**FLOWERING PLANT REPRODUCTION**

**Learning aims:**

1. To learn how to draw a biological diagram using a flower from their local ecosystem
2. To understand the significance of biological magnification
3. To relate the structure of a flower to seed production, whilst learning relevant terminology, such as, pollination, fertilization. To identify pollen grains using microscopy
4. To understand the structure of seeds
5. To evaluate the methods used by seed banks in the conservation of endangered plants
6. To inquire about the life cycle of a named insect and its role in pollination
7. To collect pollen from flowers and observe it under a microscope
8. To inquire about the effects of Global warming in seasonal flowering, pollination and seed biology
9. To design and perform an experiment to investigate the time that they can store selected seeds

**Materials:**

* Hand lens
* Pencil
* Ruler
* Flowers
* Seeds
* Pollen grains
* Microscopes
* Stereoscopes
* Camera

The floral industry attracts both the artist and the scientist. The floral industry involves flower production, distribution, design, retailing, operations, marketing, publishing, importing, research, teaching, greenhouse design and engineering, climate control systems engineering, soil analysis, sales and pest management. Field-work with a theme of ”wildflower hunting” is a wonderful way to get students to understand how a tiny flower can be such an important part of an entire ecosystem, thus promoting sensitivity to sustainability as well as teaching students about wild flower ethics. Students need to understand that wildflowers are fragile and many wilt and perish soon after being picked. Yet, the loss of an unknown to be endangered flower is not the only reason why wildflowers should not be picked. Students need to realize that wildflowers support entire ecosystems for pollinators, birds, and small animals on a micro scale. Insects, small birds, and animals depend on seeds, nectar, and pollen for their food supply and life support system. It may be a new idea to introduce students to some pollinators which are not very mobile, have very small home ranges, or depend on just one species of plant and die once their habitat has been destroyed.

**Basic biology of flower reproduction**

Sexual reproduction in plants occurs when the pollen (male sex cell/ gamete) from an anther is transferred to the stigma in a process called pollination. Self-fertilization occurs when pollen fertilizes the egg (female sex cell/ gamete) found inside the ovule of the same flower. The transfer of pollen to the stigma of an entirely different plant, a process called cross-pollination, may lead to cross-fertilization when the pollen fertilizes the egg inside the ovule.

When the egg inside an ovule is fertilized, the ovules will develop into seeds. The petals of the flower fall off leaving only the ovary behind, which will develop into a fruit. There are many different kinds of fruits, including apples and oranges and peaches. A fruit is any structure that encloses and protects a seed, so fruits are also "helicopters" and acorns, and bean pods. When you eat a fruit, you are actually eating the ovary of the flower.

***Exercise 1***

Draw on the blank (next page) a selected flower (magnified approximately 5X) found in their local ecosystem (link with learning aims of activity 3: inquiring for the name of an unknown plant) indicating clearly the reproductive organs.

***Instructions for a biological drawing***

1. Use a pencil and unlined paper when drawing a biological diagram. Position the diagram at the center of the page. Draw only what you actually observe, as opposed to what you think you should be seeing.
2. Use sharp single lines to represent an object. Do not use soft lines characteristic of sketches. Make the illustration large, so that various parts of the specimen are easily distinguishable.
3. Represent darker areas of an object with stippling or dots. Do not shade any areas of the diagram.
4. Print when labelling the different parts of the diagram. Do not use the plural form when identifying a single part or object. Draw a straight line from each label to the part or object it describes. Make sure that these lines do not cross or overlap.
5. Keep in mind that the first part of a scientific name, or the genus name, must be capitalized. The second portion, or the species name, begins with a lower case letter--except when used in the diagram title. Underline scientific names.
6. Write the title of the diagram in capital letters and center it. Remember that the title must be concise and accurately explain the subject of the illustration.
7. Draw scale bars indicating the length and width of a specimen. A scale bar is a straight line that represents the relationship between space on your page and the actual space occupied by the specimen.
8. For microscopic specimens, indicate the magnification at which you observed the object through a microscope. Use sharp single lines to represent an object. Do not use soft lines characteristic of sketches. Make the illustration large so that various parts of the specimen are easily distinguishable.

Read more: How to Draw a Biological Diagram |

eHow.com http://www.ehow.com/how\_5695958\_draw-biological-diagram.html

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| --- | --- |
| D.M. = | drawing length |
|  | actual length |

**Drawing Magnification (D.M.)**

**Further information is given to the students in order to obtain uniform drawings and labeling of the reproductive organs of the flower**

The female reproductive structures are called carpels. In most flowers, the carpels are fused together to form a pistil. The stigma at the top is often sticky and is where the pollen attaches. Draw the stigma (J). The style is the long tube that attaches the stigma to the ovary. Each pollen, found on the stigma, will grow a tube, down the style, towards the ovule (s). Each ovule, contains an egg, is stored in the ovary. Draw the style (K), and the ovary (L). Draw the ovules (O). **Be sure to draw only what you see (refer to biological drawing instructions above).**

Plants can only fertilize eggs of the same species. Special chemicals prevent sperm from fertilizing the eggs of flowers that are not of the same kind.

The male reproductive structures are called the stamens. Draw and label the stamens (H). Each stamen consists of an anther (A), which produces pollen, and a filament (F), which supports the anther. Pollen produced by the anther is carried by insects, or other animals, to the pistil of another flower where it may fertilize an egg.

The receptacle is the part of the branch on which a flower forms. Draw the receptacle (B). Sepals are leaf like structures that surround and protect the flower before it blooms. Draw the sepals (C). Petals are the colorful part of the flower that attracts insects and even other small animals, such as mice, birds, and bats. Draw the petals (D).

All flowering plants have flowers, but some are not brightly colored. The petals of these flowers are reduced or absent and the plant relies on the wind or water for pollination.

***Questions***

Identify a flower which has a visiting insect .

Why do insects visit flowers?

Draw a circle around the characteristic of the flower

A. Large petals

B. Small petals

C. Hanging anthers

D. Small anthers

E. Presence of large numbers of pollen

F. Presence of small numbers of pollen

**Additional information**

Identification of pollen can be used in criminology investigations-forensics- and also to study climate change. Pollen grains and spores form the basis of palaeoclimate reconstruction, generally referred to as pollen analysis, or palynology. Where pollen and spores have accumulated over time, a record of the past vegetation of an area may be preserved. Often, changes in the vegetation of an area may be due to changes of climate. Interpreting past vegetation through pollen analysis may therefore offer a form of palaeoclimatic reconstruction. Sediments containing fossil pollen have been taken from peat bogs, lake beds, alluvial deposits, ocean bottoms and ice cores. Unfortunately, the difficulties associated with pollen analysis have meant that most palaeoclimate reconstructions have proceeded in a qualitative way only - the climate was wetter/drier or warmer/colder.

***Exercise 2***

Pollen grains produced by different species of plant have a distinctive appearance. This allows us to work out what type of plant they came from, which in turn tells us the plants that used to grow in the area. We can observe the distinctive features of different types of pollen using a microscope. This helps us to identify what they are. Two useful features for identifying pollen are pores and furrows. Pores are holes in the surface of a pollen grain. Furrows are slits in the surface of a pollen grain.

**Safety: Be considerate of sensitivity to pollen**

***Follow the methodology below describing how to collect pollen from flowers and observe it under a microscope***

1. Place a dry, sterile, open bag/container under the opening male flowers. Gently tap the stem with a finger. The pollen will slowly settle into the container. (If you are careful, only a few flowers will fall into the mix.)
2. Remove any flower/plant parts that land in your container with the pollen. Tap them off gently before removing, to recover the pollen. (Moisture = BAD)
3. Dilute pollen with sterilized flour at a four-to-one ratio. This will allow more coverage if required (Optional)
4. Refrigerate until use. (Viable for around 3-5 days)
5. Immediately change your clothing and clean up before going near your female plants.
6. Use a paint brush to transfer some pollen from one of the flowers onto a slide and cover with a cover slip.
7. Using x400 magnification count the number of pollen grain visible in the field of

view.

1. Using a different slide, transfer some of each type of pollen onto the slide. The

pollen may stick better if the slide is slightly damp.

1. Observe, measure and draw each type of pollen at x400 magnification. Take

care in measuring, so that you measure the pollen grain only and not any air

bladders that may be present.

**Extended questions**

* Identify the structural features of a wind pollinated flower and explain their role
* Identify the structural features of a maize fruit and explain their role
* Measure and calculate size of pollen using a microscope graticule
* Calculate the rate of germination of pollen tubes.

***Exercise 3***

***Read the passage below:***

Changes in habitat or habitat loss pose the greatest threat to migratory pollinators. A single change along a migratory route can have long lasting and rippling effects that spread beyond any one population of pollinators.

“Bats, hummingbirds, moths and butterflies are among the pollinators that seasonally migrate long and short distances between mountain ranges, regions and countries. Their migratory routes are often well-defined "***nectar corridors***" where the sequence of flowering plants over a season offers pollinators sufficient energy to sustain their journey. Many of these nectar corridors are no longer fully intact. Land conversion has eliminated many floral resources over 20 to 60 mile segments, in some cases longer than the distance energy-depleted pollinators can fly in one day." [(Our Forgotten Pollinators: Protecting the Birds and Bees. By Mrill Ingram, Gary Nabhan and Stephen Buchmann.)](http://www.pmac.net/birdbee.htm)

***Questions***

1. Investigate the life cycle of an insect or another organism that is involved in pollination or requires a specific plant to feed that you have identified in the field study.

2. Inquire about the possibility of new emerging trends in flowering, linking with Global Warming (Refer to the activity of taxonomy).

3. Inquire whether the pollinator that you have identified follows a migratory route of long and short distances between mountain ranges, regions and countries.

***Exercise 4***

Use the web link and the passage below to introduce research that takes place in the Royal Botanic Gardens( RBG) in Australia:

<http://www.rbgsyd.nsw.gov.au/science/> Horticultural\_ Research/seed\_biology

The seed research program is integral to the Seed Quest project, and has provided strong collaborative links to other Millennium Seed Bank partners via projects, such as seed longevity testing. Seeds of many Australian species are expected to be long-lived in storage, with groups, such as, acacias, eucalypts, and casuarinas topping the list. However, the longevity of seeds of most species is unknown. In order to address this, the RBG are collaborating with Australian partners of the Millennium Seed Bank Project to rank a wide range of species according to the longevity of their seeds (Martyn, 2009). The ranking is useful for prioritizing, which species must be cleaned and stored first - a key task at the end of a busy collection season. The ranking will determine which species’ seeds are likely to survive for long periods in storage, help us set appropriate re-testing schedules for banked seeds, and work out which species will need to be regenerated or replenished regularly with fresh seed.

**Experimental work for this project has concluded in late 2009, with data analysis and a draft publication was produced .**

**Questions**

1. Inquire in the network about the final status of the publication?
2. Inquire in the network about the final status of the germination testing program.

***Exercise 5***

Design and perform an experiment to investigate the time that they can store selected seeds (e.g. from a tomato fruit) without loss in the germination rate.

**Further information**

Seeds are considered viable if they can germinate and produce a radicle (young root), which protrudes through the seed coat (testa). However with time, all seeds lose their ability to germinate. Scientists operating in a seed bank need their seeds to remain viable while in storage. Find the Seed Bank Projects in your country, which conduct research to determine the longevity of the seeds they store. Draw a flow chart to summarize the processes involved in the storage of seeds in a seed bank. Students should realize that seed banks storing seeds have a role in scientific research and in reintroducing species to the wild.

**Questions**

1. Inquire about the structure of a seed. Draw seeds or fruits of different plants.
2. From the appearance of the seed structures, make a guess at how each one is dispersed giving reasons for your answers.
3. What are the advantages for a plant having an effective method of seed dispersal?
4. Why is it useful for researchers to know the longevity of the seeds?
5. Why may seeds lose their viability with time?
6. Evaluate the methods used by seed banks in the conservation of endangered plants.
7. Inquire about the longest living seed. Your inquiry will require a web search engine.