NCERT Archive

SOLUTIONS BOOK

CLASS 9

Science · Exploration

CHAPTER 11

Reproduction: How Life Continues

Complete Questions and Activities Solutions

In-text Questions | Revise, Reflect, Refine | The Journey Beyond

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Every question is followed by its answer. Question numbers above are clickable and the PDF bookmarks panel lets you jump to any exercise set or question. Figures are reproduced from the NCERT textbook (© NCERT) for educational use.

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11.1

CLASS 9 SCIENCE · CHAPTER 11

In-text Questions

Solutions · 32 questions

Directions (Questions 1–32): These are the questions that appear inside the chapter (Think It Over, activities, Pause and Ponder and other in-text questions), numbered in the order in which they appear. Many are open-ended or activity-based; model answers based on the chapter are given, and you may add examples from your own surroundings.

QUESTION 1 *Think It Over · p. 208*

When does a farmer prefer asexual or sexual methods of reproduction for crops production?

ANSWER

The choice depends on what the farmer wants from the crop. Both methods have their own uses.

Method	Farmer prefers it when	Reason
Asexual (vegetative propagation)	The farmer wants plants with the same desirable characters, quickly and on a large scale (e.g. banana, rose, sugarcane, potato, lemon)	Only one parent is involved, so the new plants are genetically identical to the parent and keep its good qualities
Sexual (through seeds)	The farmer wants new varieties, variation, or plants that can adapt to changing conditions (e.g. wheat, maize, rice)	Two parents mix their characters, so the offspring show variation; this is the basis of plant breeding for high-yielding and disease-resistant varieties

Therefore, a farmer prefers asexual methods to get identical, desirable plants quickly, and sexual methods to get variation and new varieties.

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QUESTION 2 *Think It Over · p. 208*

Why do you think most complex animals and flowering plants use sexual reproduction, while many simple organisms, like yeast and hydra mainly reproduce asexually?

ANSWER

Sexual reproduction produces variation, while asexual reproduction is quick and simple. Each suits a different kind of organism.

a Simple organisms (yeast, hydra)

- A single parent can reproduce by budding or similar methods without needing a partner, so the population increases quickly when conditions are favourable.
- The offspring are clones of the parent.

b Complex animals and flowering plants

- Two parents contribute genetic material, and the mixing of characters (through meiosis and fertilisation) gives small differences between parents and young ones.
- Accumulated over many generations, such variation helps living beings adapt to changing environments and sometimes gives rise to new kinds of species.

Therefore, complex organisms depend on the variation created by sexual reproduction to adapt, whereas simple organisms can multiply quickly by asexual reproduction.

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QUESTION 3 *Activity 11.1 · p. 209*

Interact with gardeners working in your school garden or farmers working in a field. Observe the technique of cutting followed by them. (i) Does the gardener cut the overgrown branches of a plant at the end of its growing season? (ii) Observe them prepare the cuttings; note the average length of the cuttings. (iii) Count the number of nodes and internodes on the cuttings. Then collect shoot cuttings in the morning, remove leaves from the lower half, insert them up to about half their length in soil mixed with compost at an angle of about 45–60° (Fig. 11.2) and water them regularly.

ANSWER

Cutting is a method of vegetative propagation in which a piece of a stem grows into a new plant. This is a model record of the observations.



Fig. 11.2: Cutting

Point	Model observation
(i)	Yes. Gardeners usually trim overgrown branches at the end of the plant's growing season (different plants have different growing seasons), and use these branches for cuttings
(ii)	Cuttings are pieces of a shoot; the length depends on the plant and the gardener, so note the average length in your notebook
(iii)	Count and record the nodes and internodes on each cutting (a node is the point on the stem where leaves are attached)
After planting	With regular watering, the cuttings sprout new shoots and roots and grow into new plants

- Cuttings are planted in the morning; the leaves of the lower half are removed so that this part can be buried in the soil.

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- Examples from the chapter: money plant stem and sugarcane stem cuttings grow into new plants.

Therefore, a stem cutting planted in moist, compost-mixed soil grows into a new plant identical to the parent.

QUESTION 4 *Activity 11.1 · p. 210*

Observe the technique of grafting followed by gardeners. Take a healthy rooted plant (Plant A) and a healthy stem piece from another plant (Plant B). Create a slit on a twig of Plant A; insert and fit the cutting of Plant B into it; protect the wound with a cotton cloth or wrapping film; cut the other branches of Plant A; water regularly and observe the growth of Plant B along with Plant A (Fig. 11.3).

ANSWER

In grafting, a stem piece of one plant is joined to a rooted plant so that the two grow together as one plant.

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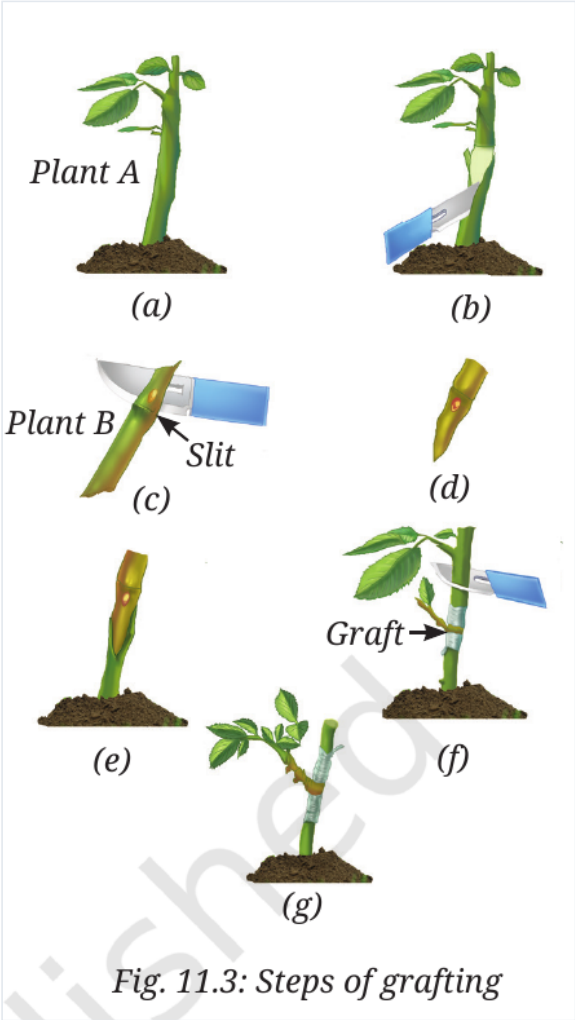

Fig. 11.3: Steps of grafting

Step	What is done (Fig. 11.3)
1	Take a healthy rooted plant (Plant A), e.g. a wild rose variety, and a healthy stem piece (Plant B) of another variety, e.g. a yellow or pink rose (Fig. 11.3a, c, d)
2	Make a wound or slit on a twig of Plant A (Fig. 11.3b)
3	Insert and fit the cutting of Plant B into the slit of Plant A (Fig. 11.3e)
4	Cover the slit with cotton cloth or wrapping film so that pests do not enter until the graft heals (Fig. 11.3f); cut the other branches of Plant A
5	Water the plant regularly and observe the growth of Plant B along with Plant A

- Observation: after the graft heals, the shoot of Plant B grows on Plant A and bears the flowers or fruits of variety B.
- KVKs under ICAR teach farmers modern grafting so that they can grow high-yield fruits and increase their income.

Therefore, grafting combines the rooted plant A with the desirable variety B, which grows as part of one plant.

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QUESTION 5 *Activity 11.1 · p. 210*

Observe the technique of layering followed by gardeners. Select a flexible, thin twig of a tree or a shrub, such as a lemon, and bury the middle part of the twig under the soil surface (Fig. 11.4). Water it regularly and observe the growth of new leaves. After 10–15 days the roots will develop; once roots have developed, cut the twig from the parent plant so that it can grow as a new plant.

ANSWER

In layering, roots are made to grow on a twig while it is still attached to the parent plant.



Fig. 11.4: Layering

- The buried middle part of the twig gets enough water and develops roots after about 10–15 days; new leaves appear on the part of the twig above the soil.
- When roots have developed, the twig is cut from the parent plant, and it grows as a new, independent plant.
- The new plant is genetically identical to the parent plant.

Therefore, in layering a bent twig buried in soil develops roots and, once cut, becomes a new plant.

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QUESTION 6 *Section 11.1.1 · p. 209*

How is vegetative propagation in plants helpful in agriculture?

ANSWER

Vegetative propagation gives genetically identical plants from one parent, so farmers can multiply desirable crops quickly and on a large scale.

- Methods such as cutting, grafting, layering and tissue culture are used widely to propagate plants efficiently, and have improved agricultural and horticultural practices.
- The plants keep the desirable characters of the parent (e.g. high yield, good fruit).
- Tissue culture (Fig. 11.5) gives mass-produced healthy plantlets from the shoot tip (apical meristem). It helps eliminate virus-infected plants and ensures high yields, as in banana farming.



Fig. 11.5: Plant tissue culture

Therefore, vegetative propagation lets farmers cultivate desirable crops on a large scale with uniform, healthy plants.

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QUESTION 7 *Activity 11.2 · p. 211*

Take 20 mL of sugar solution (1 g in 10 mL) in a test tube. Add a pinch of yeast granules, plug with cotton and keep it undisturbed in a warm place. After 1–2 hours, observe a drop of the mixture under a compound microscope. Do you observe any small, round outgrowths (buds) emerging from the parent yeast cells as shown in Fig. 11.6? Do these features indicate that the yeast is duplicating? How do these observations help you in understanding reproduction in yeast?

ANSWER

Yes, small round outgrowths (buds) are seen on the yeast cells, and they show that yeast is reproducing.

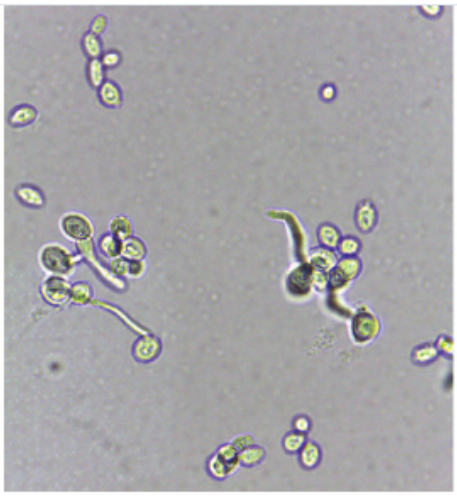

Fig. 11.6: Yeast with outgrowths

- The warm sugar solution lets the yeast become active, and the cells start to reproduce.
- Buds appear on parent cells and later separate to become new yeast cells. So the features indicate that the yeast is duplicating.
- This helps us understand that yeast reproduces asexually by budding, from a single parent, and the new cells are identical to the parent.
- Hydra also reproduces by budding. Repeated cell division at a specific site produces a bud which enlarges and separates from the parent to live independently (Fig. 11.7).

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Fig. 11.7: Budding in hydra

Therefore, the outgrowths seen in yeast are buds, which shows that yeast reproduces by budding.

QUESTION 8 *Section 11.1 · p. 211*

You may have noticed that, if you leave cooked food on the kitchen counter for a day in warm weather, it starts to smell and may even grow fuzzy patches. Black patches are often seen on a damp wall. These are microorganisms. Where do these microorganisms come from?

ANSWER

Microorganisms come from pre-existing life, not from non-living matter.

- For long, people thought living things arose spontaneously from non-living matter.
- Experiments by Louis Pasteur proved that new life always comes from pre-existing life. He also found the germ theory of disease, strengthened the cell theory (all cells arise from pre-existing cells), and led to practices like food and instrument sterilisation.
- The fungi on food and walls grow from spores that are already present in the air and settle on moist places (see Activity 11.3).

Therefore, microorganisms arise from pre-existing microorganisms or their spores, which are present in the air.

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QUESTION 9 *Activity 11.3 · p. 211*

Take a small slice of bread or a roti and lightly moisten it. Prepare a moist chamber (plastic box or steel dabba) with a thin layer of cotton covered with tissue paper moistened with pre-boiled water; put the bread on it. Keep it in a warm and dark place away from direct sunlight. Observe it every day without touching it directly. After three days, observe the surface carefully using a magnifying glass. Do you notice the growth of mould?

ANSWER

Yes, after about three days fuzzy patches of mould grow on the bread or roti.

Point	Explanation
Observation	Fuzzy, thread-like patches (mould) appear and spread over the surface
Where the mould came from	From spores already present in the air, which settled on the moist bread and began reproducing rapidly
Why warm, moist and dark	Spores need warmth and moisture to grow. The chamber was kept warm (25–35 °C); lower temperatures slow or stop their reproduction
Why not touched	Moulds may be harmful, so the bread is observed without touching it directly

Therefore, mould grows on moist bread kept in a warm place because spores from the air germinate there.

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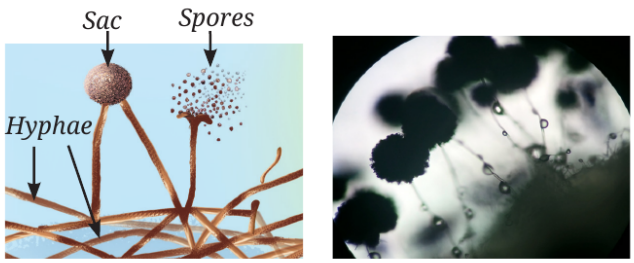
QUESTION 10 *Activity 11.3 · p. 212*

7. Transfer a little mould onto a microscope slide with a needle and add cotton blue stain under the guidance of your teacher. 8. Observe the mould under the microscope and draw its diagram. 9. Compare the diagram with Fig. 11.8 and share your observations.
Do you observe thread-like structures with a round sac at the tip? Do you also see tiny round structures (spores) inside the sac? Where did the mould on your bread slice come from? It was not present when the bread was fresh.

ANSWER

Yes, thread-like hyphae with a round sac (sporangium) at the tip, containing tiny spores, are seen.



(a) Rhizopus (b) Aspergillus

Fig. 11.8: Fungi

- Your diagram should show thin thread-like hyphae, upright stalks with a round sac at the tip, and tiny round spores inside the sac. This matches Rhizopus (Fig. 11.8a).
- The mould was not there when the bread was fresh because it grew from spores already present in the air, which settled on the moist bread.
- Spores are formed in a sac-like structure or on a swollen vesicle on a long strip of fungal hyphae. They are produced in huge numbers (millions from one colony), are lightweight and usually single-celled, and float easily through air currents until they find moisture and nutrients.
- This is asexual reproduction by spore formation. Fungi grow very fast by spore formation.

Therefore, the mould on the bread arose from air-borne spores, and fungi reproduce asexually by forming spores.

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QUESTION 11 *Bridging Science and Society · p. 212*

Do you know any fungus that can degrade plastic?

ANSWER

This is a research question. Scientists have reported that some fungi can break down certain plastics.

- The chapter notes that fungi grow very fast by spore formation and degrade organic wastes and pollutants.
- Examples reported by researchers include *Aspergillus tubingensis* and *Pestalotiopsis microspora*, which can break down polyurethane plastic. You can search for more on this topic.
- Such fungi may help in managing plastic waste in future.

Therefore, some fungi, such as Aspergillus tubingensis, have been found to degrade plastic; this is an active area of research.

QUESTION 12 *Activity 11.4 · p. 213*

Take three pairs of beads of different colours (Fig. 11.9), each pair representing two contrasting characters on different chromatids of different chromosomes. Pair 1 (green): light green (blonde hair) and dark green (black hair). Pair 2 (blue): light blue (straight hair) and dark blue (curly hair). Pair 3 (red): light red (brown eyes) and dark red (black eyes). Make a combination by randomly picking one bead from each pair. 4. How many combinations can you make with just these three pairs of characters? 5. Imagine how many combinations are possible with 23 pairs of chromosomes, each carrying genetic information for many characters. (Also: How many combinations of characters can gametes carry?)

ANSWER

A gamete gets only one bead (one chromosome) from each pair, so each pair gives two choices.

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ous floral parts in the different flowers
.1.

dy the parts of a flower

different		Other feature(s)	Guess the function of flower part
	D		

a Three pairs of characters

No.	Combination of beads	Characters
1	light green, light blue, light red	blonde, straight, brown eyes
2	light green, light blue, dark red	blonde, straight, black eyes
3	light green, dark blue, light red	blonde, curly, brown eyes
4	light green, dark blue, dark red	blonde, curly, black eyes
5	dark green, light blue, light red	black hair, straight, brown eyes
6	dark green, light blue, dark red	black hair, straight, black eyes
7	dark green, dark blue, light red	black hair, curly, brown eyes
8	dark green, dark blue, dark red	black hair, curly, black eyes

- Number of combinations = $2 \times 2 \times 2 = 2^3 = \mathbf{8}$.

b Twenty-three pairs of chromosomes

- Each of the 23 pairs gives 2 choices, so the number of combinations = 2^{23} = 8,388,608 (about 84 lakh), even before counting the many characters on each chromosome.
- This random mixing makes children genetically different from their parents and siblings. Each of us receives a unique combination of chromosomes, which creates variation.

Therefore, three pairs give 8 combinations, and 23 pairs give 2^{23} = 8,388,608 combinations.

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QUESTION 13 *Section 11.2.2 · p. 214*

Flowers also enhance the aesthetics of the plants as they are coloured and/or fragrant. How are these features of flowers useful for reproduction?

ANSWER

Colour and fragrance help flowers to attract pollinators, and pollination is needed for reproduction.

- Insects such as bees and butterflies, and birds, are attracted by bright colours, nectar and fragrance, and visit the flowers.
- When they visit, pollen sticks to their bodies and is carried to the stigma of another flower, which brings about pollination and then fertilisation, followed by seed and fruit formation.

Therefore, the colour and fragrance of flowers attract pollinators and so help in pollination and reproduction.

QUESTION 14 *Section 11.2.2 · p. 214*

Explore flowers and their buds on some plants. Do you observe thin, flat, green covering, and coloured projections present in both? … Do you think that sepals protect flowers in the bud stage, along with other parts of the flower when it blooms? Do all flowers have these two parts? What are the other parts of a flower?

ANSWER

Yes. The green covering is the sepal and the coloured projections are the petals.

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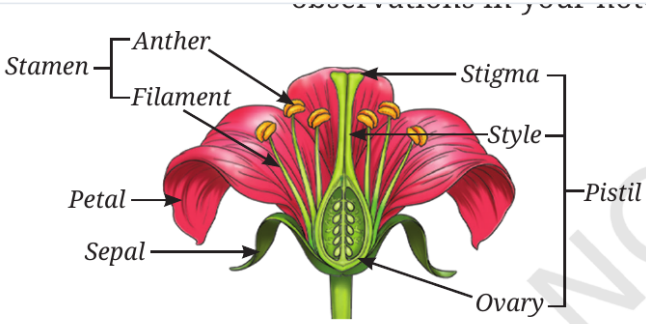

Fig. 11.10: Longitudinal section of a flower showing its different parts

- In the bud stage, the green sepals form the outermost whorl and cover the coloured petals and the inner parts, so they protect the flower bud (and other parts of the flower when it blooms).
- Not all flowers have both: in some flowers the sepals and petals are fused. A complete flower has four parts.
- The other parts are the **stamens** (male part: filament and anther) and the **pistil** (female part: stigma, style and ovary).

Therefore, a flower has sepals, petals, stamens and pistil; sepals protect the bud.

QUESTION 15 *Activity 11.5 · p. 214*

Collect different types of flowers from your surroundings. Carefully observe each part starting from the outer whorl to the inner one. Record the presence of various floral parts in Table 11.1, guess their functions, cut a transverse and a longitudinal section of the ovary and observe it under a dissecting microscope, and draw a diagram.

ANSWER

The presence of parts in flowers A–D depends on the flowers you collect. The part names, functions and the ovary observation are given below.

S. No.	Flower part	Function (guess from visible characters)	Other feature(s)
1.	Sepal	Green; protects the flower in the bud stage	Outermost whorl; may be fused in some flowers
2.	Petal	Coloured and/or fragrant; attracts pollinators	Coloured projections; may be fused

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S. No.	Flower part	Function (guess from visible characters)	Other feature(s)
3.	Stamen (male)	Anther produces pollen grains containing male gametes; filament holds the anther	Absent in some flowers (as in flower A)
4.	Pistil (female)	Stigma receives pollen; style connects stigma to ovary; ovary contains ovules	Stigma is at the tip, flat and/or sticky

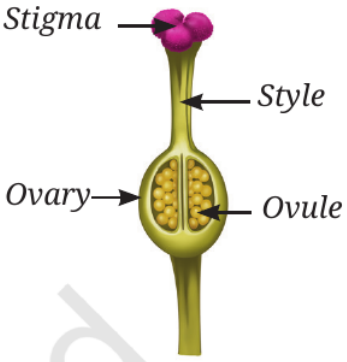

Fig. 11.11: Structure of a pistil

- Ovary sections: the ovary (swollen base of the pistil) contains small round ovules, and each ovule has an egg cell (female gamete). Both the transverse and the longitudinal sections show the ovules inside the ovary; draw what you see.
- Flower A in the table: sepal Yes, petal Yes, stamen No, pistil Yes (given in the chapter), so it has only the female part.

Therefore, sepals protect, petals attract, stamens produce pollen and the pistil contains the ovary with ovules.

QUESTION 16 *Section 11.2.2 · p. 215*

Can you guess the function of the most attractive part of a flower — the coloured petals? … You have learnt that the transfer of pollen from stamen to stigma is essential for the formation of fruits. How can you investigate it?

ANSWER

The coloured petals attract pollinators such as insects and birds.

- Bright colour (and fragrance) draw bees, butterflies and birds to the flower, so pollen can be carried from one flower to another.

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- To investigate whether pollen transfer is needed for fruit formation, we can cover some flowers with muslin bags and remove the stamens from some, as in Activity 11.6, and then see in which flowers fruits form.

Therefore, petals attract pollinators, and the need for pollen transfer is tested by Activity 11.6.

QUESTION 17 *Activity 11.6 · p. 215*

Select two juvenile flower buds and three freshly blossomed flowers on the same pea plant. Remove the stamens from one of the two buds and one of the three flowers. Loosely wrap muslin cloth bags around the flower bud, the flower bud with stamens removed, the flower with stamens removed and one freshly blossomed flower (Fig. 11.12). Leave one freshly blossomed flower uncovered. Note your observations in Table 11.2. In which treatment(s) do you find the flowers are replaced by fruits? What can we infer from this activity?

ANSWER

Fruits form in all the treatments except the flower bud whose stamens were removed.



Fig. 11.12: Experimental set-up for pollination

Treatment (Table 11.2)	Fruit formation	Reason
Flower bud (wrapped with muslin cloth bag)	Yes	Its own stamens are present, so its pollen reaches its stigma

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Treatment (Table 11.2)	Fruit formation	Reason
Flower bud with removed stamens (wrapped)	**No**	No stamens and the bag stops other pollen, so no pollen reaches the stigma
Flower with removed stamens (wrapped)	Yes	The freshly blossomed flower may already have received pollen before its stamens were removed
Flower (wrapped with muslin cloth bag)	Yes	Self-pollination by its own stamens
Flower (without muslin cloth bag)	Yes	Pollen can reach it freely

a Inference

- Fruit forms only when pollen reaches the stigma. The transfer of pollen grains from the anther to the stigma is necessary for fruit formation.
- The transfer of pollen grains from the anther to the stigma of a flower is called **pollination**.

Therefore, fruits form in all treatments except the bud with stamens removed; pollen transfer (pollination) is necessary for fruit formation.

QUESTION 18 *Section 11.2.3 · p. 216*

What do you think will happen if pollination does not occur?

ANSWER

If pollination does not occur, the flower will not form fruits and seeds.

- The transfer of pollen grains to the stigma is important for the formation of fruits and seeds.
- Without pollen on the stigma, no pollen tube grows, so fertilisation cannot take place and no zygote, seed or fruit is formed. The plant cannot reproduce sexually, as seen in the bud whose stamens were removed in Activity 11.6.

Therefore, without pollination there is no fertilisation, and so no seeds and fruits.

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QUESTION 19 *Section 11.2.4 · p. 217*

What is the approximate success rate of the common strategies — wind pollination and insect pollination — with respect to the seed formation?
Activity 11.7: 1. Compare and analyse the two strategies in terms of (Table 11.3) — pollen to seed ratio; efficiency of pollination and seed formation.
Table 11.3: Wind-pollinated grasses (e.g., maize, wheat): pollen grains per flower 5,00,000–10,00,000; seeds formed 50–200.
Insect-pollinated plants (e.g., sunflower): pollen grains 20,000–40,000; seeds 800–1,000.

ANSWER

Insect pollination turns a much larger share of pollen into seeds than wind pollination.

Calculation	Wind (maize, wheat)	Insect (sunflower)	Check
Pollen grains per flower	5,00,000–10,00,000	20,000–40,000	Table 11.3
Seeds formed	50–200	800–1,000	Table 11.3
Pollen : seed ratio	From 500000 ÷ 200 = 2,500 : 1 to 1000000 ÷ 50 = 20,000 : 1	From 20000 ÷ 1000 = 20 : 1 to 40000 ÷ 800 = 50 : 1	About 2,500–20,000 pollen grains per seed (wind) against 20–50 (insect)
Seeds per pollen (success rate)	200 ÷ 500000 = 0.04 % to 50 ÷ 1000000 = 0.005 %	1000 ÷ 20000 = 5 % to 800 ÷ 40000 = 2 %	Insect: about 2–5 %; wind: about 0.005–0.04 %

- Insect pollination is far more efficient: about 2–5 % of pollen results in seeds, compared with only about 0.005–0.04 % for wind pollination (roughly 50 to 1000 times more efficient).
- Wind-pollinated plants waste a lot of pollen because the wind carries it randomly; insects carry pollen directly from flower to flower.

Therefore, the success rate of wind pollination is very low (about 0.005–0.04 %), and that of insect pollination is much higher (about 2–5 %).

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QUESTION 20 *Activity 11.7 · p. 217*

2. Explain why producing a very large number of pollen grains can still be an effective pollination strategy.

ANSWER

Producing huge amounts of pollen makes up for the poor chance that any one grain reaches a stigma.

- In wind pollination the pollen is carried by chance, and most of it is lost. A very large number (5,00,000–10,00,000 per flower) increases the chance that at least some grains land on the stigma.
- Wind-pollinated flowers have light, small pollen grains produced in large numbers, and a long, feathery stigma to trap them.
- Even with a low success rate, the numbers are so large that 50–200 seeds are formed per flower. The plant also does not spend energy on bright petals, nectar or fragrance to attract pollinators.

Therefore, large pollen numbers improve the odds of pollination, so the strategy still works even though most pollen is wasted.

QUESTION 21 *Pause and Ponder 1 · p. 217*

In a china-rose (hibiscus or gudhal) plant, a pollen tube grows and continues through the style after pollen lands on the stigma. Which process is about to happen next?

ANSWER

The next process is fertilisation.

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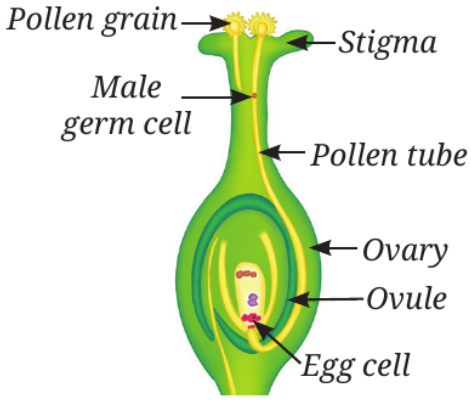

Fig. 11.14: Germination of pollen on stigma

- The pollen tube grows down through the style into the ovary. The male gamete moves through this tube and reaches the ovule.
- In the ovule, the male gamete fuses with the egg cell; this fusion of gametes is fertilisation. The fertilised egg is the zygote, which later develops into an embryo.

Therefore, fertilisation (fusion of the male gamete with the egg cell in the ovule) takes place next.

QUESTION 22 *Pause and Ponder 2 · p. 217*

Look at the pictures (Fig. 11.16) of calotropis (madar) seeds and dandelion seeds. Can you guess what kind of seed dispersal these seeds are adapted for?

ANSWER

These seeds are adapted for dispersal by wind.

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(a) Madar seeds

(b) Dandelion seeds

Fig. 11.16

- Both seeds have fine, light, hair-like or feathery tufts. These make the seeds very light and let them float in the air and be carried far by wind.
- Seed dispersal takes place by wind or water and animals; here the structures are adaptations for wind dispersal.

Therefore, madar and dandelion seeds are adapted for dispersal by wind.

QUESTION 23 *Pause and Ponder 3 · p. 217*

A farmer plants two varieties of maize side by side, but notices that seeds form only when pollen from one variety reaches the stigma of the other. What type of pollination is this?

ANSWER

This is cross-pollination.

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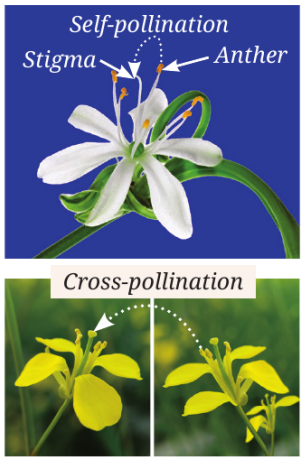

Fig. 11.13: Self and Cross-pollination

- In cross-pollination, pollen is transferred from the anther of a flower of one plant to the stigma of a flower of another plant of the same type.
- Here pollen of one variety must reach the stigma of the other variety, so the pollination is between different plants.

Therefore, it is cross-pollination.

QUESTION 24 *Pause and Ponder 4 · p. 218*

Why do animals with external fertilisation generally produce more eggs than animals with internal fertilisation?

ANSWER

In external fertilisation many eggs are lost or destroyed, so a large number must be laid.

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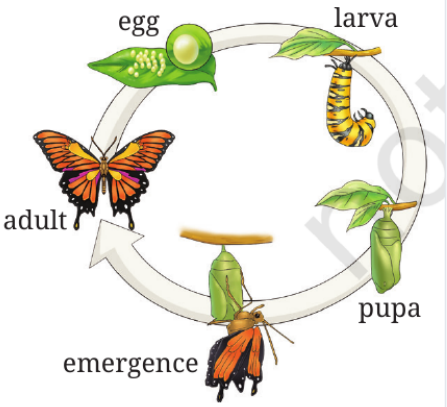

Fig. 11.17: Life cycle of a butterfly

- In external fertilisation (frogs and most fish), the female releases eggs into the water and the male releases sperm over them. Many eggs are destroyed by water currents or eaten by other animals, and the survival of young ones is low.
- Producing very many eggs (e.g. frog 5,000–50,000 at a time, Table 11.4) increases the chance that some young ones survive.
- In internal fertilisation the fertilised egg or embryo is better protected, survival is higher, and fewer eggs are enough (lizard 2–20, bird 1–15 at a time).

Therefore, animals with external fertilisation lay more eggs to make up for the heavy loss of eggs and young ones.

QUESTION 25 *Pause and Ponder 5 · p. 218*

In animals, which fertilisation method the gametes are more protected?

ANSWER

The gametes (and the embryo) are more protected in internal fertilisation.

- In internal fertilisation (reptiles, birds and mammals), fertilisation takes place inside the body of the female, so the gametes are not exposed to water currents or predators.
- In external fertilisation the eggs and sperm are in water, where many are destroyed or eaten.

Therefore, internal fertilisation protects the gametes more.

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QUESTION 26 *Threads of Curiosity · p. 221*

The mother always contributes an X chromosome to a baby and the father contributes either an X (Female: XX) or a Y (Male: XY) chromosome. Now, from the above information, can you predict who determines the sex of a baby?

ANSWER

The father determines the sex of the baby.

Egg from mother	Sperm from father	Baby
X	X	XX: girl (female)
X	Y	XY: boy (male)

- Every egg carries an X chromosome, while a sperm carries either an X or a Y chromosome. So it is the chromosome in the sperm that decides whether the baby is a girl or a boy.

Therefore, the sex of the baby is determined by the father's chromosome (X or Y).

QUESTION 27 *Pause and Ponder 6 · p. 222*

Ravi suddenly notices that he is growing taller rapidly, his shoulders are broadening, and his voice cracks. What stage of life is he entering?

ANSWER

Ravi is entering puberty (adolescence).

- At puberty, the reproductive organs mature and begin producing gametes. In boys the testes produce a hormone that controls sperm production and causes physical changes such as rapid growth, broadening of shoulders and a change in voice.
- This is the stage when a child grows into an adult and reproductive maturity begins.

Therefore, Ravi is entering puberty.

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QUESTION 28 *Pause and Ponder 7 · p. 222*

Rina’s period occurs every 28 days. Her last period was on the 5th of March. On which day is she most likely to get her next period?

ANSWER

She is most likely to get her next period on 2nd April.

Step	Working
Cycle length	28 days
Last period	5th March (March has 31 days)
Days left in March after the 5th	31 − 5 = 26 days (up to 31st March)
Remaining days	28 − 26 = 2 days, i.e. 2nd April
Check	5th March + 28 days = 2nd April

Therefore, Rina’s next period is most likely on 2nd April.

QUESTION 29 *Pause and Ponder 8 · p. 222*

A human zygote has just formed. How many chromosomes does it have?

ANSWER

The zygote has 46 chromosomes.



Egg *Sperm* *Zygote*

Fig. 11.20: Process of fertilisation

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- Human body cells have 46 chromosomes, but the sperm and the egg have only 23 each (formed by meiosis).
- Zygote = sperm + egg = 23 + 23 = 46 chromosomes (23 pairs), the same number as in the parents.

Therefore, a human zygote has 46 chromosomes (23 + 23).

QUESTION 30 *Pause and Ponder 9 · p. 223*

What protective devices can be used during sexual activity to reduce the spread of STIs?

ANSWER

Condoms are the protective devices that reduce the spread of STIs.

- Condoms (and vaginal covers) act as barriers and prevent the transmission of infections from an infected person to an uninfected person. They also help prevent pregnancy.
- STIs include gonorrhoea, herpes, syphilis, genital warts and HIV (which can eventually lead to AIDS). Some of them are not curable yet, so prevention is important.

Therefore, using condoms reduces the spread of STIs.

QUESTION 31 *Pause and Ponder 10 · p. 223*

If a couple uses oral contraceptive pills but not condoms, which risks remain and why?

ANSWER

The risk of sexually transmitted infections remains.

- Oral pills contain hormones that change the release of eggs. They do not act as a barrier, so they do not stop infections from passing from one person to the other.
- They may also have some side effects. Condoms are needed to prevent the transmission of STIs, such as HIV.

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Therefore, STIs can still spread, because pills prevent pregnancy but do not give protection against infection.

QUESTION 32 *Pause and Ponder 11 · p. 224*

In many animals, the young ones can walk or find food soon after birth but human babies are completely dependent on adults for a long time. What might be some advantages and disadvantages of this for humans as a species?

ANSWER

A long period of dependence has both benefits and costs.

Advantages	Disadvantages
Care, protection and feeding (including mother's milk) improve the chances of survival of the young	Parents and family must spend a lot of time, energy and resources for many years
Time to learn skills, language and behaviour from adults, and to grow and mature	The baby is helpless and may be in danger if care is not available
Strong bonds in the family and society	The mother and family have limited ability to look after many young ones at the same time

Therefore, long dependence improves survival and learning but needs sustained care from adults.

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CLASS 9 SCIENCE · CHAPTER 11

11.2 Revise, Reflect, Refine

Solutions · 13 questions

Directions (Questions 1–13): These are the Revise, Reflect, Refine questions at the end of the chapter (pages 225–226). Solutions are given with reasons and, where needed, calculations.

QUESTION 1

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

ANSWER

The correct option is (ii) Cross-pollination.

Option	Verdict	Reason
(i) Self-pollination	Incorrect	The anthers were removed, so the flower’s own pollen cannot reach its stigma
(ii) Cross-pollination	**Correct**	Pollen from the anther of another plant of the same species was transferred to the stigma of this flower
(iii) Fertilisation	Incorrect	Fertilisation is the fusion of the male gamete with the egg inside the ovule, after pollination
(iv) Tissue culture	Incorrect	It is a method of vegetative propagation (asexual), not a sexual process

Therefore, the process ensured is cross-pollination: option (ii).

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QUESTION 2

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

ANSWER

The correct order is (iii) → (i) → (ii) → (iv).

Order	Stage	What happens
1	(iii) Pollination	Pollen is transferred from the anther to the stigma
2	(i) Pollen germination on stigma	The pollen grain produces a pollen tube that grows down through the style into the ovary
3	(ii) Fertilisation	The male gamete reaches the ovule and fuses with the egg cell
4	(iv) Formation of zygote	The fertilised egg is the zygote, which later develops into an embryo

Therefore, the correct sequence is pollination, pollen germination, fertilisation, formation of zygote.

QUESTION 3

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.

ANSWER

The correct option is (iv): A is false, but R is true.

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- Assertion A is false: after fertilisation in the oviduct, the zygote does not attach immediately. It undergoes a series of mitotic divisions while travelling to the uterus, and then implants into the inner lining of the uterus.
- Reason R is accepted as true: in every cycle the uterus prepares itself, and its inner lining becomes thick and rich in blood vessels to receive and nourish a developing zygote. (If no egg is fertilised, the lining is shed as menstruation.) This preparation, however, does not explain immediate attachment.
- Since A is false, only option (iv) is possible among the given options.

Therefore, the correct option is (iv): A is false, but R is true.

QUESTION 4

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

ANSWER

Because asexual reproduction involves only one parent and the cells divide by mitosis.

- The central process in asexual reproduction is mitosis, a type of cell division that produces two daughter cells, each having the same number of chromosomes identical to the parent cell.
- No second parent contributes any genetic material, and there is no mixing of characters, so the offspring are genetically identical to the parent. Such offspring are called clones.

Therefore, asexual offspring are genetically identical to the parent because they arise from mitosis of a single parent.

QUESTION 5

Explain why the menstrual cycle stops during pregnancy.

ANSWER

The uterine lining is needed to nourish the developing baby, so it is not shed.

- Menstruation occurs only when an egg is not fertilised: the thick lining, rich in blood vessels, is no longer needed and is shed.

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- If the egg is fertilised, the zygote implants in the inner lining of the uterus to receive nourishment, and the lining stays thick and rich in blood vessels to support the embryo and foetus.
- The hormones of pregnancy also prevent the release of new eggs, so the cycle of ovulation and menstruation stops until after the baby is born.

Therefore, the menstrual cycle stops during pregnancy because the uterine lining is retained to nourish the baby.

QUESTION 6

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

ANSWER

Light-coloured flowers are easier to see in the dark and so attract night-active pollinators.

- At night there is very little light. White or pale flowers reflect what light there is and stand out, whereas dark or deeply coloured flowers would not be visible.
- Pollinators active at night, such as moths and bats, are attracted to such pale flowers, which are often also fragrant. Flowers of the day are brightly coloured to attract bees, butterflies and birds.
- Colour and fragrance help in pollination, which is essential for reproduction.

Therefore, night-blooming flowers are white or light so that pollinators can see them in the dark.

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QUESTION 7

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

ANSWER

Vegetatively propagated plants are genetically identical, so they have the same weaknesses.

- Vegetative propagation involves only one parent and produces clones, so there is no variation among the plants.
- If a disease can infect one plant, it can infect all the plants, since they are all equally susceptible. A virus-infected parent can also pass the infection to all the new plants (this is why tissue culture from the shoot tip is used to get virus-free plants).
- Sexual reproduction mixes characters of two parents and creates variation. Some individuals are likely to have resistance, so the species is more likely to survive.

Therefore, lack of variation makes vegetatively propagated plants more vulnerable to diseases.

QUESTION 8

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.

ANSWER

The genetic diversity would decrease over the generations.

- In self-pollination the pollen comes from the same flower or another flower of the same plant, so the genetic material comes from a single plant.
- There is little mixing of characters, so the offspring are very similar to the parent and to one another, and variation would be lost over generations.
- With low variation, the plants would be less able to adapt to changing environments or to resist diseases, and new kinds of species would arise less easily.
- In cross-pollination, pollen from another plant mixes characters and increases variation.

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Therefore, only self-pollination would reduce genetic diversity and make the species less adaptable.

QUESTION 9

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

ANSWER

Vegetative propagation (asexual reproduction) is the most suitable.

Method	Why it is effective
Cutting	A piece of the stem grows into a new plant; simple and quick (e.g. sugarcane, money plant)
Grafting	Joins a desirable variety to a rooted plant, so improved varieties of fruits can be grown
Layering	A twig develops roots while attached to the parent and then grows as a new plant
Tissue culture	Mass-produces healthy plantlets from the shoot tip, free from virus (e.g. banana)

- All these methods involve only one parent, so the new plants are genetically identical (clones) and keep the desirable characters of the parent.
- They do not depend on seeds and pollination, and let farmers cultivate desirable crops on a large scale.

Therefore, cutting, grafting, layering and tissue culture give many identical plants quickly.

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QUESTION 10

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?

ANSWER

The only thing that changes between the slides is the sugar concentration, so the set-up tests how sugar affects pollen germination.

a (i) Hypotheses that can be tested

- Pollen grains do not germinate in plain water (0 % sugar); sugar is needed for germination.
- Germination increases as the sugar concentration increases, up to a certain value.
- Beyond a certain concentration, germination decreases (a very high sugar concentration is harmful).
- There is an optimum sugar concentration at which the maximum number of pollen grains germinate (and the pollen tubes are longest).

b (ii) Parameters to keep the same

Parameter	Kept same
Pollen	Same plant species and flower, with pollen of the same freshness and about the same number of grains per slide
Solution	Same volume of solution on each slide
Conditions	Same temperature, humidity, light and the same time allowed for germination
Observation	Same microscope magnification and the same way of counting germinated grains

- The variable changed is the sugar concentration; the quantity measured is the percentage of germinated pollen grains (or the pollen tube length).

Therefore, hypotheses relate germination to sugar concentration, and all other conditions are kept constant.

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QUESTION 11

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.

ANSWER

Tomato	Wheat	Papaya
		
Stamens cover the stigma.	Flowers open after pollination.	Male and female flowers are often borne on different papaya trees.

Plant	Type of pollination	Reason
Tomato	Self-pollination	The stamens cover the stigma, so pollen falls on the stigma of the same flower
Wheat	Self-pollination (mainly)	The flowers open after pollination, so pollen has already reached the stigma inside the flower. (The chapter also lists wheat among wind-pollinated plants, so wind can carry pollen between flowers too)
Papaya	Cross-pollination	Male and female flowers are on different trees, so pollen must be carried from one plant to another

Therefore, tomato: self-pollination; wheat: self-pollination; papaya: cross-pollination.

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QUESTION 12

In the lower Himalayan region of northern India, apples are an important cash crop that contribute significantly to farmer's livelihoods. The fruit yield in apple cultivation is declining continuously, associated with climate change and a significant decline in the population of natural pollinators. A researcher-farmer group set up two experimental apple orchards at two distinct locations: Places A and B. In apple orchards at Place A, they allowed natural pollinators to pollinate the flowers of the apple. In apple orchards at Place B, they applied mixed farming techniques of beekeeping. Along with honey, the farmer yielded apples. The yield is depicted in Fig. 11.24, in terms of fruit setting and fruit drop.
(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?

ANSWER

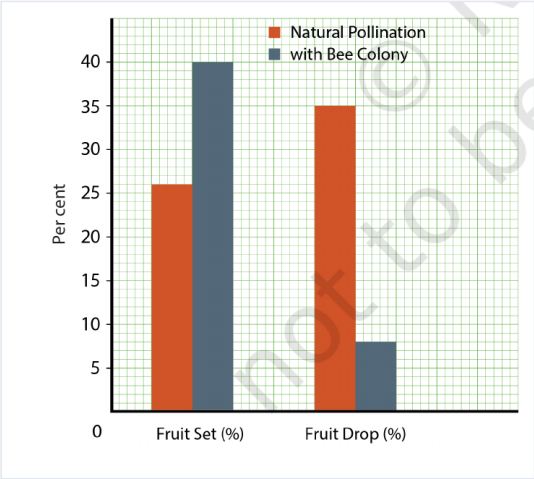

Fig. 11.24. Fruit set (%) and fruit drop (%) in apple orchards: natural pollination (Place A) and with bee colony (Place B)

a **(i) Hypotheses**

- Keeping bee colonies in the orchard (beekeeping) increases fruit setting compared with depending only on natural pollinators.
- Bee colonies reduce fruit drop (premature falling of developing fruits).
- The decline in natural pollinators is one reason for the declining apple yield.

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b (ii) Parameters

Type	Parameters
Variable changed	Pollination method: natural pollinators only (Place A) or with a bee colony (Place B)
Variables measured	Fruit set (%) and fruit drop (%)
Kept the same (ideally)	Apple variety, age and number of trees, climate, soil and orchard management

c (iii) Comparison (values read from the graph, approximate)

Measure	Place A (natural)	Place B (bee colony)	Difference
Fruit set (%)	about 26	about 40	+14 percentage points (about 54 % more)
Fruit drop (%)	about 35	about 8	−27 percentage points (about 77 % less)

d (iv) Inference

- Place B has higher fruit setting and much lower fruit drop, so more apples are retained and the yield is higher.
- So bee colonies improve pollination and apple yield; beekeeping is beneficial for orchards when natural pollinators decline, and the farmer also gets honey.

Therefore, orchards with bee colonies (Place B) give higher fruit set and lower fruit drop than orchards with natural pollination (Place A).

QUESTION 13

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.

ANSWER

The claim is not correct. Ovulation happens around day 14 only in a typical 28-day cycle.

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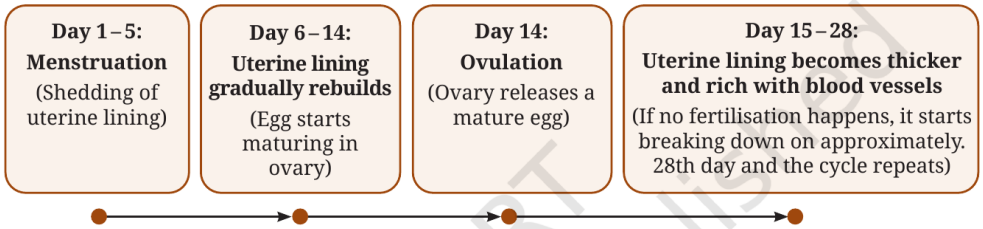

Fig. 11.21: Key stages of the menstrual cycle across a typical 28-day period

- **Reason 1:** The length of the cycle varies; it typically repeats every 21–35 days (often around 28 days). Ovulation is not fixed at day 14: in a shorter or longer cycle it comes earlier or later.
- **Reason 2:** Fig. 11.21 shows a typical 28-day period only; the “Day 14” is a general guide and the “At a Glance” summary says ovulation takes place around the 14th day.
- **Reason 3:** The cycle differs from person to person, and also from month to month in the same person (for example with age, health or stress), so the exact day of ovulation can vary.

Therefore, ovulation occurs around day 14 in a typical 28-day cycle, but not always; the claim is incorrect.

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11.3

CLASS 9 SCIENCE · CHAPTER 11

The Journey Beyond

Solutions · 5 questions

Directions (Questions 1–5): These are the questions in The Journey Beyond and The Quest Continues ... sections at the end of the chapter (page 227). Field activities and reports are answered with model answers.

QUESTION 1

Read about the ‘Seed Village Programme’ (Beej Gram Yojana) run by the Government of India. Why is it important to save indigenous seeds?

ANSWER

Indigenous (local) seeds are an important resource that should be saved for agriculture and for the future.

- They are adapted to local soil, climate and conditions, and are often more resistant to local pests and diseases.
- They keep genetic diversity, which is needed to breed new varieties (disease-resistant, high-yielding) in the future.
- Farmers can save and reuse their own seeds, which reduces dependence on bought seeds.
- Seed village programmes help farmers produce and exchange quality seeds in their own village.

Therefore, saving indigenous seeds protects variation, local adaptation and the farmers’ independence.

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QUESTION 2

Prepare a report on IVF, its uses and drawbacks. Discuss it with your class.

ANSWER

Model report based on the chapter (Meet a Scientist, p. 220).

Heading	Details
What is IVF?	In-vitro Fertilisation: an egg and a sperm are combined outside the female body, usually in a laboratory culture dish (not a test tube). The resulting fertilised egg is implanted in the uterus to begin a possible pregnancy
Uses	Helps couples who cannot have a baby by the natural method. A baby born through this method is commonly known as a "test tube baby"
History in India	In 1978, Subhash Mukhopadhyay of Kolkata pioneered India's first test tube baby, Kanupriya Agarwal (nicknamed Durga)
Drawbacks (for discussion)	It is a costly, medically complex procedure and success is not guaranteed; it may be emotionally and physically stressful. Discuss these points with your teacher

Therefore, IVF is fertilisation outside the body that helps in having babies, but it has limits that should be discussed.

QUESTION 3

Assist your elders in cutting fruits in the kitchen. While cutting fruits like lady finger, tomato, brinjal, capsicum, papaya, orange, muskmelon and more, make your observations based on the following and draw diagrams — (i) L.S. of the fruit, (ii) T.S. of the fruit, (iii) attachment of seeds. Link your observations of the L.S. and T.S. of the fruit with the internal structure of the ovary of the same species.

ANSWER

The fruit develops from the ovary, and the seeds from the ovules, so the inside of the fruit matches the inside of the ovary.

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(a) L.S. of Tomato fruit



(b) T.S. of Tomato fruit



(c) L.S. of Tomato flower

Observation	Model answer (tomato, Fig. (a)–(c))
(i) L.S. of fruit	Cut lengthwise, the fruit shows the seeds inside, in the central part, with the thick fruit wall around
(ii) T.S. of fruit	Cut across, the fruit shows several compartments (chambers) with seeds in them
(iii) Attachment of seeds	The seeds are attached inside the fruit to the part from which the ovules were attached in the ovary
Link with the ovary	The L.S. and T.S. of the tomato flower (c) show the ovary with ovules in its chambers; after fertilisation the ovary becomes the fruit and the ovules become the seeds

- Do the same with the other fruits (lady finger, brinjal, capsicum, papaya, orange, muskmelon), draw the diagrams and note the number of chambers and the arrangement of seeds in each.

Therefore, the chambers and seed attachment in a fruit correspond to the ovary and ovules of the flower.

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QUESTION 4

Explore the crop fields near your school and find out different pollination strategies adopted by different cereal and vegetable crop plants. Talk to farmers on the following points — (i) Pollinators of different crops (ii) Reason for the declining population of pollinators and their solutions.

ANSWER

This is a field activity. Model answers based on the chapter and the apple orchard example are given.

Point	Model answer
(i) Pollinators of crops	Cereals such as wheat, maize and rice are pollinated by wind; sunflower and similar crops by insects such as bees and butterflies; aquatic plants by water; and flowers like hibiscus and coral tree also by birds
(ii) Reasons for decline	The chapter links the decline with climate change and a significant decline in the population of natural pollinators. Other reasons you may find from farmers can be added
Solutions	Keeping bee colonies (beekeeping) in orchards, which raised fruit set and reduced fruit drop (Revise, Reflect, Refine Q12); protecting the pollinators and their surroundings

Therefore, crops use wind, insects, water or birds for pollination, and pollinator decline can be reduced, for example by beekeeping.

QUESTION 5

The Quest Continues … Does a unicellular organism like amoeba or yeast ever ‘grow old’? When it divides, it produces almost two identical copies. So, does aging happen at all?

ANSWER

This is an open question for discussion; here is a cautious model answer.

- Amoeba and yeast reproduce by division or budding, giving almost identical copies, so it seems that they might never age.

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- But the two copies are only “almost” identical. Studies on yeast show that the parent cell can bud only a limited number of times and shows signs of ageing, while a new bud starts fresh.
- So ageing may also happen in single-celled organisms, although it is not as clear as in complex organisms. Scientists are still studying this.

Therefore, even unicellular organisms may show some ageing, and this is a topic of continuing research.

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