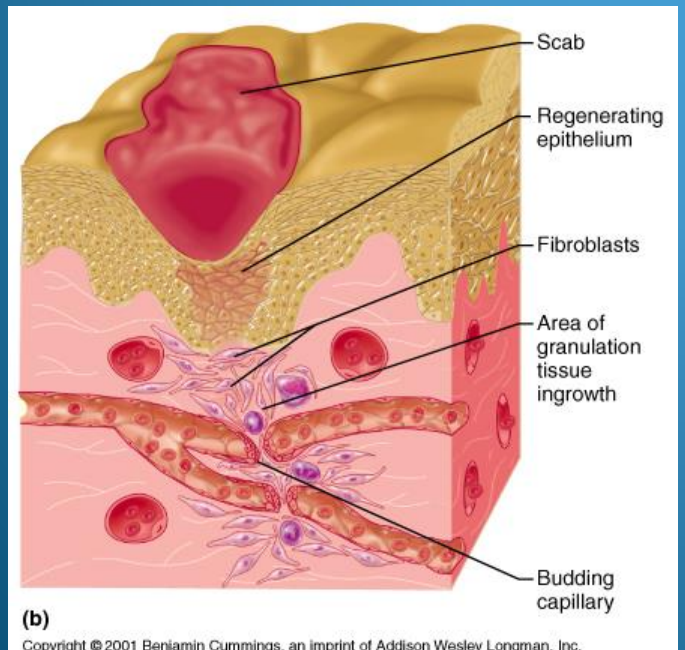
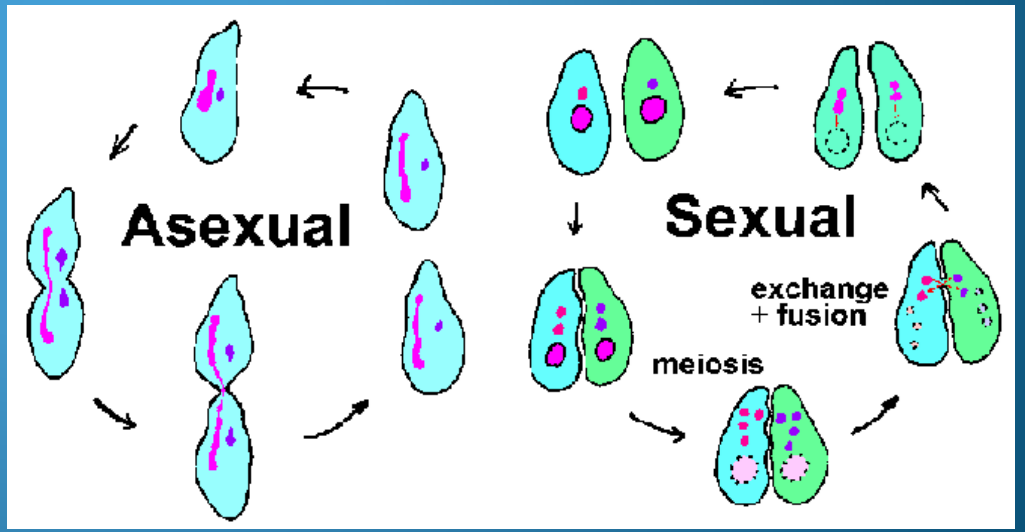
Page 30
Topic: Cell Division (Mitosis and Meiosis)

EQ: Why and how do cells divide?

Brainstorm: There are 3 reasons why you might need new cells. What are they?

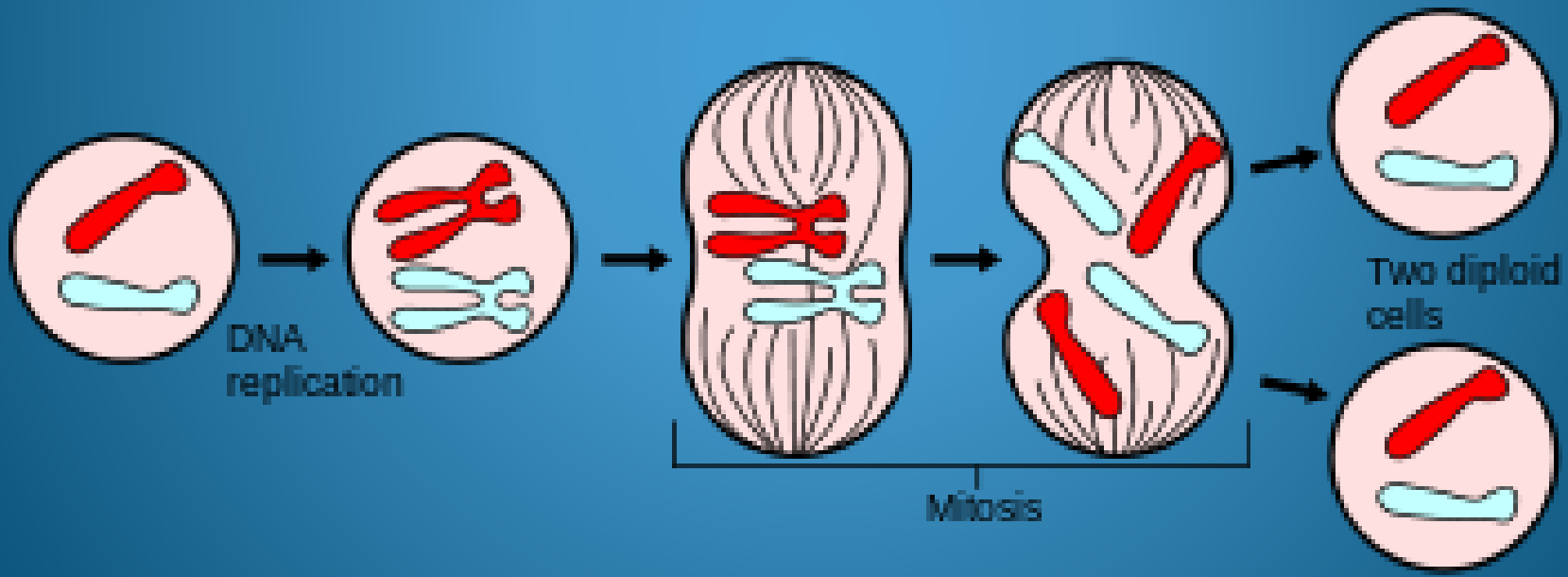
We need new cells for: Growth, Repair and Reproduction.





Mitosis

Cell Division for growth, repair and asexual reproduction

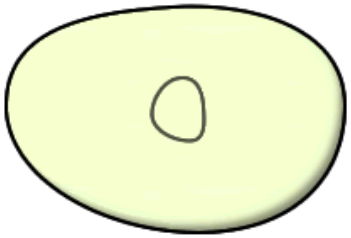


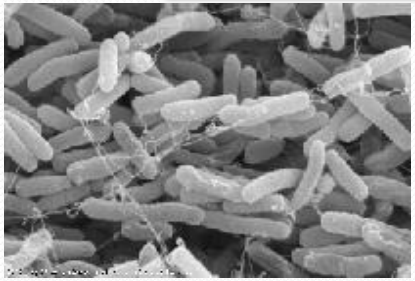
All types of Asexual Reproduction

- Uses only one parent/set of DNA = "cloning"
- Offspring have 100% the same chromosomes as the parent
- Most *unicellular* organisms reproduce this way.
- Most *unicellular* organisms use mitosis which takes one regular **somatic** (body) cell and divides it into 2 **identical** cells
- Cells are **diploid** (2 sets of DNA per cell)

Binary Fission

- Binary fission is a form of asexual reproduction where every organelle inside is copied and the parent organism divides into two identical 'daughter' cells. (parent doesn't exist after)
  - Bacteria
  - Protists



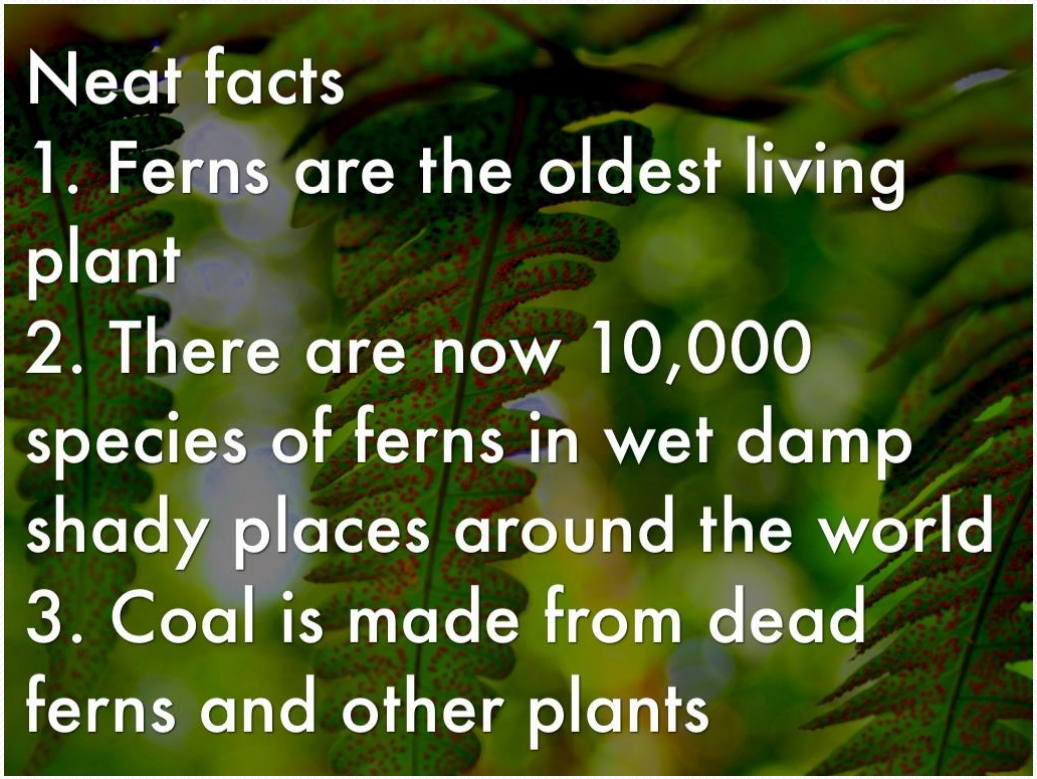


Spore Formation

- Spores ≠ Seeds
  - Spores are identical clones (1 parent)
  - Seeds are unique offspring (2 parents) plus protection & food for germinating plant

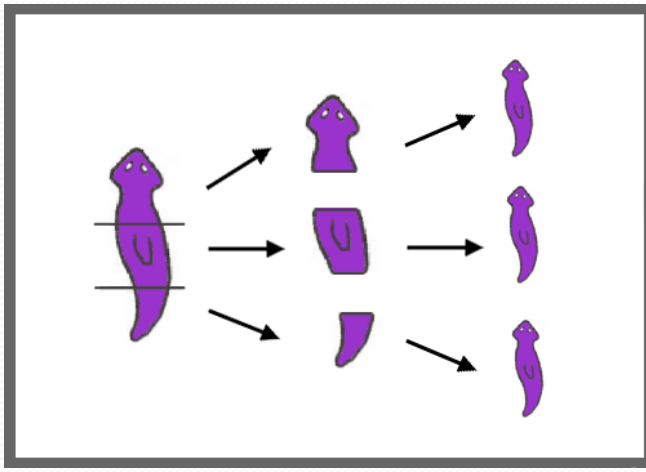
Spore Formation

- Spores are cloned and each spore develops into offspring which are identical to parent
  - happens in fungi, green algae, molds and non-flowering plants (e.g. ferns)



Cuttings/Fragmentation

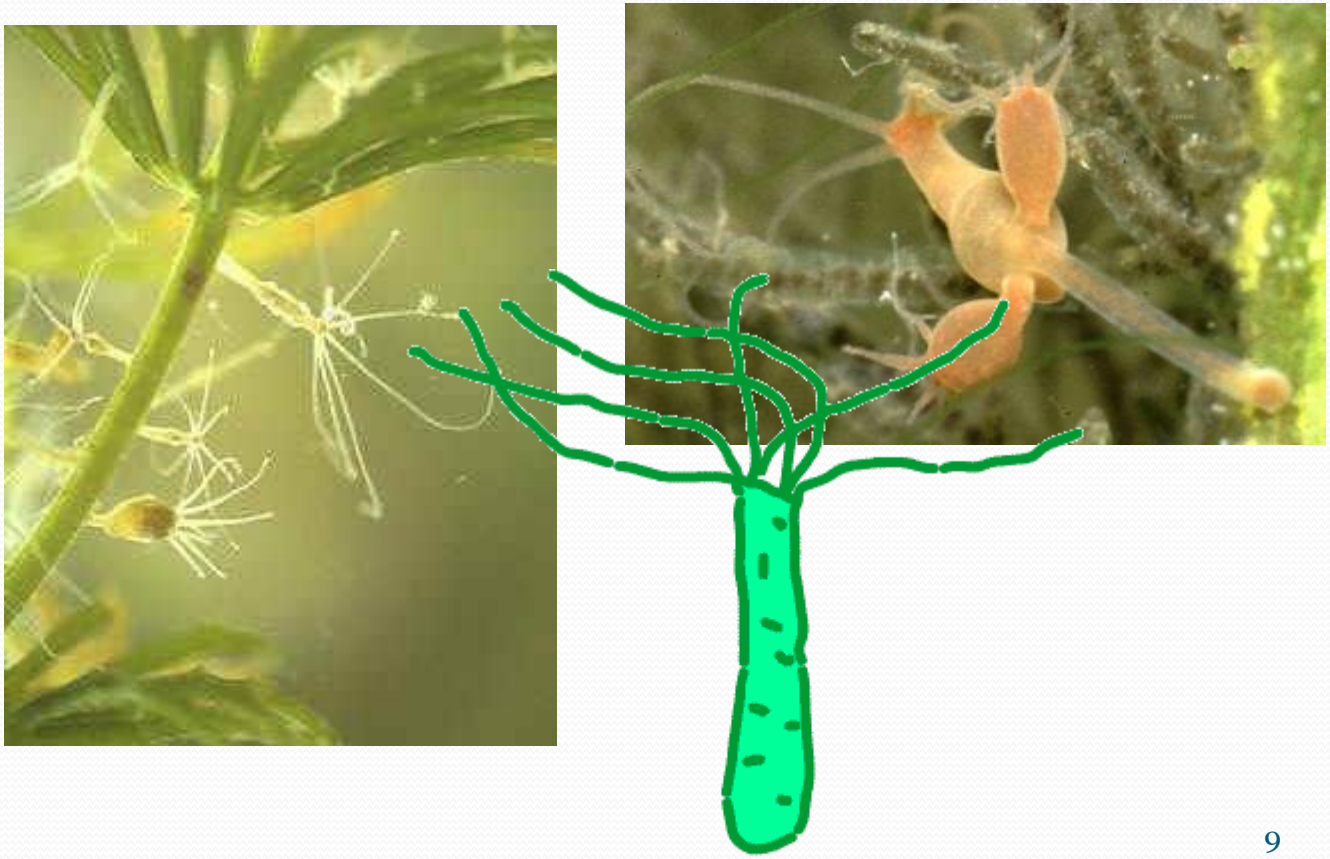
- Where a single parent breaks into parts that regenerate into whole new individuals.
  - does not involve spores or seeds
  - **Plants:**
    - cuttings (e.g. coleus)
    - runners (e.g. strawberries)
    - tubers (e.g. potatoes)
    - bulbs (e.g. tulips)
  - **Animals**:
    - Sea stars
    - flatworms



Long been exploited in horticulture and agriculture, with various methods employed to multiply stocks of plants.

Budding

- Budding is a means of asexual reproduction whereby a new identical individual develops from an outgrowth of a parent, splits off, and lives independently as a clone. Parent still exists.
  - Hydra
    - Movie

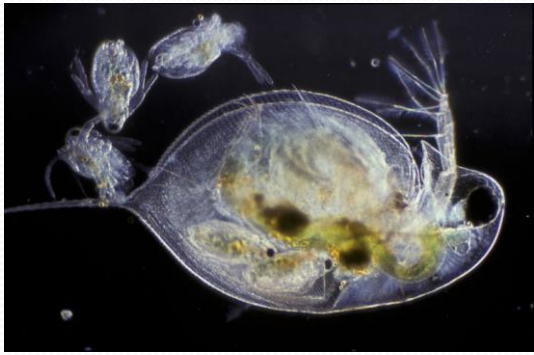


Parthenogenesis

Greek parthenos, "virgin", + genesis, "creation")

A natural form of asexual reproduction in which **eggs** are produced by a female but embryos occur **without** fertilization by a male.

It is more accurately defined as an incomplete form of sexual reproduction. This is because it involves the production, activation, and development of a female egg which is a specialized reproductive cell.

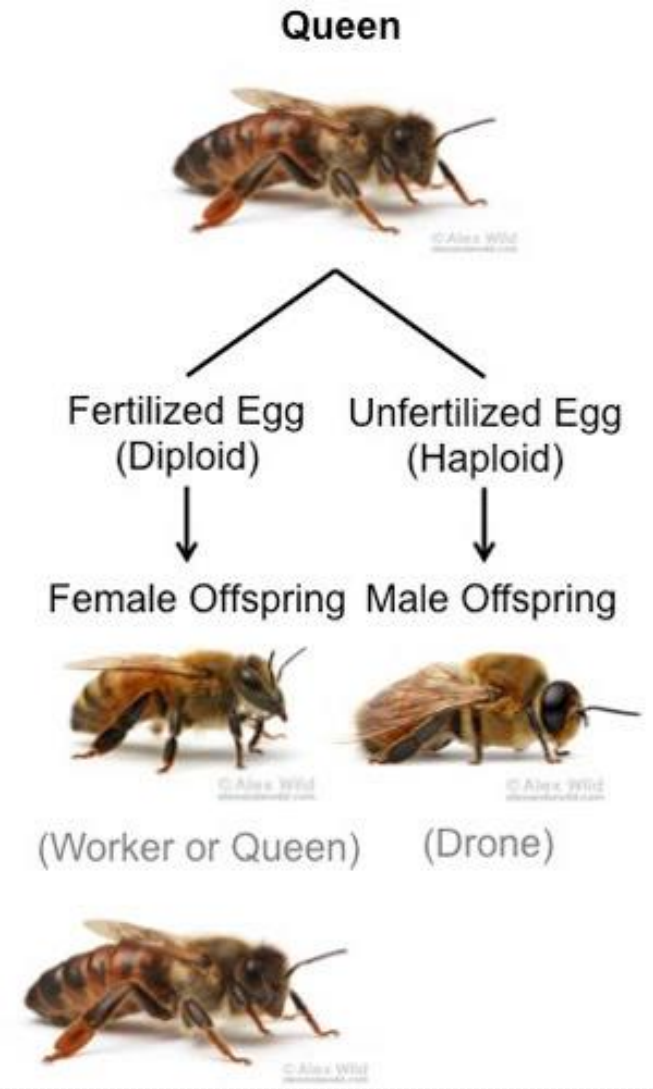


While there is still only one parent, the offspring are NOT clones! They are made by a limited recombination of the mother's genes.

Some species that normally reproduce sexually will sometimes reproduce asexually, either for lack of males, for population sex control, or in some cases because of an abundance of resources (when times are good).

Parthenogenesis

- Occurs in many types of plants (ex. roses & oranges)
- Few Vertebrates
  - komodo dragons
  - mole salamanders
  - hammerhead sharks
  - some reptiles
  - some amphibians
  - some fish
  - rarely in birds
- Invertebrates
  - water fleas
  - aphids
  - some bees
  - some scorpions
  - many others



Asexual Healing/Cell Reproduction

- *Regeneration*

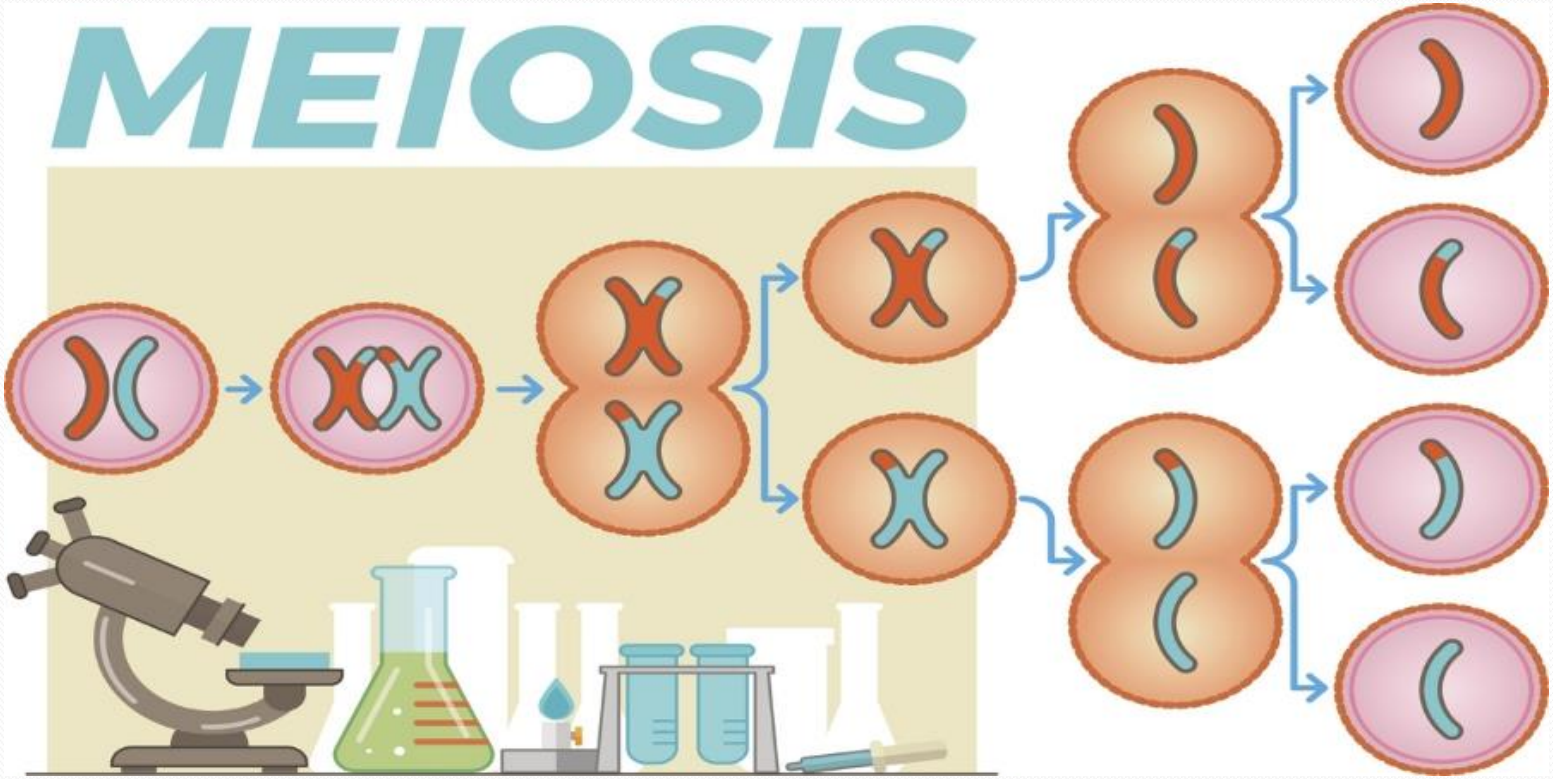
Regeneration occurs when a body part has broken off and the organism grows a new one.

Sexual Reproduction

Not just for humans!!!

Sexual Reproduction

- Requires two parents that each share ½ of the genetic information.
  - Uses <u>Meiosis</u>
- Makes **<u>gametes</u>** [sperm (or pollen) and eggs (ovules)]
- <u>Haploid</u> cells can combine to form offspring



Sexual Reproduction

- All the members of the Animal Kingdom
  - Fish
  - Mammals
  - Amphibians
  - Birds
  - Reptiles
  - Insects
  - Crustaceans

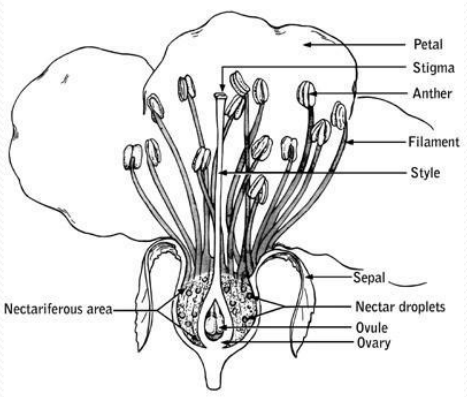
Sexual Reproduction

- Plant Kingdom
  - Flowers are the reproductive organs of plants.

Male flower

Female flower

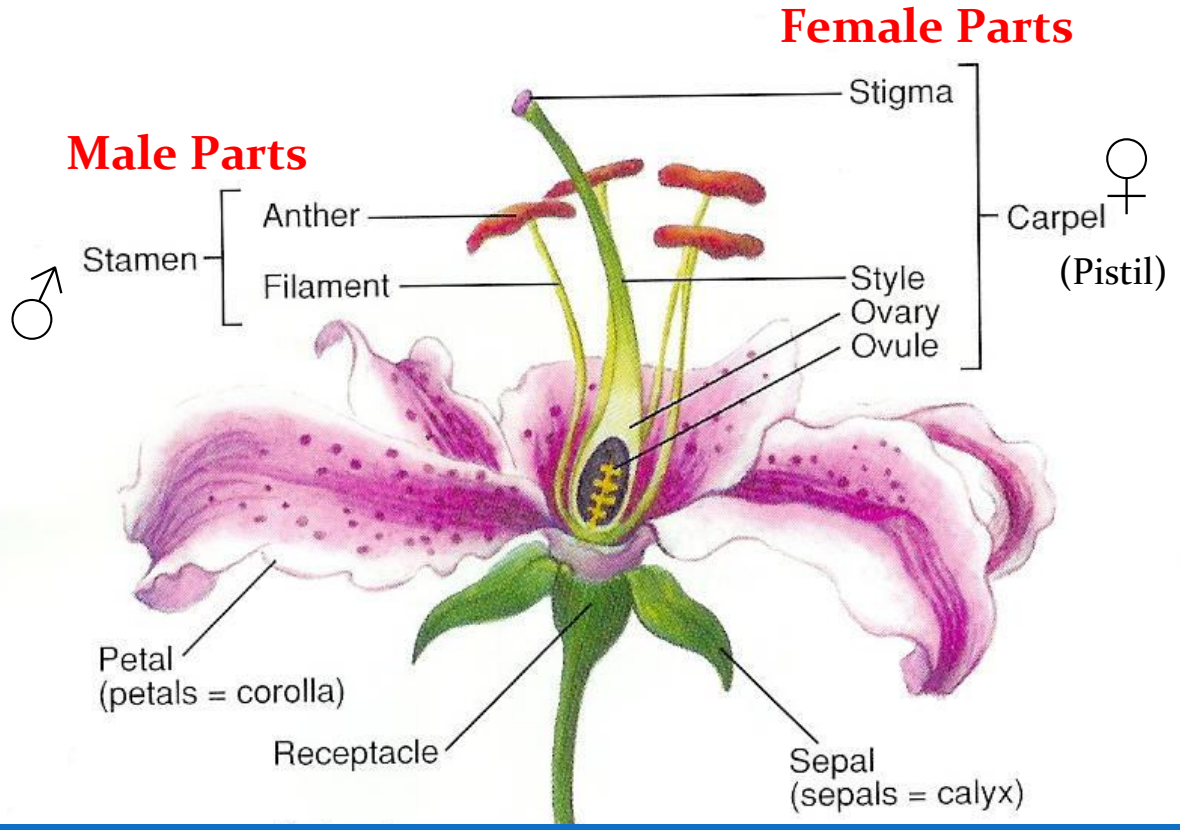
  - Some flowers have both male and female reproductive organs on the same flower. ex: lily



Sexual Reproduction in Plants

Lilium longiflorum is both male & female

Fun Fact: Fruits will not grow unless the flower has been fertilized. Fruits are actually the flower's enlarged, fertilized ovary!



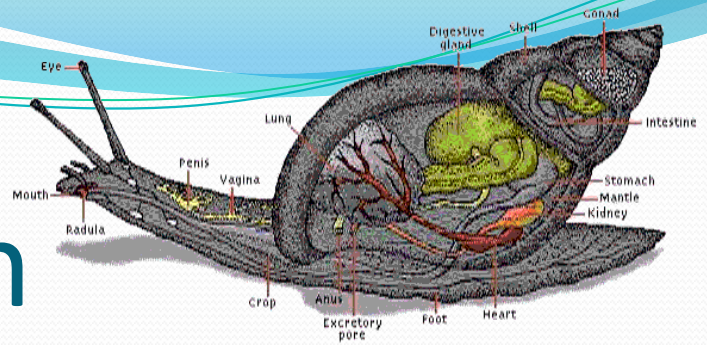
pollen (male) + ovule (female) → single-celled zygote → multi-celled unique embryo (contained in a seed) → new individual

Pine Trees are both male & female

The **pine cones** typically thought of as **pine cones** are actually the bigger **female pine cones**; **male pine cones** are not as woody and are much smaller in size.**Female pine cones** hold the seeds whereas **male pine cones** contain the pollen. Most conifers, or **cone**-bearing trees, have **female** and **male pine cones** on the same tree.

https://www.reference.com/science/difference-between-male-female-pine-cones-6e98872b55cabb16

Sexual Reproduction



- Examples of organisms that reproduce sexually
  - Chickens
  - Iguanas
  - Lobsters
  - Sharks
  - Humans
  - Butterflies
  - Flowering Plants
  - Sea Sponges

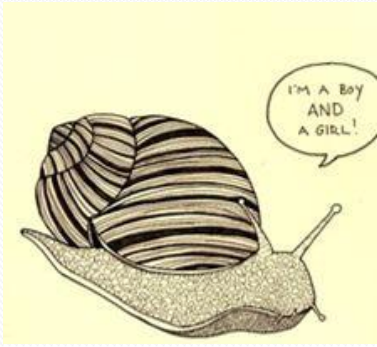
Sperm (male) + egg (female) → single-celled zygote → multi-celled embryo (contained in an egg or placenta [pregnancy]) → new individual

Sexual Reproduction

- Happens one of 2 ways:
  - Internally (inside) "sex" "pregnancy"
    - The egg is fertilized by sperm inside the female
      - Mammals, birds, reptiles, insects, spiders
  - Externally (outside)
    - The egg is fertilized by sperm outside the female
    - The female lays the eggs and then the male fertilizes them.
      - Fish and some amphibians
      - Plants and fungi (pollen and spores)

Coral Blooming: external fertilization 2min

Internal Sexual reproduction requires specialized parts:



Male:

Gamete: Sperm (haploid (n))

Made in: Testes (2)

-Outside the body for cooler temperature during sperm development

Delivery into female: penis or hemipene

Female:

Gamete: Egg (haploid (n))

Made in: Ovaries

-1 egg is released each month "ovulation" alternating ovaries

-All the eggs a female will ever release are made *before* she is born!

-When run out of eggs = menopause

Delivered down fallopian tubes (2) where the might meet a sperm, become fertilized, and implant (attach) to uterus to develop until ready to survive on own.

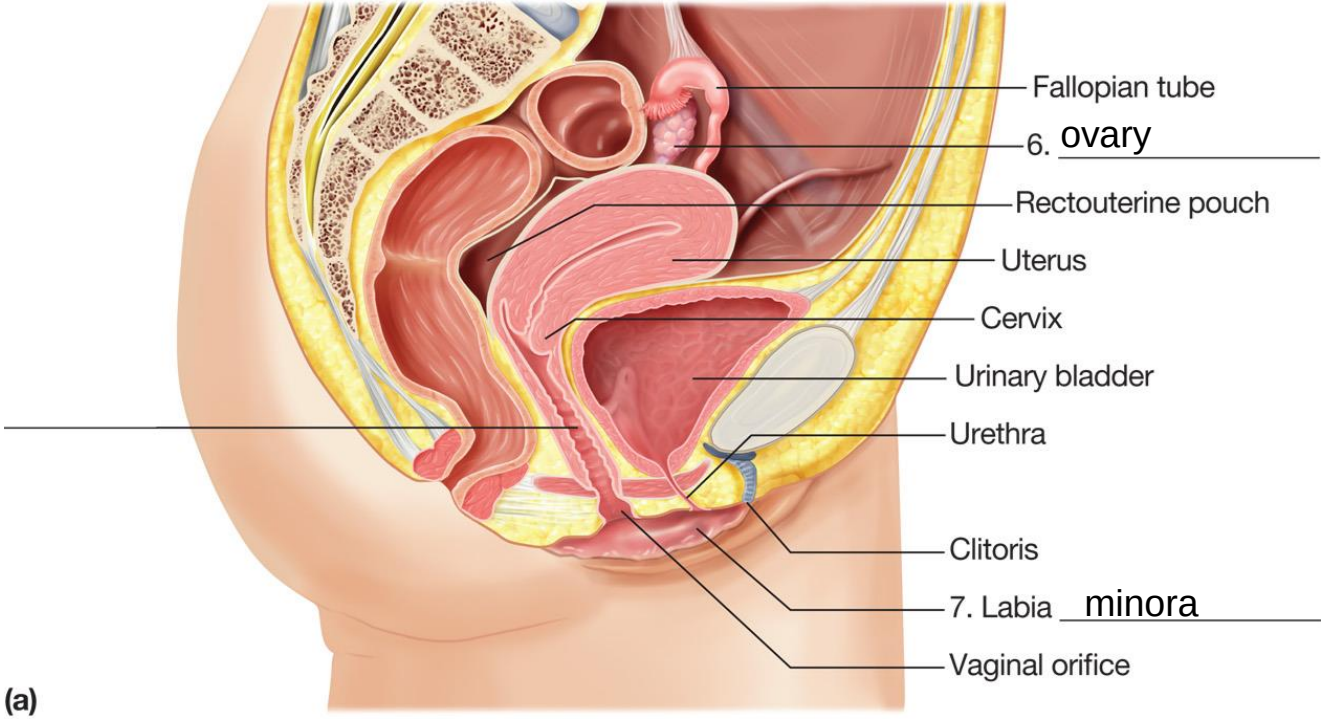
- Elephant pregnancy is 18-22 months long! Rats' is only 21 days!

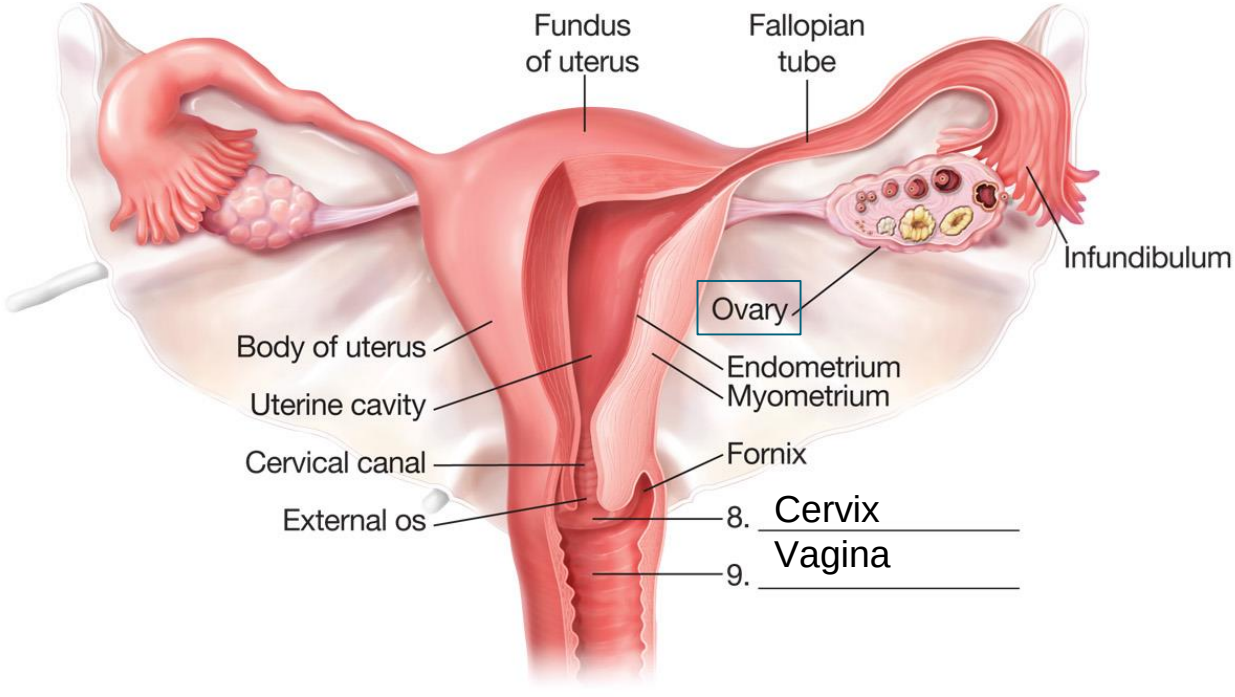
Human Female

Mammal females have a separate opening for sexual reproduction & childbirth called a vagina.

Other sexually reproducing organisms may not- they can have waste excretion and reproduction share one opening, called a cloaca.

Ex: birds, sharks

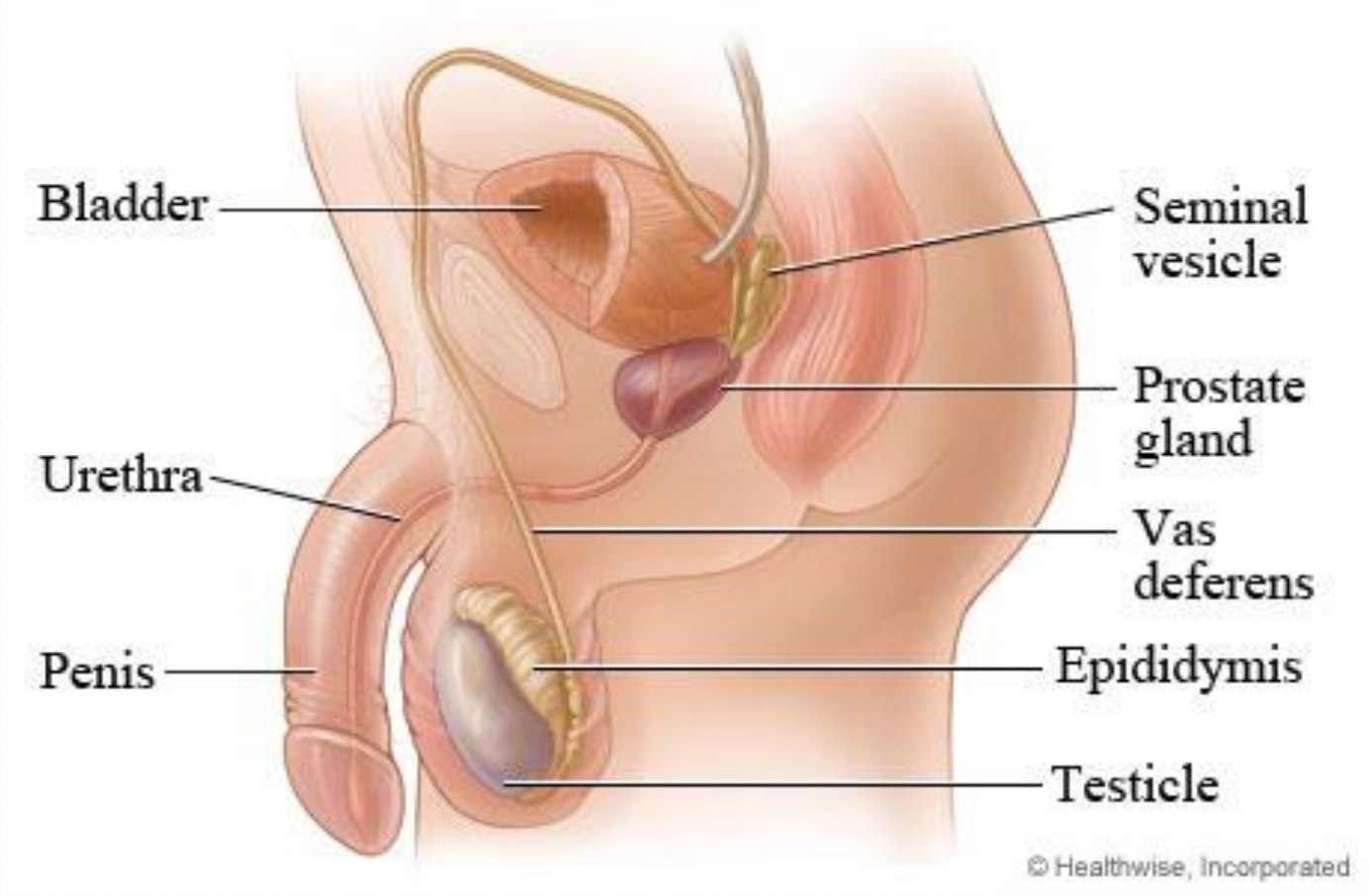




Human Male

One pathway shared for urine and sperm but not at the same times.

Seminal vesicle releases re-ejaculatory fluid to clean out urethra before use for sexual reproduction.



Fun Fact: Snakes have two penises!

The two penises of squamates (snakes and lizards) are called hemipenes.

Each hemipenis is associated with a single testis, meaning that sperm produced in the right testis are ejaculated through the right hemipenis, etc.

Hemipenes are stored inside out when not in use.

Unlike in humans, female snakes have a lot of control over whether or not they get pregnant after mating. They can store sperm for up to 5 years, which can result in a single clutch of baby snakes being fertilized by multiple fathers.

http://snakesarelong.blogspot.com/2014/03/why-do-snakes-have-two-penises.html

Sexual Reproduction Summary

	Male Gamete	Female Gamete	Type of Union	Result of Union	Final Result
Plants	pollen	ovule (egg)	pollination	single-cell zygote	multi-cell embryo (in seed)
Animals	sperm	egg	fertilization	single-cell zygote	multi-cell embryo

Some Organisms do ***Both*** Asexual & Sexual Reproduction- but WHY?

- most plants that produce seeds (sexual reproduction) can **also** reproduce asexually by things like cuttings or runners
- this choice gives them an advantage for survival:
  - Save energy when conditions are good by asexually reproducing
  - Stay alive and ensure future generations by switching to sexually reproducing during harder conditions

sponges and hydra

moss

Which is Better?

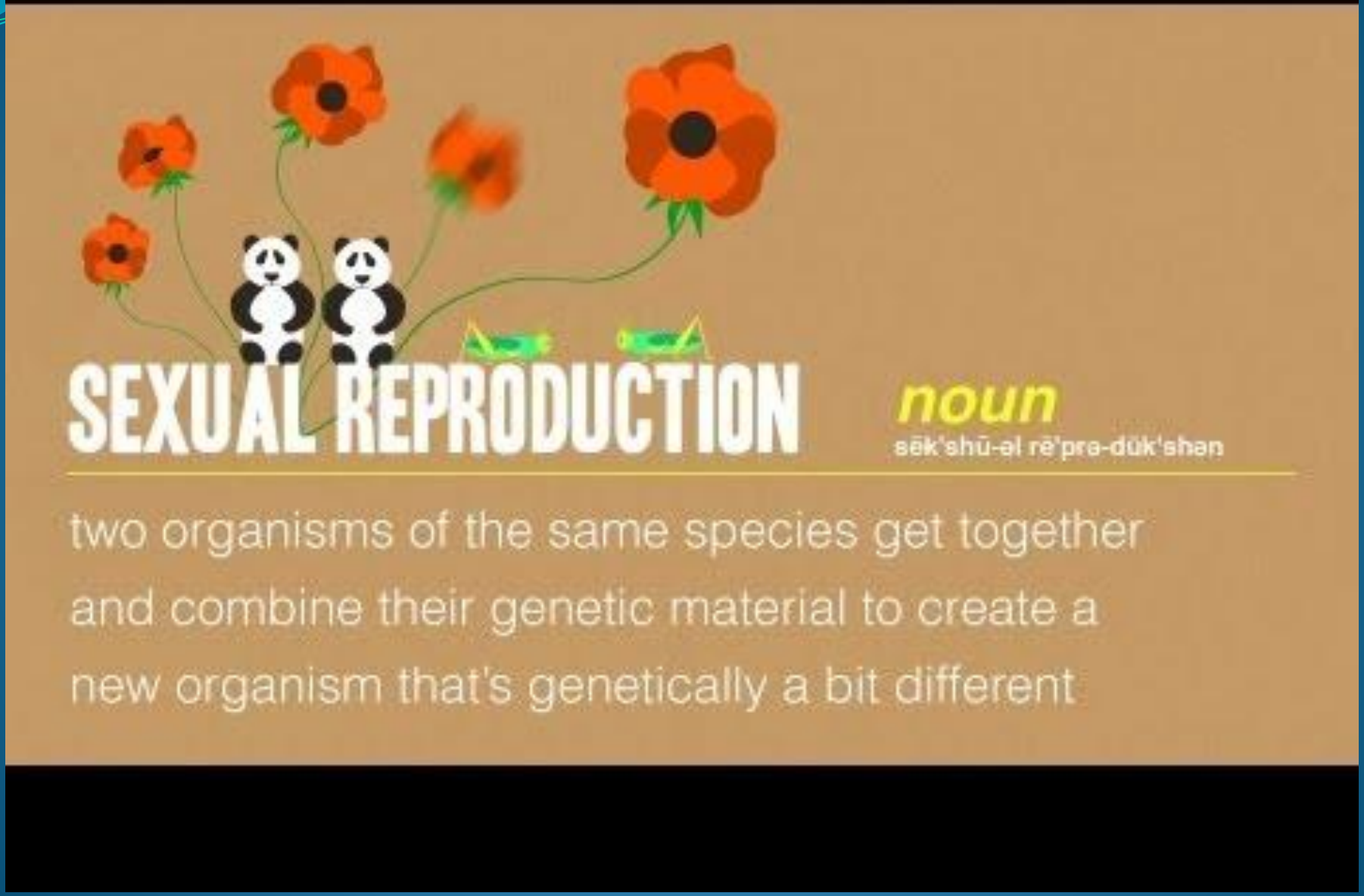
It depends!

Asexual Reproduction

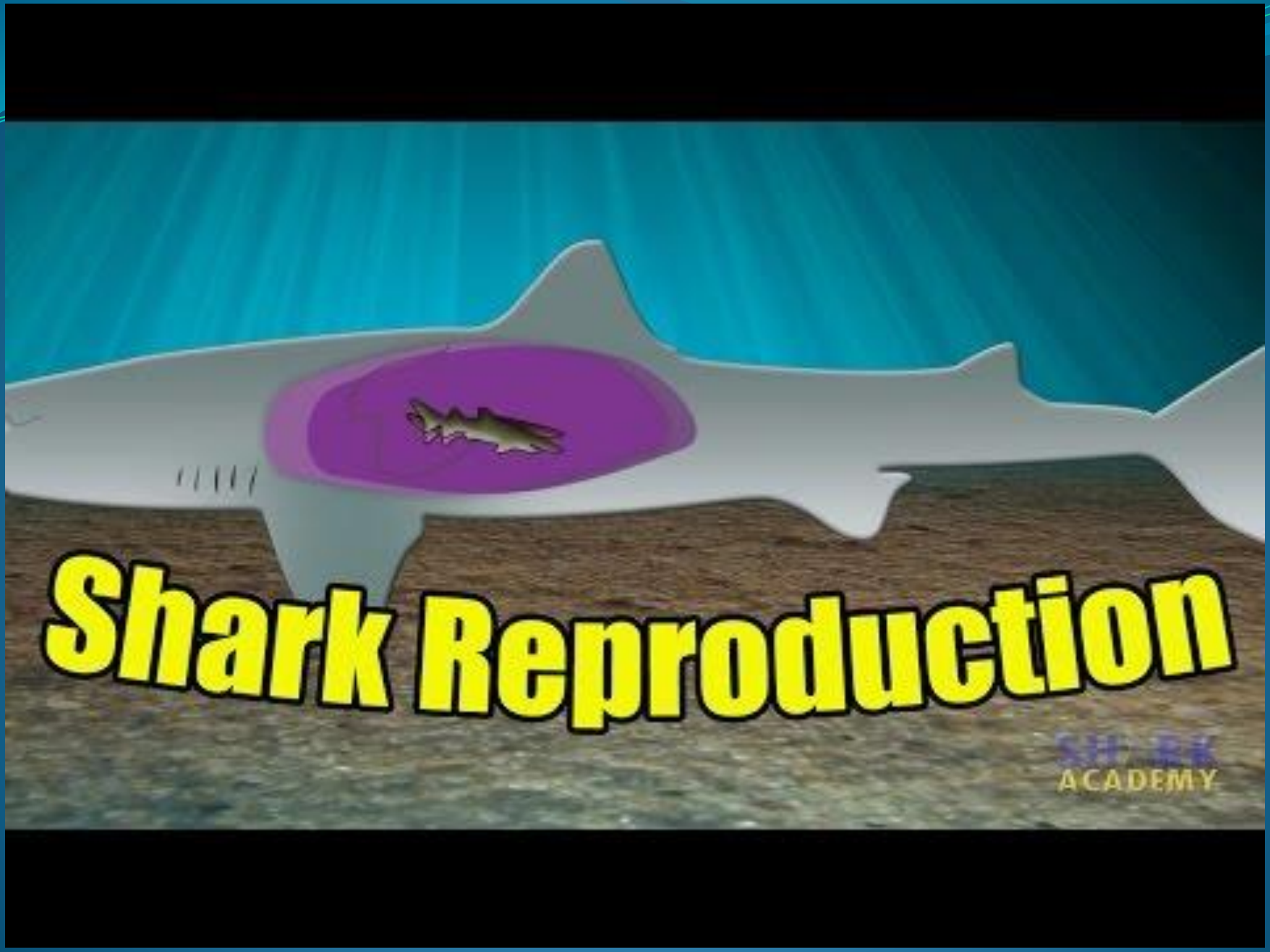
- **advantages**
  - does not require special cells or a lot of energy
  - can produce offspring quickly
  - in a stable environment creates large, thriving population
- **disadvantages**
  - clones have a limited ability to adapt (have same weaknesses)
  - face massive die-off if environment changes

Sexual Reproduction

- **advantages**
  - lots of variation within a species
  - able to live in a variety of environmental settings
  - able to adapt to changes in the environment
- **disadvantages**
  - needs time & energy (to make gametes, make sexual organs, attract mate, complete pregnancy)
  - produce small populations



SciShow “Why sex?” 5min


Shark Reproduction
ACADEMY

Mitosis or Meiosis???

- 1. Asexual Reproduction? _____
- 2. Results in 2 identical cells? _____
- 3. Results in 4 non-identical cells? _____
- 4. Produces gametes? _____
- 5. Results in variation? _____
- 6. Results in haploid cells? _____
- 7. Used for growth and repair? _____
- 8. Skin cells? _____
- 9. Sperm cells? _____

Mitosis or Meiosis???

- 1. Asexual Reproduction? ____Mitosis_
- 2. Results in 2 identical cells? ___Mitosis__
- 3. Results in 4 non-identical cells? __meiosis___
- 4. Produces gametes? ___Meiosis__
- 5. Results in variation? ___Meiosis__
- 6. Results in haploid cells? ____Meiosis_
- 7. Used for growth and repair? ___Mitosis_
- 8. Skin cells? ___Mitosis__
- 9. Sperm cells? ____Meiosis_

Summarize

Answer the essential question and compare and contrast Mitosis and Meiosis