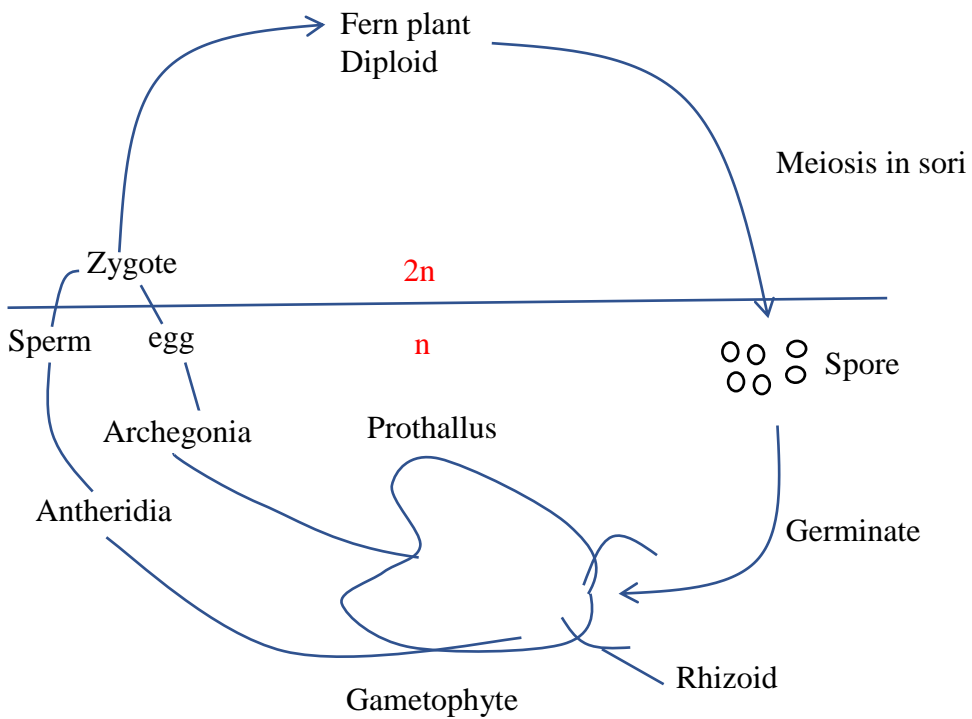
The gametophyte is dominant in bryophyte such as moss

1. The leafy shoot bears separate male and female gametangia: the antheridia and archegonia.
2. Flagellate sperms are produced in antheridia and these swim in external water to archegonia that contain a single egg.
3. When the egg is fertilized, the developing embryo is retained within the archegonia.
4. The mature sporophyte growing on top of the gametophyte produce spores by meiosis that when they spread by wind and find favorable conditions germinate into anew gametophyte.



Life cycle of Fern

The sporophyte is dominant in fern



The similarities and differences between bryophytes and pteridophytes

- *In both the diploid sporophyte produces spores and the haploid gametophyte produce gametes*
- In both female gametes are non-motile while male gametes are motile
- In both spores are produced by meiosis
- In both the sporophytes grow out of the gametophyte
- In both gametes are produced by mitosis
- In both spores germinate into gametophyte
- In both zygote grows into sporophyte
- In both Sporophyte produce spores whereas gametophyte produce

Differences between moss and fern

Life cycle of a moss	Lifecycle of a fern
<ul style="list-style-type: none"> - Gametophyte is dominant - Sporophyte is dependent - Spores first germinate into a thread-like protonema which produce buds that grow into gametophyte - Transfer of sperms from antheridia to archegonium is by rain splash - Gametophyte long lasting - Sporophyte is very temporary and photosynthesize to limited extent 	<ul style="list-style-type: none"> - Gametophyte is dependent - Sporophyte is dominant - Spores germinate directly into gametophyte - Sperms swim in moist environment from the antheridia to an egg at the base of archegonium. - Gametophyte temporary organ - Sporophyte long lasting and is photosynthetically active

The importance of alternative generation to the life of a moss and fern (3marks)

- Spores can survive harsh conditions and only germinate when conditions are favorable
- Formation of spore result in variation
- It ensures rapid multiplication of plant species as spores are usually produced in large number.
- Enable the different generations occupy different ecological niches and allow the survival of the plant.
- Interdependence between the gametocyte and sporophytes generations ensure that both generation exist at any given time. This prevents extinction of the plant

Reasons why mosses are restricted in wet environment

- Body is not covered with cuticle, thus require water to prevent desiccation
- Water is required to enable male gametes to swim to the eggs to allow fertilization.
- Lack true roots, and thus need to absorb water by osmosis.
- They lack vascular system therefore require water to parts by osmosis

Reason why ferns are more adapted to terrestrial life than mosses.

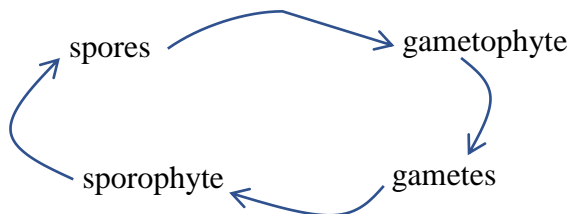
- *Ferns have rhizomes (horizontal underground stems) which act as organs of perennation, allowing the ferns to survive unfavorable climatic conditions unlike mosses.*
- *Ferns produce more spores than mosses. This increases their chance of reproduction and colonization of habitat compared to mosses*
- *The lignified xylem offers more support to the fern*
- *Ferns have broader leaves that offer large surface area for trapping light for photosynthesis*
- *Sporophyte generation of ferns is nutritionally independent while that of the mosses depend on the gametophyte for nutrition*
- *Ferns have true stems to support the leaves to obtain enough light for photosynthesis.*
- *Leaves of ferns have cuticle to prevent water loss and desiccations.*

Significance of alternative generation

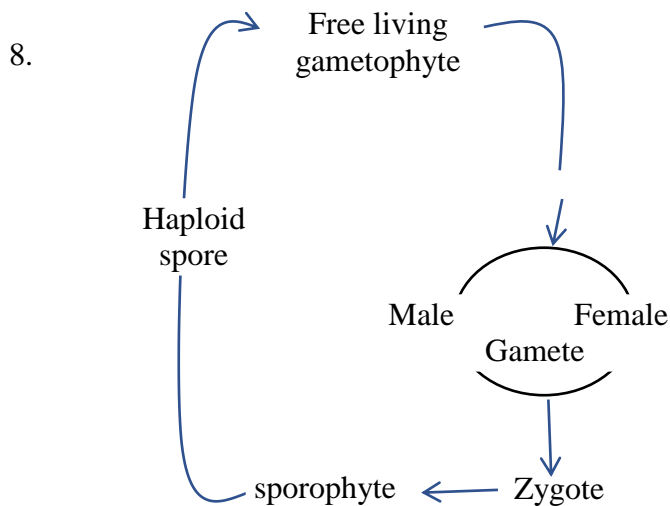
- (i) Rapid multiplication through production of spores
- (ii) Spore survive harsh conditions
- (iii) Spore formation by meiosis leads to variation
- (iv) Random fusion of gametes by fertilization causes variation
- (v) Gametophytes and sporophytes occupy different ecological niches reducing competition

Exercise

1. Which one of the following has a dominant gametophyte?
 - A. Chlorophyta
 - B. Spermatophyte
 - C. Pteridophyte
 - D. Bryophyte
2. Ferns are considered to be more advanced land plants than mosses because sporophytes of fern
 - A. Are able to produce spores
 - B. Have green leaves
 - C. Develop rhizoids
 - D. Have well developed vascular system
3. The genetic conditions of the spores produced in the sporophyte of bryophytes is
 - A. Tetraploid
 - B. Haploid
 - C. Polyploid
 - D. diploid
4. Bryophytes and pteridophytes cannot fully exploit terrestrial life mainly because they
 - A. lack well developed vascular system
 - B. depend on water for fertilization
 - C. lack roots
 - D. are covered with thin cuticle
5. The figure below represents the life cycle of a moss.



- The stage in the life cycle formed by meiosis is the formation of
- A. gametes
 - B. spores
 - C. gametophyte
 - D. sporophyte
6. At which of the following stages does meiosis occur in the life cycle of a fern? During the formation of the
 - A. gametes
 - B. Gametophyte
 - C. Spores
 - D. sporophyte
 7. In which of the following plants showing alternation of generation is the sporophyte generation dominant?
 - A. Mosses and algae
 - B. Algae and ferns
 - C. Fern and mosses
 - D. Ferns and gymnosperm



The diagram above summarizes the life cycle of a plant. Which plant is likely to be

- A. Colonial algae
 - B. Moss
 - C. Flowering plant
 - D. Unicellular algae
9. In bryophytes gametes are produced by
- A. Gametophytes through mitosis
 - B. Sporophytes through meiosis
 - C. Sporophytes through mitosis
 - D. Gametophytes through meiosis
10. Parthenogenesis differ from a sexual reproduction in that, parthenogenesis involves
- A. Two organisms of different sex
 - B. Fertilization
 - C. Formation of gametes
 - D. Mixing of genetic material
11. Which one of the following is a form of vegetative propagation?
- A. Spore formation
 - B. Conjugation
 - C. Budding
 - D. Diploid parthenogenesis
12. What is the advantage of fragmentation over conjugation as a means of reproduction in spirogyra?
- A. Varied offspring are produced
 - B. Fast-growing offspring are produced
 - C. Many offspring are produced
 - D. More resistant offspring are produced.

13. The common method of reproduction in organism which have a large number of undifferentiated cells is
- A. Conjugation
 - B. Fragmentation
 - C. Sporulation
 - D. fission
14. Which one of the following is the diploid stage in the life-cycle of a moss?
- A. Protonema
 - B. Sprophyte
 - C. Gametophyte
 - D. Antheridium
15. Which one of the following statements on reproduction is true?
- A. Asexual reproduction always results into identical offspring.
 - B. Gametes are always produced by meiosis.
 - C. Mitosis always produces diploid cells.
 - D. Gametes are always haploid.
16. A moss alternates between two distinct forms in its life cycle; as a gametophyte and sporophyte
- (a) Describe how
 - (i) A gametophyte forms a sporophyte
 - (ii) A sporophyte forms a gametophyte.
 - (b) Explain why mosses are restricted to living in wet environment.
17. (a) Explain what is meant by alternation of generation.
- (b) State two difference and two similarities between pollen grains of a flowering plant and the spore of moss.
 - (i) Differences
 - (ii) Similarities
 - (c) How are ferns better adapted to live on land than mosses?
 - (d) Suggest why Bryophytes are
 - (i) Restricted to growing in damp environment
 - (ii) Able to grow successfully on land

18. (a) What is meant by alternation of generation?
- (b). Ferns and mosses show alternation of generation. State the dominant stage in each case
- (i) ferns
- (ii) Mosses
- (c) Give important of alternation of generation in the life cycle of an organisms
- (d) Outline the limitations that mosses face in growing in terrestrial inhabitants
19. (a) Explain what is meant by term alternative generation? (02marks)
- (b) Compare the life cycle of a moss and fern (13marks)
- (c) What is the importance of alternative generation to the life of a moss and fern (3marks)
20. (a) Explain how ferns are better adapted to terrestrial life than mosses.
- (b) How does temperature influence the following processes in plants?
- (i) Plant growth.
- (ii) plant distribution.
21. (a) State the similarities and differences between bryophytes and pteridophytes
- (b) Discuss the significance of alternation of generation to the life histories of plants
22. (a) What is meant by the term “alternative generation?”
- (b) State the advantage of alternation of generation provide for sexual reproduction
- (c) Why is life better as a sporophyte than a gametophyte

Answers to objective question

1.	D	5.	B	9.	A	13	B		
2.	D	6.	C	10	C	14	B		
3.	B	7.	D	11	C	15	D		
4.	B	8.	B	12	B				

16. Solution

(a) (i) The gametophyte is haploid produces gametes by mitosis. The gametes fuse to produce a diploid zygote which grow by mitosis into the diploid sporophyte.

(ii) The sporophyte produces spores by meiosis. Spores are therefore haploid. They are small, light and readily dispersed by wind. On a suitable surface, and when conditions are favorable, spores germinate and grow by mitosis into a haploid gametophyte.

(b) Body is not covered with cuticle. Therefore, they need water for protection from desiccation.

They lack vascular tissue. Therefore, they need water to be supplied to their various parts osmosis.

They need water for swimming of gametes before fertilization can occur.

17. (a) Alternation of generation is the alternation between a diploid spore producing sporophyte generation and a haploid gametes gametophyte generation in a single life cycle of a plant in the same cycle. The alternates between a diploid (2n) sporophyte generation and haploid (n) generation.

(a) Differences

Spore	Pollen grains
Can germinate into an independent plant structure	Cannot form an independent plant structure.
Not gametes	Male gametes
Others:	
Remain viable over a long period of time	Are viable for only a limited time

(iii) Similarities

They are both formed by meiosis

They are both haploid

Others

They are both light and dispersed by wind.

(b)

- Ferns are vascular plants containing vascular tissue made up of xylem and phloem
- Their sporophyte generation has true roots, stems and leaves
- Their bodies are supported by xylem because it contains lignified cells of great strength and rigidity.

Others:

- The true leaves trap more light for photosynthesis

(c) They lack a well-developed root system and rely on diffusion across the whole plant body and the root-like rhizoids to obtain water

They are delicate and small.

They lack a cuticle, thus, they can easily be subjected to desiccation in a drier environment

They depend on water for the movement of male gametes towards female gametes during fertilization.

Have chlorophyll and are therefore capable of photosynthesizing

They grow in clusters and therefore strengthen their positions on the soil.

They reproduce both sexually and asexually. This increases their chances of survival on land

18. Solution:

- (a) Alternation of generation is a life cycle of plants which consists of two alternating stages of growth (generation); a haploid gametophyte which produces gametes by mitosis and a diploid sporophyte which produces spores by meiosis

The life cycle is complete when the plant passes through both stages as seen in bryophytes and pteridophytes.

(b) (i) Sporophyte stage

(ii) Gametophyte stage

(c) It promotes variation through meiosis, which then ensures that only the better adapted organisms survive.

Others:

It enables the organism to colonize more than one habitat of varying environment conditions.

It leads to rapid colonization of habitat as by an organism since several spores are produced.

(d)

- Mosses lack a cuticle hence are prone to desiccation
- Leaves are small and sessile and provide a small surface area for trapping sunlight for photosynthesis.
- Thallus provides a large surface area for water loss thus liable to desiccation.
- Leaves are pale-green and thus have chlorophyll content inadequate for photosynthesis
- False roots are superficial and incapable of absorbing enough water.

19. Solution:

(a) Alternation of generations is the alteration between a diploid sporophyte generation and the haploid gametophyte generation in a single life cycle of a plant.

(b) Similarities between the life cycle of a moss and a fern

- In both the diploid sporophyte produces spores and the haploid gametophyte produces gametes.
- In both the female gamete is non-motile while the male gamete is motile.
- In both the sporophyte grows out of the gametophyte.
- In both gametes are produced by mitosis.

Differences

Life cycle of moss	Life cycles of a fern
<ul style="list-style-type: none">- Gametophyte is dominant- Sporophyte is dependent- Sporophyte is very temporary and photosynthesizes to a limited extent- Gametophyte is long-lasting	<ul style="list-style-type: none">- Gametophyte is dependent- Sporophyte is dominant- Sporophyte is long-lasting and photosynthetically active- Gametophyte is a temporary organ

(c) Significance of alternation of generations

- There is rapid multiplication as spores are normally produced in large numbers
- Spores can survive harsh conditions and germinate when conditions are favorable
- Spores leads to formation of different varieties since meiosis takes place during their formation.
- Fertilization restores diploid chromosome number. Production of gametes by mitosis ensures that the haploid gametophyte state is maintained. This maintains the plant genome.
- Alternative between gametophyte and sporophyte generations ensures that the plant colonizes different habitats in the ecosystem.
- Interdependence between gametophyte and sporophyte generation ensures existence of both generations and avoids extinction of the plant species.

20.Solution.

(a) Feerns are better adapted to terrestrial life than mosses because;

- Ferns have rhizomes (horizontal underground stems) which act as organs of perennation, allowing the ferns to survive unfavorable climatic conditions unlike mosses.
- Sporophytes of ferns have true roots for anchorage and transport of water and mineral salts, unlike mosses which have false roots (rhizoids)
- Ferns produce, more spore than mosses. These increases their chances of reproduction and colonization of habitat compared to mosses.
- Ferns have a well-developed vascular system that supplies the whole plants with water

and food.

- The lignified xylem offers more support to the fern.
- Ferns have broader leaves which present a larger surface area for photosynthesis.
- Sporophyte generation of ferns is nutritionally independent while that of the mosses depends on the gametophyte for nutrients.
- Ferns have true stems to support the leaves to obtain enough light for photosynthesis. They also help them to withstand air currents present in the terrestrial environment.
- Leaves of ferns have waxy cuticle to prevent desiccation.

(b)(i) Temperature acts as a limiting factor in plant growth and development by influencing the rate of cell division, cell metabolism, photosynthesis, respiration, excretion etc. which directly impact on growth.

- Above or below the enzyme working range, the enzymes are denatured or inactivated respectively. In either case the reactions cease, leading to delayed/limited plant growth.
- Low temperatures stimulate flowering and germination in plants.

(ii) Temperate plants are distributed in cool regions whose temperatures do not usually exceed 25°C while plants that can withstand higher temperatures are more abundant in the tropics or deserts where temperatures are usually above 25°C .

- C_4 plants are more abundant in hot climatic temperatures because they are more efficient at fixing carbon dioxide at high temperatures. On the hand C_3 plants are more abundant in cooler environments because they fix carbon dioxide better at lower temperatures.
- Some aquatic plants can withstand very high temperatures and can thrive in hot springs while some can withstand very cold temperatures thrive in snow. The biggest percentage thrives in moderate temperatures which can support their metabolic activities.

21 (a) Similarities between bryophytes and pteridophytes

- (i) Both show alternative generation involving two distinct plants: a haploid gametophyte and diploid sporophytes
- (ii) Both reproduce by asexual and sexual means
- (iii) In both female gametes are non-motile while the male gametes are motile
- (iv) Both produce spores by meiosis
- (v) Both produce gametes by mitosis

Differences between bryophytes and pteridophytes

Bryophytes	Pteridophytes
Sporophyte has no roots	Sporophyte has roots
Gametophyte dominant	Gametophyte a temporary structure
Sporophyte nutritionally depend on gametophyte	Sporophyte dominant
Lack vascular tissue	Has vascular tissue to transport both water and food

(b) Significance of alternative generation

- (vi) Rapid multiplication through production of spores
- (vii) Spore survive harsh conditions
- (viii) Spore formation by meiosis leads to variation
- (ix) Random fusion of gametes by fertilization causes variation
- (x) Gametophytes and sporophytes occupy different ecological niches reducing competition