Biology 30 – Reproductive Strategies (Life Cycles) Notes Guide

Use this booklet and your textbook pages 573-580 to complete the following.

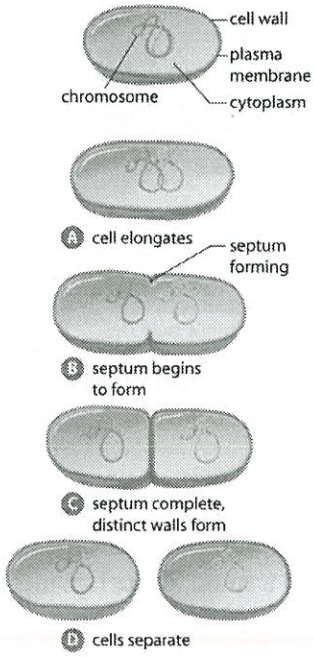
1. **Define** *asexual* reproduction. **Identify** whether mitosis or meiosis is the key mechanism involved in asexual reproduction.

mitotic cell division, identical cells are produced
i.e. $2n \rightarrow 2n$

2. **Define** *sexual* reproduction. **Identify** whether mitosis or meiosis is the key mechanism involved in asexual reproduction.

chromosomal reduction $2n \rightarrow n$
gametes are produced

Reproductive Strategies – Asexual Reproduction



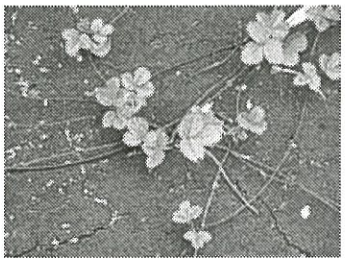
Prokaryotes – e.g., bacteria

- reproduce by:
  - ***binary fission*** (bacteria does not have a nucleus so does not undergo mitosis → this is simply a distribution of one copy of DNA into each of its identical daughter cells, as shown on the left)
    - in favorable conditions, bacteria can produce one generation of new offspring every 20 minutes, and huge populations are produced in a short time, which is called *exponential growth*
    - these populations are genetically *identical* (there is *NO DIVERSITY*, so the population cannot adapt to the changing environment)

Budding – a complete but miniature version of the parent grows out from the parent's body then splits off to become an independent organism

e.g., yeast, *Hydra* (a type of jellyfish)

bud/offspring



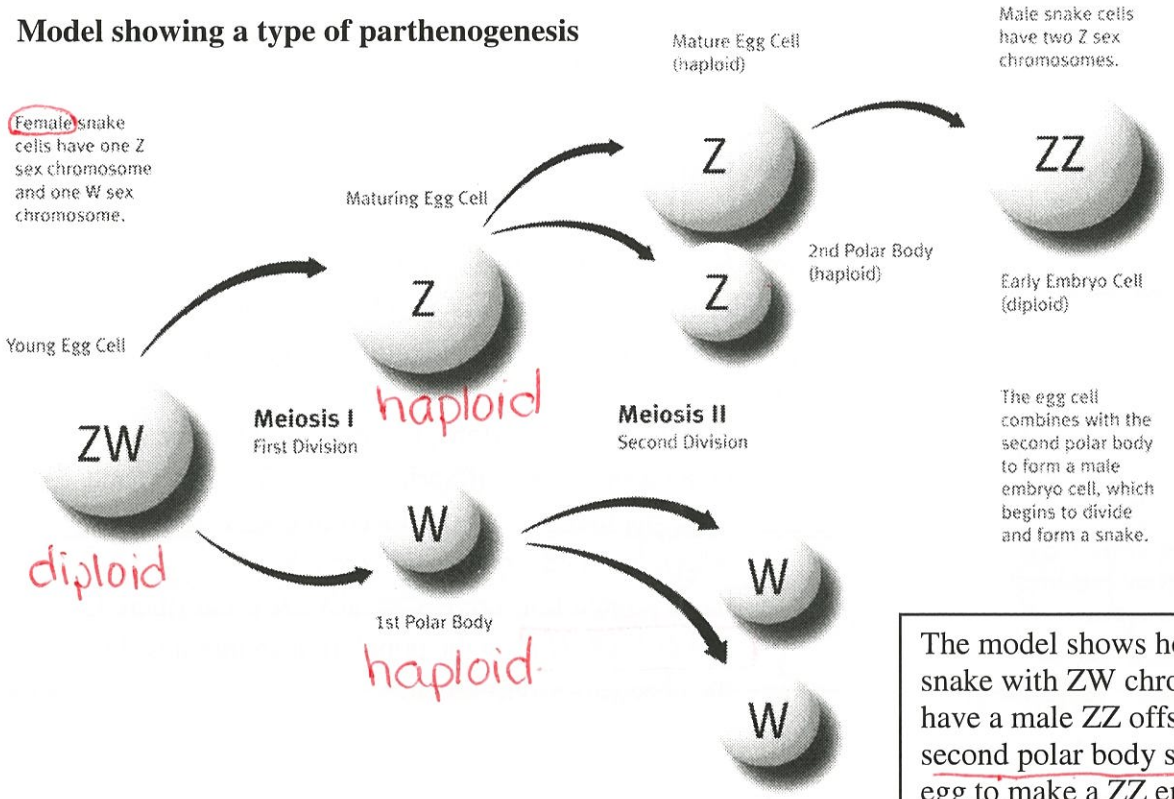
Vegetative Reproduction – a new plant forms from a modified stem
e.g., strawberries – produce "runners" = creeping stems

Fragmentation – a new organism is created from a fragment (portion) of a parent organism e.g., taking cuttings off plants to grow new plants

Parthenogenesis – a form of asexual reproduction in which an unfertilized egg develops into an adult – e.g., honeybees, lizards, some snakes and turkeys

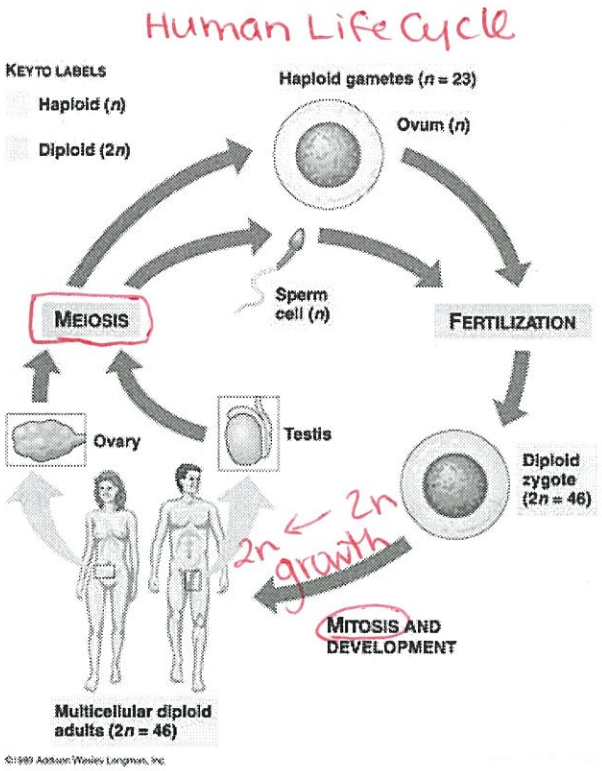
Parthenogenesis is considered a form of *asexual reproduction* because only ONE parent is needed, not two distinct parents like what is needed for sexual reproduction. Since the egg is produced by meiosis, there will be *some genetic diversity* due to the reshuffling of genes that happens in prophase I of meiosis, but since there is no second parent (no fertilization by the opposite sex gamete), there is less diversity than sexual reproduction. So, although this is an asexual strategy, there may be some genetic diversity due to production of gametes by meiosis.

Model showing a type of parthenogenesis



The model shows how a female snake with ZW chromosomes can have a male ZZ offspring. The second polar body self-fertilizes the egg to make a ZZ embryo. If a W polar body fertilizes a W egg, the resulting WW embryo does not survive.

Sexual reproduction



= the production of gametes by meiosis, followed by fertilization between genetically distinct parental gametes to produce genetically distinct offspring → this is the key to ***diversity***

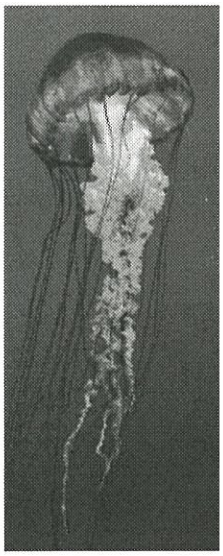
- humans are diploid ($2n$) organisms throughout their lifespan – only their gametes are haploid (n)
- male and female human gametes must fuse (the *fusion of gametes* is called *fertilization*) to form a diploid zygote which develops into a diploid individual
- humans are not the only living things → other organisms must reproduce too!

Alternation of generations

= cycling between diploid and haploid stages within the life cycle of sexually-reproducing organisms (such as plants)

Important terminology to help you do life cycle questions:

- ***sporophyte*** = diploid ($2n$) generation of a plant → produces haploid (n) spores by meiosis ***ADULTS are usually sporophytes
- ***gametophyte*** = haploid generation of a plant → produces male and female gametes (n) by mitosis ($n \rightarrow n$ or $2n \rightarrow 2n$ is mitosis: the chromosome number is maintained)
- ***gametes*** = haploid cells that fuse to form a diploid zygote that grows into a multicellular diploid sporophyte
  - ***gametes are always haploid (n)***
- ***spores*** = reproductive cell capable of developing into a new organism without fusion with another cell (in contrast to a gamete, which needs to fuse with another cell in the process of fertilization)



- spores are very hardy cells, meaning they can stay dormant for years until environmental conditions are favorable and then they will germinate (sprout) into a sporophyte
  - many spores are carried by wind to a new area; others are released into water and swim to a new location

spruce

Mosses – haploid (gametophyte) stage is dominant in these plants

Conifers (evergreen trees) – e.g., spruce tree, pine tree – haploid structures are found within cones; diploid (sporophyte) stage is dominant in these plants

Cnidarians – e.g., jellyfish, sea anemones, corals

- non-motile polyp and free-swimming medusa
- can reproduce asexually and sexually (this is rare for animals)

How to do life cycle questions

- look for gametes (sperm or eggs) → they are always haploid (n)
  - gametes may be created by meiosis or mitosis
- look for a zygote or fertilization (fusion of gametes)→ zygotes are always diploid ($2n$)
- MOST spores are haploid (n) and are produced by meiosis – e.g., all plants and some fungi
  - caution: some spores are diploid ($2n$) if produced by mitosis and asexual reproduction – e.g., some fungi
- the gametophyte is haploid (n), the sporophyte is diploid ($2n$)
- you will be asked to ***determine the ploidy*** at each stage of an organism's life cycle
  - What this means is: is it diploid ($2n$) or haploid (n) …????
  - Use the clues above to determine the ploidy
- make sure to label major events like mitosis, meiosis and fertilization
- remember that meiosis is reduction division, so the chromosome number is reduced by half ($2n$ to n)
- mitosis maintains the ploidy/ chromosome number ($n \rightarrow n$ or $2n \rightarrow 2n$ is mitosis)
- fertilization restores the ploidy ($n + n = 2n$)

3. Circle the correct answer. If the statement is false, correct it.

(a) Binary fission results in genetically distinct organisms. True or False

identical

(b) Vegetative reproduction and fragmentation are both examples of asexual reproduction in plants. True or False

(c) Parthenogenesis results in the development of an adult from an unfertilized egg. True or False

(d) Spores are always diploid and are the product of mitosis. True or False

may be. diploid or haploid + can be produced by mitosis or meiosis

(e) Binary fission is a form of ~~sexual~~ reproduction. True or False

asexual

(f) The diploid generation of a plant is called a gametophyte. True or False

haploid=gametophyte. diploid=sporophyte

(g) The life cycles of all plants include a sporophyte and a gametophyte generation. True or False

(h) Moss reproduces ~~asexually by budding~~. True or False

sexually

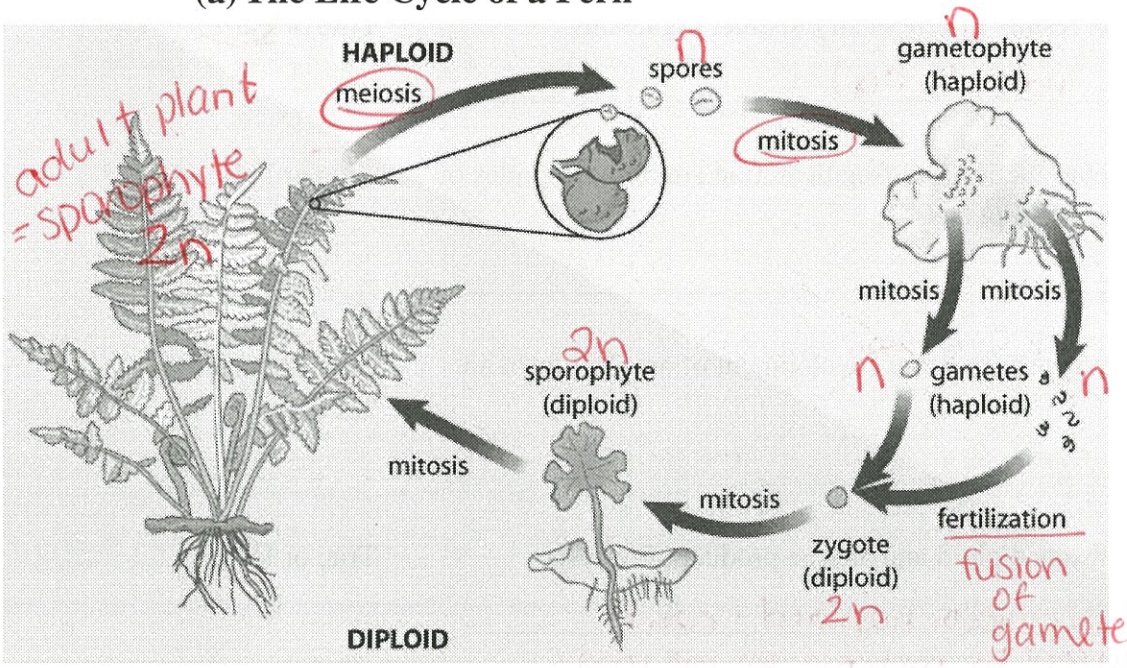
(i) Some animals reproduce both sexually and asexually, exhibiting alternation in sexual cycles. True or False

4. For each of the following life cycle diagrams:

- determine the ploidy of each stage and label it on the diagram
- add in the labels "fertilization", "meiosis", and "mitosis" where appropriate

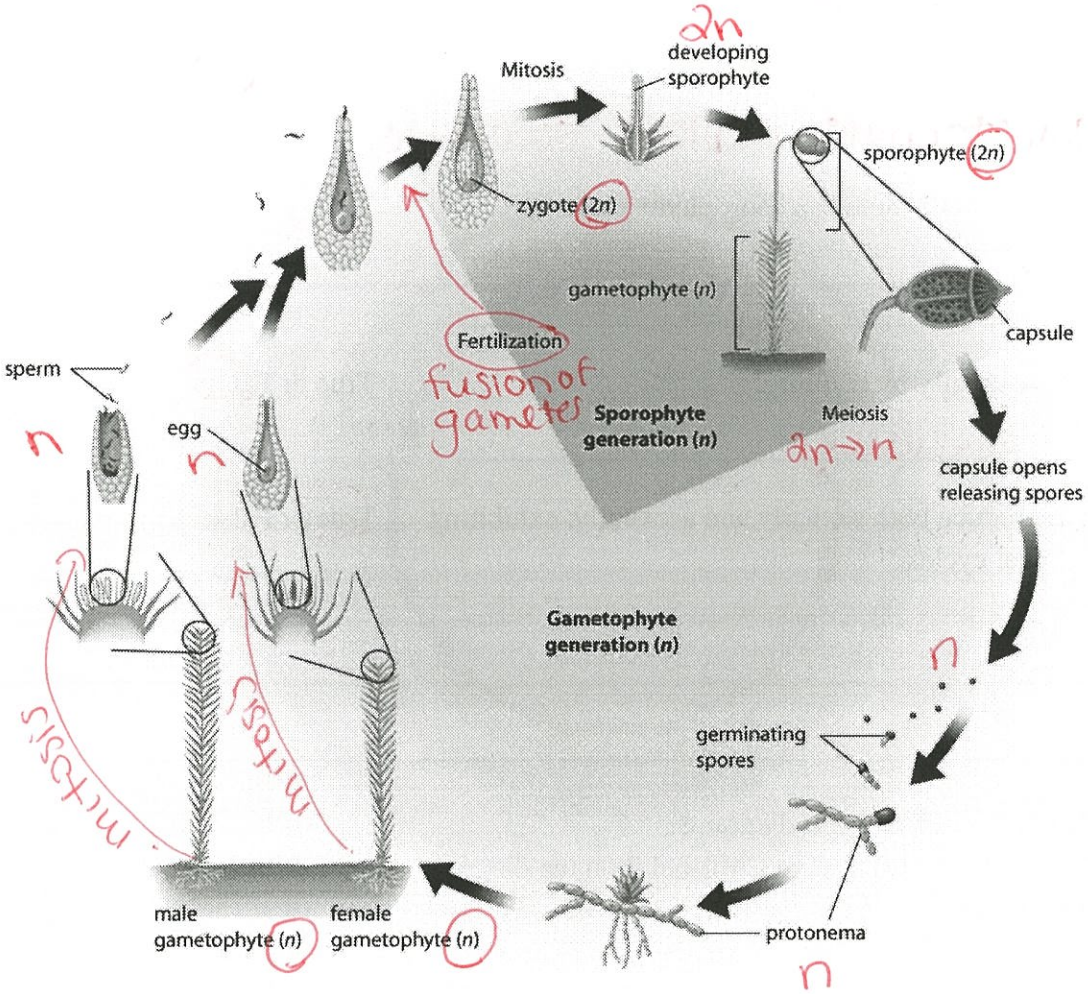
* Errors in textbook Fig 16.26 + 16.27 should read sphorophyte generation (2n) not n

(a) The Life Cycle of a Fern



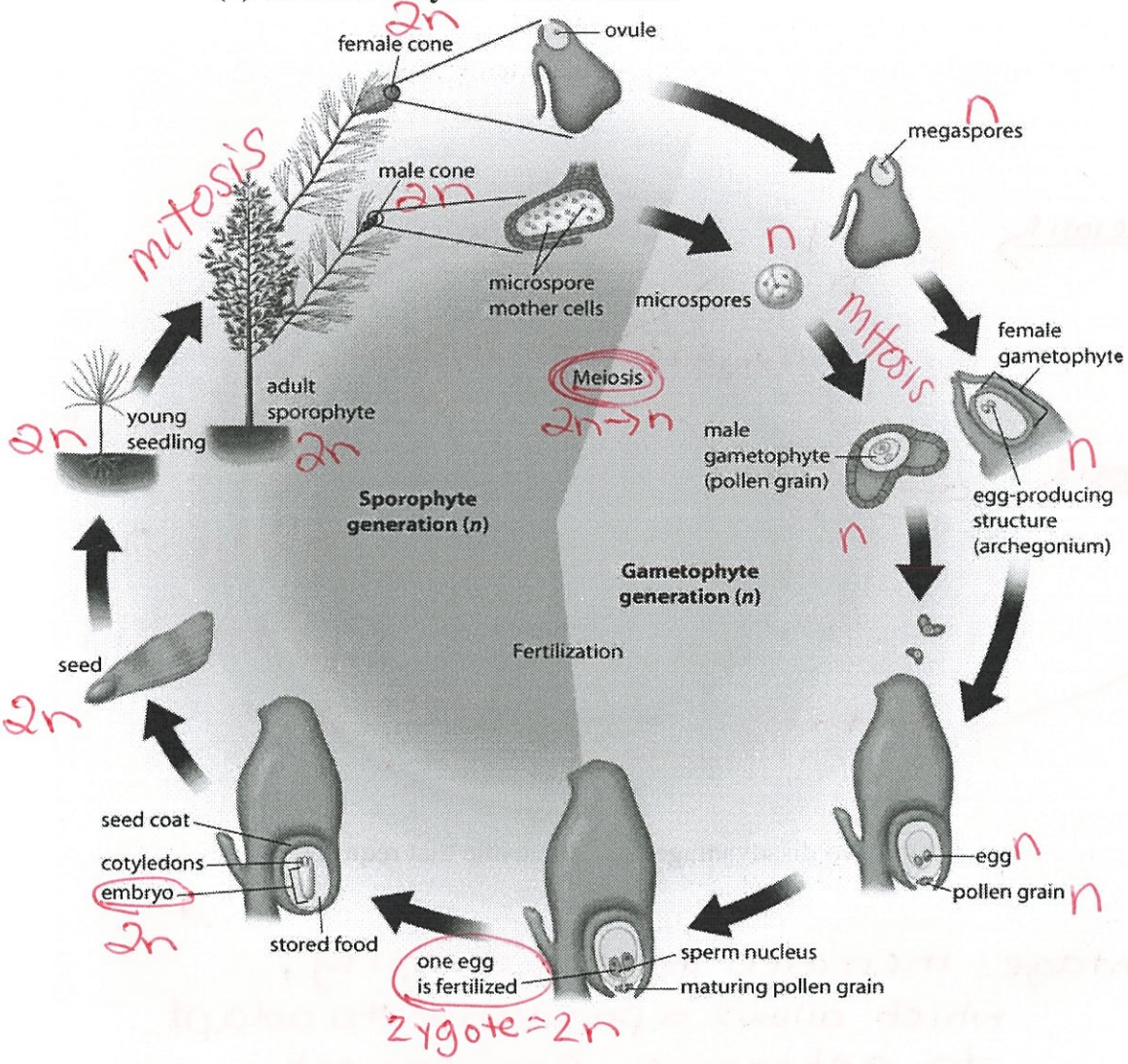
The life cycle of a fern, like all plants, consists of the alternation of generations of diploid sporophytes and haploid gametophytes.

(b) The Life Cycle of a Moss



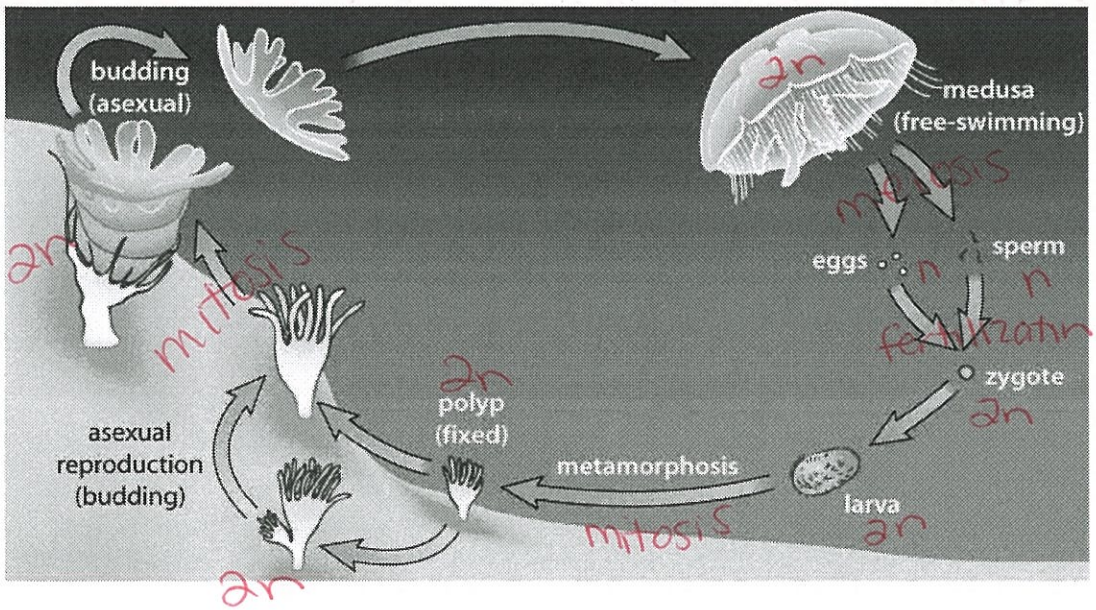
The life cycle of moss. The moss gametophyte produces gametes that join to form a zygote. The zygote develops into the sporophyte that produces spores. Spores can germinate and grow into a gametophyte, completing the life cycle.

(c) The Life Cycle of a Conifer



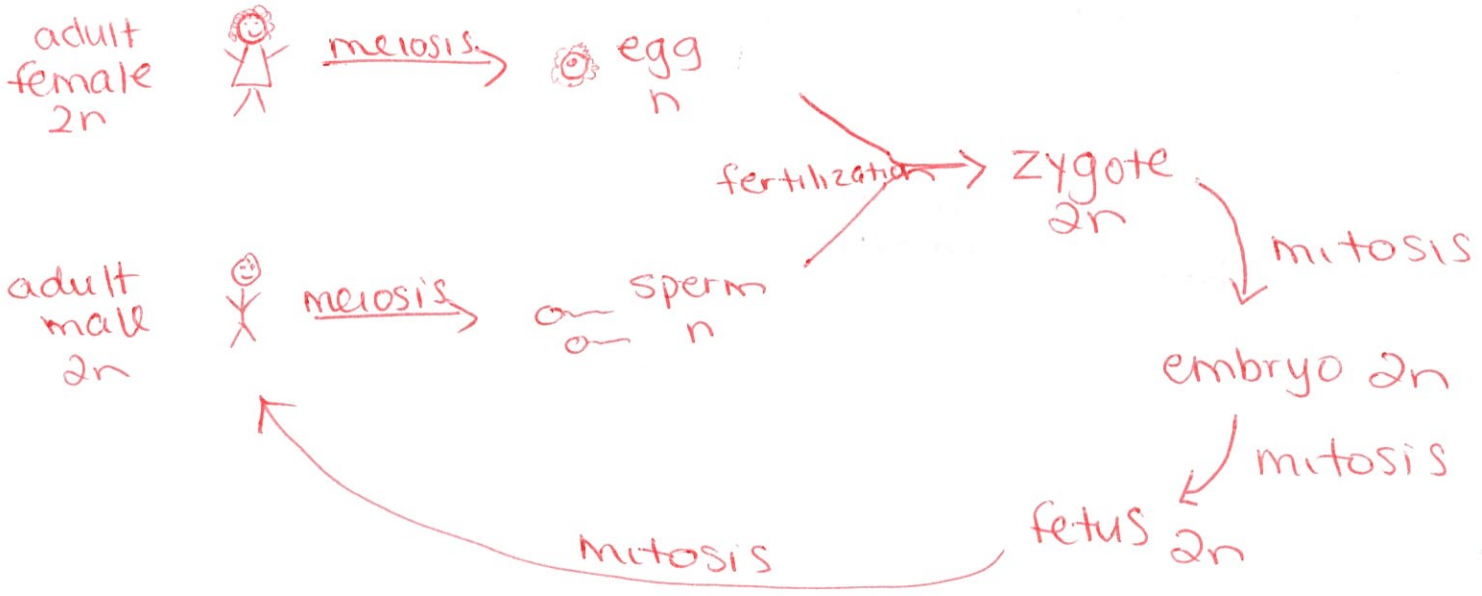
The life cycle of a conifer, such as a pine tree, includes the production of two types of spores by the sporophyte. These spores develop into the male and female gametophytes.

(d) The Life Cycle of a Cnidarian



A generalized representation of the cnidarian life cycle. Not all cnidarians alternate adult forms like this, but most cnidarians can reproduce both sexually and asexually.

5. **Sketch** a diagram that illustrates the life cycle of a mammal. Use the following terms to **label** your diagram: haploid phase, diploid phase, meiosis, mitosis, fertilization, zygote. (You may need to use some of these terms more than once).

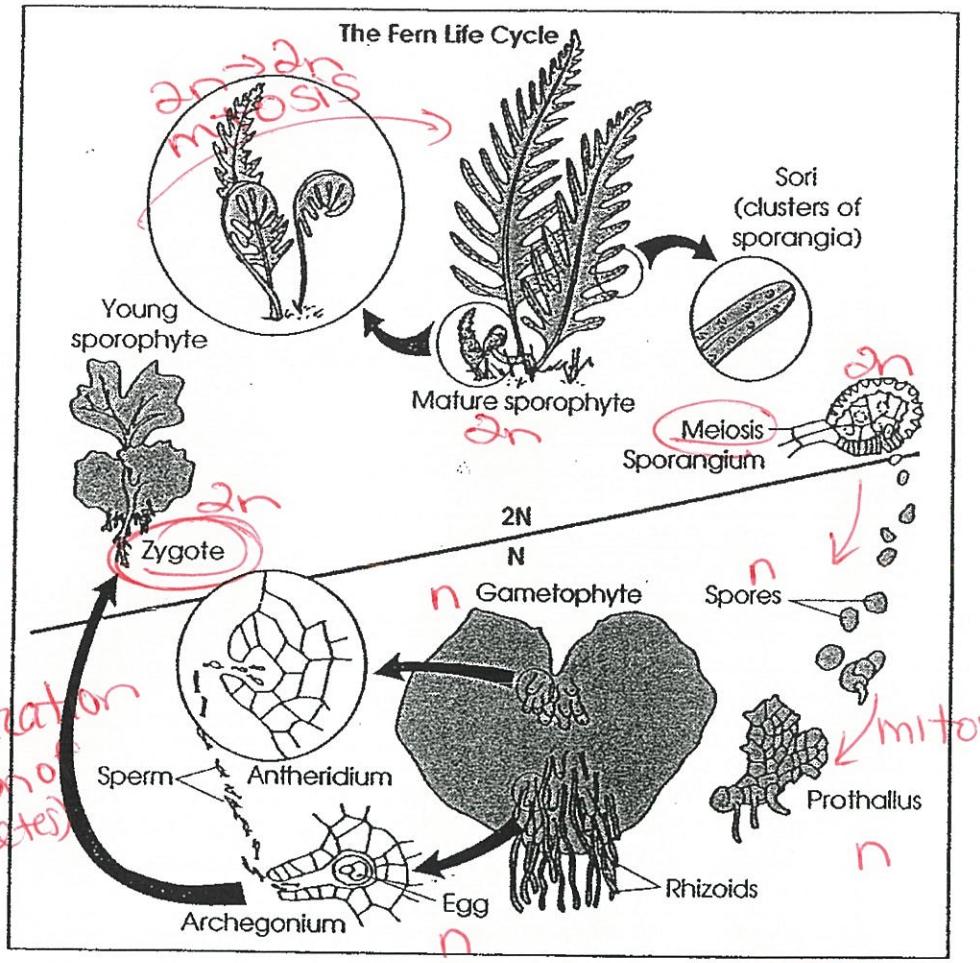


6. **Describe** two advantages and two disadvantages of a life cycle that requires sexual reproduction.

Advantage: increased genetic diversity, which allows a population to adapt to a changing environment

Disadvantage: requires a mate which may be difficult
slower
more energy required

Use the following information to answer the next question.



7. **(a)** Is the dominant stage of a fern plant a gametophyte or a sporophyte? 2n

(b) Are the cells of a fern plant diploid or haploid?

(c) Do fern plants produce gametes or spores for reproduction? Both

(d) Are spores produced by meiosis or mitosis? meiosis 2n → n

(e) Are spores haploid or diploid? haploid

(f) Is a small prothallus a gametophyte or sporophyte? → produces haploid gametes by mitosis

(g) Does the heart-shaped prothallus produce gametes or spores? → sperm / egg

(h) Does the zygote grow into a sporophyte or a gametophyte?

2n → 2n
mitosis