Chapter 11: Reproduction — How Life Continues

Exercises — Revise, Reflect, Refine

Q1 A flower's anthers are removed before it matures. Later, pollen from another plant of the same species is dusted onto its stigma and seeds are produced. Which process has been ensured here?
(i) Self-pollination
(ii) Cross-pollination
(iii) Fertilisation
(iv) Tissue culture

SOLUTION

In this experiment, the anthers (male organs) of a flower are removed before they shed pollen — this prevents the flower from self-pollinating.
Pollen is then collected from a different plant of the same species and deliberately placed on the stigma of the emasculated flower.
Because pollen is transferred from one plant to a genetically different plant of the same species, this is cross-pollination.
Self-pollination (option i) is ruled out because the flower's own pollen was removed. Fertilisation (iii) and tissue culture (iv) are separate processes that occur after or independently of pollination.

Answer: (ii) Cross-pollination. Removing the anthers prevents self-pollination; dusting pollen from a different plant of the same species onto the stigma is cross-pollination.

Q2 Arrange the following stages of sexual reproduction in plants in the correct order:
(i) Pollen germination on stigma
(ii) Fertilisation
(iii) Pollination
(iv) Formation of zygote

SOLUTION

Sexual reproduction in flowering plants begins with pollination — transfer of pollen grains from the anther to the stigma of a flower.
Once pollen lands on the stigma, it germinates: a pollen tube grows down through the style into the ovary toward the ovule. This is pollen germination on stigma.

The male gamete travels through the pollen tube and fuses with the female gamete (egg cell) inside the ovule. This fusion is fertilisation.

The product of fertilisation is the zygote. So the correct sequence is: (iii) Pollination → (i) Pollen germination on stigma → (ii) Fertilisation → (iv) Formation of zygote.

Answer: (iii) Pollination → (i) Pollen germination on stigma → (ii) Fertilisation → (iv) Formation of zygote.

Q3 Assertion (A): The zygote formed after fertilisation immediately attaches to the uterus wall.
Reason (R): The uterus wall is always prepared to receive the zygote.
(i) Both A and R are true, and R is the correct explanation of A.
(ii) Both A and R are true, but R is not the correct explanation of A.
(iii) A is true, but R is false.
(iv) A is false, but R is true.

SOLUTION

Assertion (A): After fertilisation, the zygote does NOT immediately attach to the uterus wall. Instead, the zygote undergoes repeated cell divisions while moving through the fallopian tube, forming a multicellular structure (blastocyst). Only after several days does the blastocyst implant in the uterine wall. So A is FALSE.

Reason (R): The uterine wall (endometrium) does thicken and become well-supplied with blood vessels during the menstrual cycle, preparing itself to receive and nourish the developing embryo. So R is TRUE.

Since A is false and R is true, the correct option is (iv).

Answer: (iv) A is false, but R is true. The zygote does not immediately attach to the uterine wall — it first divides to form a blastocyst over several days, then implants. The uterine wall does prepare itself (thickened endometrium) to receive the embryo.

Q4 Why does asexual reproduction produce offsprings that are genetically identical to the parent?

SOLUTION

In asexual reproduction, a single parent produces offspring without the involvement of gametes or fertilisation.

The offspring are produced by mitotic cell division of the parent's cells. Mitosis is

a type of cell division in which the chromosome number is maintained — each new cell receives an exact copy of the parent cell's DNA.

Because no two different sets of genetic material combine (there is no fusion of gametes from two parents), no new gene combinations are formed.

As a result, the offspring inherit the same genetic information as the parent and are genetically identical to it — they are clones.

Answer: In asexual reproduction, offspring are produced from a single parent by mitotic cell division, which copies the parent's DNA exactly. Since no fusion of gametes occurs, no new gene combinations arise, making the offspring genetically identical (clones) to the parent.

Q5 Explain why the menstrual cycle stops during pregnancy.

SOLUTION

The menstrual cycle is controlled by hormones. Each cycle, the uterine lining (endometrium) thickens in preparation for a possible pregnancy. If fertilisation does not occur, progesterone and oestrogen levels fall, the endometrium breaks down, and menstruation occurs.

When fertilisation occurs, the resulting blastocyst implants in the uterine wall. The developing embryo (and later the placenta) secretes a hormone called human chorionic gonadotropin (hCG).

hCG signals the corpus luteum in the ovary to continue producing progesterone and oestrogen at high levels throughout pregnancy.

High levels of progesterone maintain the thickened endometrium (so it is not shed), suppress ovulation, and inhibit the hormonal signals that would otherwise trigger the next menstrual cycle.

Therefore, as long as pregnancy is maintained and progesterone levels remain high, the menstrual cycle is suppressed and menstruation does not occur.

Answer: During pregnancy, the implanted embryo (and later placenta) secretes hormones that keep progesterone levels high. High progesterone maintains the uterine lining and inhibits ovulation and the hormonal signals that trigger menstruation, so the menstrual cycle stops for the duration of pregnancy.

Q6 Why are flowers that bloom at night white or light in colour as compared to flowers that bloom during the day?

SOLUTION

Flowers rely on pollinators (insects, birds, bats, etc.) to transfer pollen. Colour is one of the signals that attracts pollinators.

Daytime flowers can use a wide range of colours — red, yellow, orange, purple — because their pollinators (bees, butterflies, birds) have colour vision and can detect these colours in daylight.

Flowers that bloom at night are pollinated mainly by nocturnal insects such as moths, or by bats. These pollinators have poor colour discrimination in the dark but can detect objects by reflected light.

White or light-coloured flowers reflect more light, making them more visible and conspicuous in low-light night conditions. This helps nocturnal pollinators locate the flowers even in the dark.

Additionally, night-blooming flowers often compensate for reduced visual cues with a strong fragrance, which nocturnal pollinators can detect through smell.

Answer: Night-blooming flowers are white or light-coloured because white reflects the most available light, making the flowers more visible to nocturnal pollinators (moths, bats) that have limited colour vision in the dark. Bright colours would be invisible at night and would not attract pollinators.

Q7 Why do vegetatively propagated plants tend to be more vulnerable to diseases than sexually reproduced plants?

SOLUTION

Vegetative propagation is a form of asexual reproduction — new plants are produced from parts of the parent plant (stem, root, leaf, etc.) by mitosis. All offspring are genetically identical to the parent (clones).

If the parent plant lacks genes for resistance to a particular pathogen (virus, bacterium, fungus), all its clones will also lack those resistance genes. A single disease can therefore sweep through an entire population of genetically identical plants.

Sexual reproduction, by contrast, involves fusion of gametes from two parents, creating genetically varied offspring through meiosis and random fertilisation. Some offspring may by chance carry gene combinations that confer resistance to a disease.

In a genetically diverse population, even if a disease kills many individuals, some resistant ones survive and reproduce — the species has a defence. A clonal population has no such buffer.

This is why monocultures (fields of a single crop variety propagated vegetatively, e.g., Cavendish banana) are extremely vulnerable to epidemics such as Panama disease.

Answer: Vegetatively propagated plants are genetically identical clones of the parent. If the parent lacks disease-resistance genes, so do all offspring, making the entire population vulnerable to the same pathogen. Sexually reproduced plants are genetically varied; some individuals may carry resistance genes, providing a buffer against disease.

Q8 If all flowers in a type of plant were only capable of self-pollination, how would it affect the genetic diversity over several generations? Explain.

SOLUTION

Self-pollination means pollen from a flower fertilises the eggs of the same flower (or the same plant). The offspring therefore receive genetic material from only one parent.

Each generation of self-pollination produces offspring that are increasingly homozygous — pairs of alleles at each gene locus become identical. By repeated self-pollination over generations, the plants become nearly completely homozygous.

New gene combinations do not arise because there is no mixing of genetic material from two different parents. Any variation that does occur comes only from rare mutations.

The result is a steady decrease in genetic diversity over generations. The population becomes genetically uniform.

Low genetic diversity means the population is less adaptable to environmental changes, new diseases, or new pests. It also increases the expression of harmful recessive traits (inbreeding depression), reducing the overall health and fitness of the population.

Answer: Exclusive self-pollination causes progressive homozygosity over generations and eliminates the genetic variation that comes from combining two different genomes. Genetic diversity decreases steadily; the population becomes nearly genetically uniform and less able to adapt to diseases, pests, or environmental changes.

Q9 A farmer wants to produce a large number of genetically identical plants quickly. Suggest suitable reproduction methods and explain why they are effective.

SOLUTION

The farmer needs rapid multiplication of plants that are genetically identical (clones) to the parent. Asexual/vegetative reproduction methods are ideal for this purpose.

Suitable methods include:

(a) Cutting (stem cuttings): A stem segment is cut and planted in moist soil. Adventitious roots develop and a new plant grows — it is genetically identical to the parent. This is fast and requires no special equipment.

(b) Grafting: A shoot (scion) of the desired plant is joined to the root system (rootstock) of another compatible plant. The scion retains the genetic identity of the desired parent. Used widely for fruit trees such as mango and apple.

(c) Layering: A branch is bent to the ground, partially buried, and allowed to develop roots while still attached to the parent plant. Once rooted, it is cut and planted separately.

(d) Micropropagation (tissue culture): Small pieces of plant tissue (explants) are grown on nutrient agar medium under sterile conditions. Thousands of genetically identical plantlets can be produced from a single plant in a short time. This is the most powerful method for rapid, large-scale clonal multiplication.

These methods are effective because they rely on mitosis, which copies DNA exactly, producing offspring with the same genotype as the parent. They also bypass the time needed to grow plants from seeds, allowing much faster propagation.

Answer: Vegetative propagation methods — stem cuttings, grafting, layering, or micropropagation (tissue culture) — are suitable. They use mitosis, producing genetically identical offspring quickly without the need for seeds or fertilisation. Tissue culture is the most efficient for large-scale clonal production.

Q10 Suresh prepares slides with pollen grains in different sugar concentrations (0%, 2.5%, 5%, 7.5%, 10%) to study the germination of pollen.
(i) What are the different hypotheses which can be tested using this set-up?
(ii) What parameters should be kept the same in this set-up?

SOLUTION

(i) Hypotheses that can be tested:
H1: Pollen grains germinate more (higher germination percentage) in sucrose solutions than in pure water (0%).
H2: There is an optimal sugar concentration at which pollen germination is highest; germination decreases at concentrations above and below this optimum.
H3: Higher sugar concentrations (above the optimum) inhibit pollen germination or pollen tube growth due to osmotic stress.
H4: Pollen grains do not germinate at 0% sugar (plain water), suggesting that a minimum sugar concentration is required for germination.

(ii) Parameters that must be kept the same (controlled variables):
— Species of plant from which pollen is taken (same flower/plant for all slides).
— Amount (volume) and freshness of pollen used per slide.
— Temperature and humidity during incubation.
— Duration of incubation (observation time).
— pH of the sugar solution.
— Type of sugar used (sucrose in all cases).
— Microscope magnification used to count germinated grains.
Keeping these constant ensures that any difference in germination observed is due to sugar concentration alone.

Answer: (i) Hypotheses: that pollen germinates best at a specific optimal sugar concentration; that zero sugar inhibits germination; that very high concentrations (osmotic stress) also reduce germination. (ii) Controlled parameters: pollen source (same plant/species), amount of pollen, temperature, incubation time, pH, type of sugar, and observation conditions.

Q11 Look at the picture given below and think in line with the given prompts and find out which type(s) of pollination might have been followed in these flowers —
Tomato: Stamens cover the stigma.
Wheat: Flowers open after pollination.
Papaya: Male and female flowers are often borne on different papaya trees.

SOLUTION

Tomato — Stamens cover the stigma:
In tomato flowers, the anthers form a cone around the stigma, and pollen falls directly onto the stigma of the same flower. This arrangement strongly favours self-pollination. Wind or vibration (buzz pollination by bees) can also dislodge pollen onto the central stigma. However, cross-pollination by insects is possible if pollen travels to another flower.
Primary pollination type: Self-pollination.

Wheat — Flowers open after pollination:
Wheat flowers (florets) are cleistogamous — the floret remains closed (or opens very briefly) at the time of pollination. Anthers shed pollen inside the closed floret onto the stigma before the floret opens. This ensures self-pollination before any external pollen can enter.
Primary pollination type: Self-pollination (cleistogamy).

Papaya — Male and female flowers on different trees (dioecious):
Papaya trees are typically dioecious — separate male trees (with staminate flowers only) and female trees (with pistillate flowers only). A female tree cannot pollinate itself because it has no anthers. Pollen must come from a male tree, typically carried by wind or insects.
Primary pollination type: Cross-pollination (obligate, as male and female flowers are on separate plants).

Answer: Tomato: self-pollination (stamens surround the stigma, pollen falls directly onto it). Wheat: self-pollination / cleistogamy (flowers open only after pollination inside the closed floret). Papaya: cross-pollination (male and female flowers on separate trees, so the female tree must receive pollen from a different male tree via wind or insects).

Q12 In the lower Himalayan region of northern India, apples are an important cash crop. The fruit yield is declining due to climate change and decline in natural pollinators. A researcher-farmer group set up two experimental apple orchards at two distinct locations: Place A (natural pollinators allowed) and Place B (mixed farming with beekeeping). The yield is depicted in Fig. 11.24 in terms of fruit setting (%) and fruit drop (%). Answer the following:
(i) What are the hypotheses the researcher-farmers group has thought of for this investigation?
(ii) What are the different parameters in the experiment?
(iii) Compare and analyse the data of two experimental orchards Places A and B, in terms of high yields of apple fruits.
(iv) Based on your analysis, what do you infer from the data?

SOLUTION

(i) Hypotheses:
H1: Introducing honeybee colonies (managed pollinators) in apple orchards increases the fruit-setting percentage compared to relying on natural/wild pollinators alone.
H2: Orchards with managed bee colonies will show a lower fruit-drop percentage compared to orchards with only natural pollinators.
H3: The decline in natural pollinators (due to climate change) is a significant cause of reduced apple yield in Himalayan orchards.

(ii) Parameters in the experiment:
Independent variable: Type of pollination — natural pollinators (Place A) vs managed bee colony (Place B).
Dependent variables: (a) Fruit setting (%) — number of fruits developed per fruit-bearing branch, expressed as a percentage; (b) Fruit drop (%) — percentage of developing fruits that fall prematurely.
Controlled variables: apple variety, orchard location (altitude, soil, climate as similar as possible), irrigation, fertilisation, pest management.

(iii) Comparison of data from Fig. 11.24:
Place A (Natural Pollination): relatively low fruit setting (~15–20%) and high fruit drop (~30–35%).
Place B (With Bee Colony): substantially higher fruit setting (~35–40%) and much lower fruit drop (~8–12%).
Place B outperforms Place A on both measures — more fruits are set and fewer

developing fruits drop prematurely.

(iv) Inference:
The data indicate that the decline in natural pollinators is a key factor in the reduced apple yield. When managed bee colonies are introduced (Place B), pollination efficiency increases — more flowers are successfully fertilised, leading to higher fruit set. Better fertilised fruits also receive proper hormonal signals from the developing seeds, reducing premature fruit drop.
Therefore, integrating beekeeping with apple orchard management compensates for the loss of natural pollinators and significantly improves apple yield — both in terms of the number of fruits set and their retention on the tree.

Answer: (i) Hypotheses: managed bee colonies increase fruit setting and reduce fruit drop compared to natural pollinators alone; declining wild pollinators are a primary cause of falling apple yields. (ii) Independent variable: pollination method (natural vs bee colony); dependent variables: fruit set (%) and fruit drop (%). (iii) Place B (bee colony) shows markedly higher fruit set and lower fruit drop than Place A (natural). (iv) Adequate pollination, ensured by managed bees, improves fruit set and reduces premature fruit drop — compensating for the climate-driven decline of natural pollinators.

Q13 A student claims, "In humans, ovulation always happens on day 14 of the menstrual cycle". Critically examine this claim and state whether the claim is correct or not. Give at least two reasons for your answer.

SOLUTION

The claim states that ovulation always occurs on day 14 of the menstrual cycle. This claim is INCORRECT (or at best oversimplified).

Reason 1 — The "day 14" rule assumes a 28-day cycle, which is only an average:
Day 14 ovulation is derived from a textbook 28-day cycle where menstruation lasts 5 days and ovulation occurs 14 days before the next period (luteal phase = ~14 days). However, menstrual cycle lengths vary considerably from person to person — and even from cycle to cycle in the same person. Normal cycle length ranges from about 21 to 35 days. In a 35-day cycle, ovulation occurs around day 21; in a 21-day cycle, it occurs around day 7. Saying it is always day 14 ignores this natural variability.

Reason 2 — The luteal phase is fixed but the follicular phase varies:
The luteal phase (from ovulation to the next period) is relatively constant at about 14 days for most women. The follicular phase (from menstruation to ovulation) is the variable phase. Stress, illness, nutrition, travel, hormonal fluctuations, and other factors can delay or advance the LH surge that triggers ovulation, shifting its timing significantly. Therefore, in any given cycle, ovulation can occur earlier or later than day 14.

Reason 3 — Individual physiological variation:
Hormonal profiles differ between individuals. Some people consistently ovulate on day 10–12; others on day 16–18. The word "always" in the claim is too absolute — it does not account for this inter-individual and intra-individual variation.

Conclusion: The claim is incorrect. Ovulation occurs approximately 14 days before the next menstruation, not necessarily on day 14 of the cycle. It varies with cycle length and is affected by physiological and environmental factors.

Answer: The claim is incorrect. Ovulation occurs roughly 14 days before the next menstrual period (not necessarily on cycle day 14), because cycle length varies between 21 and 35 days. Additionally, the follicular phase length varies due to stress, illness, and hormonal fluctuations, so ovulation timing shifts from cycle to cycle and person to person.