

**NEW JERSEY CENTER
FOR TEACHING & LEARNING**

Progressive Science Initiative®

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Cells Reproduce

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**NEW JERSEY CENTER
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7th Grade

Growth and Development of Organisms

2015-10-29

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Cells and Organisms Reproduce

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Cell Theory

A few chapters ago, we learned about Cell Theory. There were three parts to the theory. Do you remember them?
Fill in the blanks below then move the boxes for the answers.

All living things are

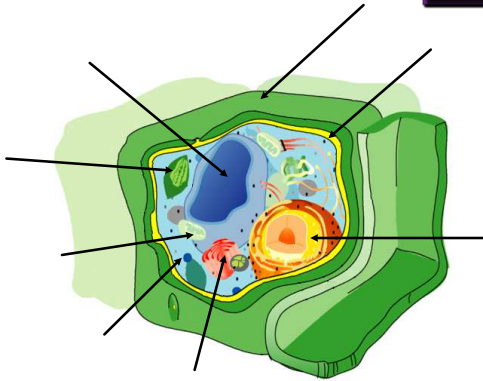
Cells are the .

Cells arise

Review: Cells

A quick recap of cell structure.
Is this a plant or animal cell? Why?

Nucleus



Drag labels from the pile above to the proper structure.

1 What is one key difference between a plant and animal cell?

- ☐ A Plant cells have a cell wall and animal cells do not.
- ☐ B Plant and animal cells both have ribosomes.
- ☐ C Animal cells have ribosomes and plant cells do not.
- ☐ D Plant cells do not have a nucleus.

1 What is one key difference between a plant and animal cell?

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Answer

A

2 What type of cell has chloroplasts?

- ☐ A small
- ☐ B non-living
- ☐ C plant
- ☐ D animal

2 What type of cell has chloroplasts?

- ☐ A small
- ☐ B non-living
- ☐ C plant
- ☐ D animal

Answer

C

3 What types of cells have a nucleus?

- ☐ A only non-living cells
- ☐ B both plant and animal cells
- ☐ C only the smallest cells
- ☐ D human cells

3 What types of cells have a nucleus?

- ☐ A only non-living cells
- ☐ B both plant and animal cells
- ☐ C only the smallest cells
- ☐ D human cells

Answer: B

B

4 What is the function of a chloroplast?

- ☐ A produce energy for cells
- ☐ B control the functions of a cell
- ☐ C assemble proteins
- ☐ D capture energy from the sun to make food

4 What is the function of a chloroplast?

- ☐ A produce energy for cells
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- ☐ D capture energy from the sun to make food

Answer: D

D

5 Which type of cell barrier do all cells have?

- ☐ A cell wall
- ☐ B cell membrane
- ☐ C nuclear membrane
- ☐ D nuclear pore

5 Which type of cell barrier do all cells have?

- ☐ A cell wall
- ☐ B cell membrane
- ☐ C nuclear membrane
- ☐ D nuclear pore

Answer: B

B

All Cells Arise from Other Cells

Once, you were only one cell, a fertilized egg.



When you were born, you were made up of about 26 billion cells.



An adult is made up of about 50 trillion cells!



Where did all those cells come from?

Injury

Have you ever been injured? Bruises, cuts and breaks are part of all our lives. Fortunately, they don't last forever.



This man's hand will heal. These rocks will be broken forever.
What is the difference?

Tissue Can Be Repaired

The man (and his hand) is made up of cells. Tissues, like those in his hand, are repaired when new cells replace damaged cells.

Where do they come from?

Of course, from other cells. (Cell Theory!)

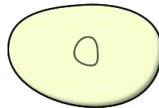
This process of creating new cells is called mitosis.

Mitosis

Cells have a limit to how large they can be and still function. When they reach the size limit, they divide into new cells.

Mitosis is cell division.

This graphic is a very simplified version of mitosis. One cell becomes two, by stretching, pinching, and separating. The new cells are identical to the parent cell.



Clay City

Imagine that you make a clay city.

In your city, all roads are made of blue clay.

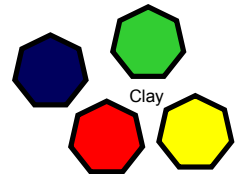
All homes are made of red clay.

All trees are made of green clay.

All stores/businesses are made of yellow clay.

You decide to make two identical cities. However, you do not have any more clay.

How would you create two cities from just one city?



Clay City

You could divide the clay into two even sets. There would be half as much clay, but each set would get all four colors.



What would the condition of your city be in while you were separating the clay?

Interphase

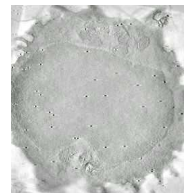
In cell division, the cell pretty much has to break down, split in two and put everything back together.

It does this in stages.

The first, and longest stage is Interphase. This is "regular life" for a cell, doing its cell activities.

At some point, the cell gets a signal, telling it to prepare to divide. All the DNA in the cell replicates (*makes a copy*).

Why is this a very important step?

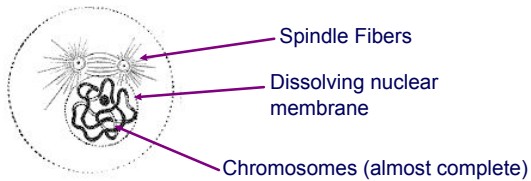


Prophase

In prophase, we begin to see the cell take itself apart. The nuclear membrane must dissolve so the DNA can move.

The DNA, not usually visible, now looks like thick strands. These strands are chromosomes.

Spindle fibers form to pull each set of DNA to the new cells.

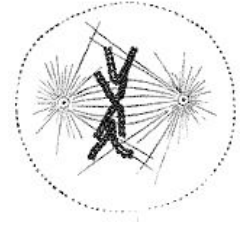


Metaphase

In this phase, the spindle fibers reach across the whole cell.

The chromosomes are pulled to line up across the middle of the cell.

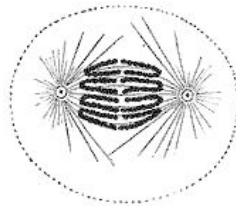
Notice, the nuclear membrane is completely gone.



This stage is easy to identify when looking at cells by remembering Metaphase....in the Middle.

Anaphase

The spindle fibers pull the chromosomes apart. They go to opposite sides of the cell.



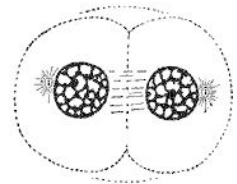
Why does this happen? Why must chromosomes move to the opposite sides of the cell?

This stage is easy to identify when looking at cells by remembering Anaphase....Apart.

Telophase

In telophase, the cell membrane pinches (called the cleavage furrow) and puts everything back together.

The nuclear membrane reforms, the chromosomes loosen back into DNA. The spindle fibers dissolve.



[Click here for an animated video about mitosis.](#)

Cytokinesis

"Cyto" refers to the cytoplasm; and "kinesis" means movement. In this final stage, the cytoplasm flows into opposite sides of the cleavage furrow.



When the pinch is complete, we have two smaller, yet identical, cells.

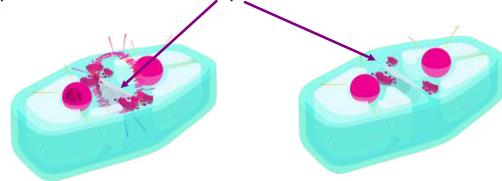
[Click here to see a video of living cells as seen through a microscope.](#)

Plant Cell Cytokinesis

Plant cells have all the same phases as animal cells.

However, there is one important structure that plant cells have that animal cells do not which makes "cell pinching" impossible. It is the cell wall.

In plant cell division, a "cell plate" forms between the new cells.



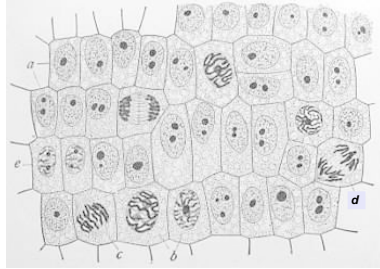
The cell plate grows into the cell wall between the new cells.

Cell Division in Onion Cells

In this group of onion cells, you can see many different stages happening at one time.

Can you find Interphase, Prophase, Metaphase, Anaphase and Telophase?

Where is a cell plate?



Cell Division in Onion Cells

In this group of onion cells, you can see many different stages happening at one time.

Can you find Interphase, Prophase, Metaphase, Anaphase and Telophase?

Where is a cell plate?

Answer

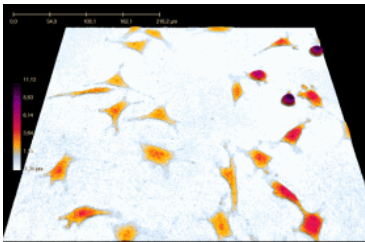
a = Interphase
b = Prophase
c = Metaphase
d = Anaphase
e = Telophase

The cell plate is at e.

Cell Cycle

All of these phases put together are part of the Cell Cycle.

It is the Cell Cycle that changed you from your babyhood body to your current level, and will continue in your growth and healing throughout your life.



These are actual cells on a slide. Find a dark ball and watch carefully.

6

☐ True

☐ False

6

☐ True

☐ False

Answer

True

7

☐ Growth of organisms

☐ Repair of damaged tissue

☐ Both A and B are true

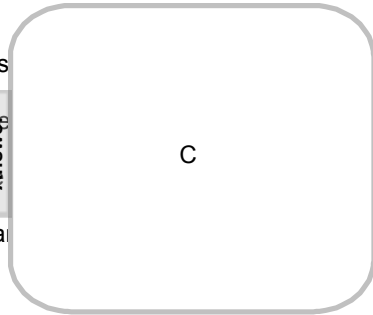
☐ Neither A nor B are true

7

- ☐ Growth of organis
- ☐ Repair of damage
- ☐ Both A and B are
- ☐ Neither A nor B are

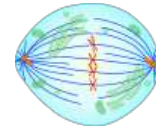
Answer

C



8

- ☐ Interphase
- ☐ Prophase
- ☐ Metaphase
- ☐ Anaphase
- ☐ Telophase

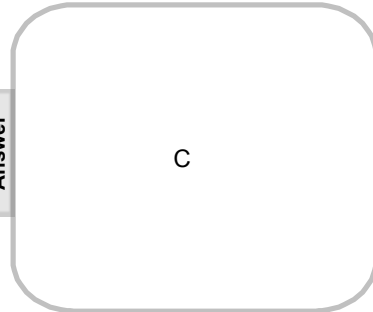


8

- ☐ Interphase
- ☐ Prophase
- ☐ Metaphase
- ☐ Anaphase
- ☐ Telophase

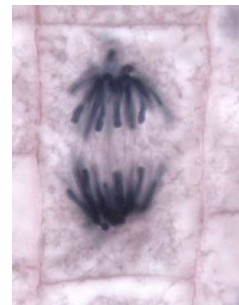
Answer

C



9

- ☐ Interphase
- ☐ Prophase
- ☐ Metaphase
- ☐ Anaphase
- ☐ Telophase

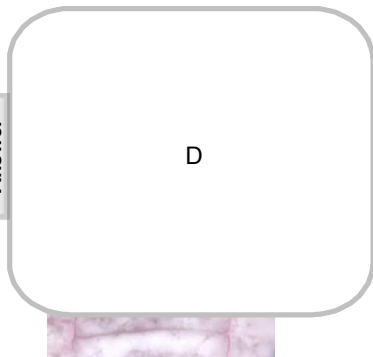


9

- ☐ Interphase
- ☐ Prophase
- ☐ Metaphase
- ☐ Anaphase
- ☐ Telophase

Answer

D



10

- ☐ True
- ☐ False

10

- ☐ True
- ☐ False

Answer

False

11

- ☐ Chromosomes
- ☐ Cell Plate
- ☐ Spindle fibers
- ☐ Cleavage furrow

11

- ☐ Chromosomes
- ☐ Cell Plate
- ☐ Spindle fibers
- ☐ Cleavage furrow

Answer

B

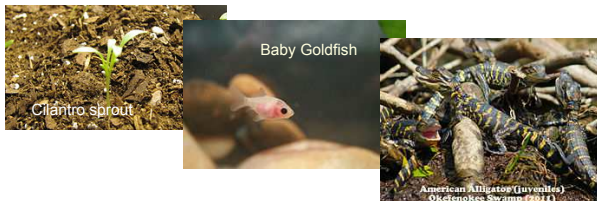
Organisms Reproduce

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All Organisms Must Reproduce

Success, biologically speaking, means for a species to continue long after present individuals have died.

This means there must be offspring and grand-offspring, and so on.



Reproductive Strategies

All organisms have strategies to have reproductive success.

We will discuss many of these.

It takes *energy* to reproduce, create seeds or eggs, nurture young. The strategies that have evolved create the greatest number of offspring which survive.



Important Note!

This will always be about the *species*, not an individual. For example, in a pride of lions, only one lioness reproduces.

The pride is successful because they help raise the young.



Asexual and Sexual Reproduction

Sexual reproduction means to have two individuals contribute genetic information to the offspring. A male and a female.

Asexual reproduction means only one individual contributes the genetic material.

There are advantages and disadvantages to both. Can you think of any right now?

Asexual Reproduction

In asexual reproduction, a piece of the parent becomes a new individual. There is no variation between the DNA of parent and young. Actually, it is more accurate to say they are identical, or clones of each other.

These are marine sponges. Each tube is an individual sponge. They are genetically identical.

Why don't the tubes all look alike if they reproduce this way?



Seedless Plants Are All Clones!

Farmers use asexual reproduction to get more of a high producing plant. *All* new individuals of seedless plants are from some type of asexual reproduction.



Bananas do not have functional seeds. The plants must be cloned.

Asexual Disadvantages

The greatest issue with asexual reproduction is there is no genetic variation.

If a disease struck the crop, they would either all survive or all die.

Variation between individuals is good for the species. The population is healthier because there is variation.



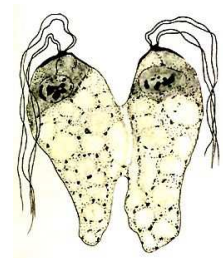
This whole banana crop has DNA identical to each other.

Types of Asexual Reproduction

Single celled organisms can divide into two new individuals. This is called binary fission.

What process that we just learned about does this remind you of?

Move those bacteria to find out.



Regeneration

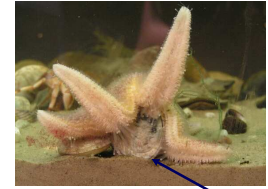
Some animals and most plants can grow a new individual from a part that has broken off. This is called regeneration.



This planarian and starfish can grow a new individual from almost any piece of their bodies.

Science in Action: A Real Life Problem

People and starfish eat clams. One group of clam diggers were frustrated at the amount of empty clam shells they found, so they decided to catch all the starfish they could find and kill them. They chopped up the starfish into pieces and threw the "dead" starfish pieces back in the sea.



Why was this a terrible mistake?

Starfish eating a clam.

Science in Action: A Real Life Problem

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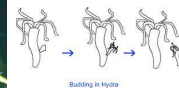
All the pieces regrew into whole starfish! Now they had *many more* starfish eating the clams!

Why was this a terrible mistake?

Starfish eating a clam.

Budding

Budding is a new individual sprouting from the parent. The baby hydra (left) will live on their own. The coral (right) will form a colony.



Are these corals all clones?

Vegetative Propagation

Most plants can create new individuals from any body part. This is called vegetative propagation.

Look closely! Each new leaflet will become a new plant.



"Vegetative" means from a root, stem or leaf.

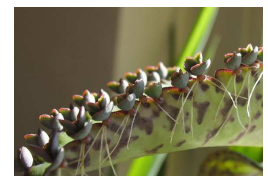
"Propagation" means to increase in numbers.

Vegetative Propagation

A dead yucca trunk sprouted new yucca plants (top).

The plant on the right lives in the rainforest. Each offspring has roots and will fall off the parent, ready for their new homes.

Vegetative propagation gives a high likelihood for survival of the offspring.

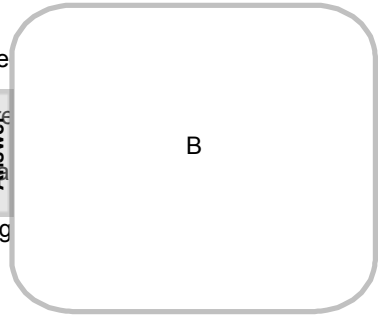


12

- ☐ No DNA is passed to the offspring.
- ☐ There is one parent.
- ☐ There are two parents.
- ☐ The offspring is genetically different from the parent.

12

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- ☐ There is one parent
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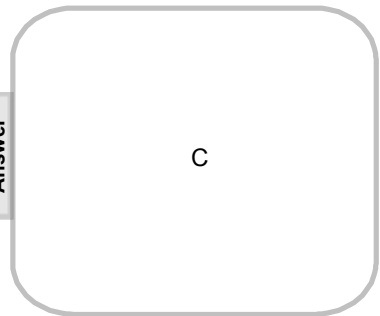


13

- ☐ The individual
- ☐ The local group
- ☐ The species

13

- ☐ The individual
- ☐ The local group
- ☐ The species

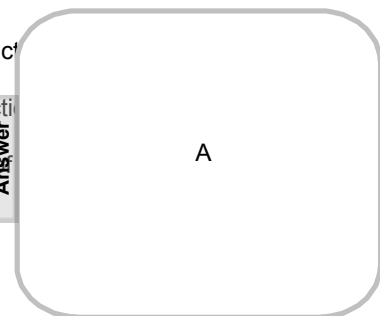


14

- ☐ Asexual reproduction
- ☐ Sexual reproduction
- ☐ Great variation of DNA
- ☐ Two parents

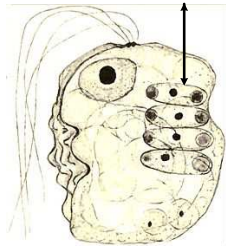
14

- ☐ Asexual reproduction
- ☐ Sexual reproduction
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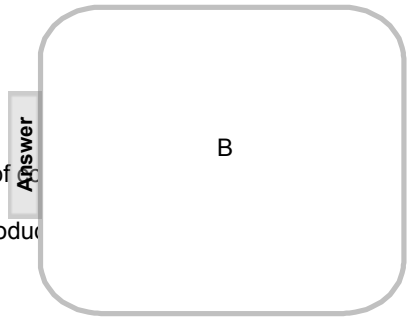
15

- ☐ Dying
- ☐ Budding
- ☐ Growing out of control
- ☐ Sexually reproducing



15

- ☐ Dying
- ☐ Budding
- ☐ Growing out of control
- ☐ Sexually reproducing



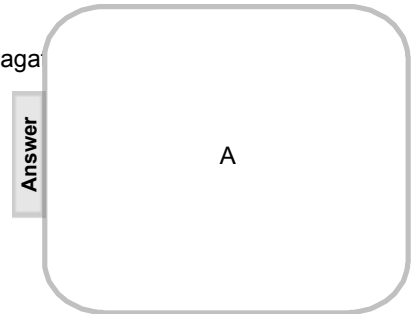
16

- ☐ Vegetative propagation
- ☐ Fertilization
- ☐ Binary Fission
- ☐ Cloning



16

- ☐ Vegetative propagation
- ☐ Fertilization
- ☐ Binary Fission
- ☐ Cloning



Sexual Reproduction

Sexual reproduction requires DNA from two parents. The DNA is blended in the offspring and there is genetic variation.

This is called fertilization.
Fertilization is the union of sex cells.
In animals, the sperm and egg join.
In plants, the pollen and ovule join.



Creating the Sex Cells

During fertilization, the nuclei of the sperm and the egg combine. It is critical that the new cell has the proper amount of chromosomes.

So, if an organism has 20 chromosomes, the fertilized egg must have 20 chromosomes.

So how many chromosomes must the sperm and egg have?

Creating the Sex Cells

During fertilization, the nuclei of the sperm and the egg combine. It is critical that the number of chromosomes is the same in both.

So, if an organism has 20 chromosomes, its sex cells must have 10 chromosomes.

So how many chromosomes do the sex cells have?

10 in each

Meiosis

In mitosis, the new cells had the same number of chromosomes and were identical to the parent cell.

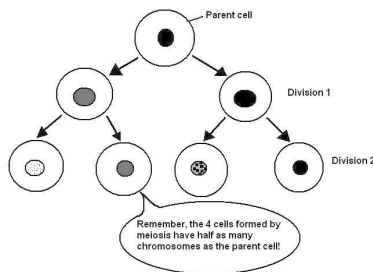
In meiosis, a complete individual is formed by 2 individuals coming together. Those sex cells have to have the chromosome number reduced by half.

This kind of division is called meiosis.

Meiosis

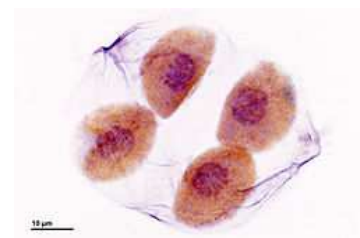
Specialized cells called primary sex cells undergo meiosis to form sperm, egg, pollen or ovule.

Essentially, the primary sex cell undergoes mitosis but does not go back into interphase. It goes into prophase and divides again. The DNA does not replicate. After the second division, each cell has half the DNA of the primary sex cell.



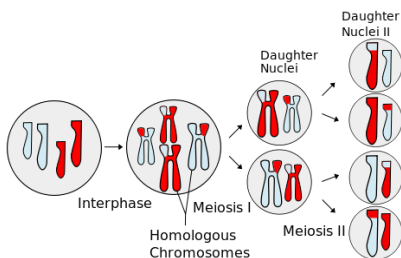
Sex Cells

Here you can see four pollen cells, which have formed from a single primary sex cell.



Chromosomes Trade Sections

During meiosis, chromosomes that are for the same traits often break and swap sections. In this diagram, the daughter cells have DNA that is somewhat different than the parent cell. This gives variation!



Sexual Reproduction

The important advantage to sexual reproduction is the variation of individuals. This comes completely from meiosis.

The disadvantage is that the organism must find a mate, somehow unite the sex cells, and create offspring in a form likely to survive. This requires a lot of energy (and in some cases, a lot of time).

For most organisms, the energy cost is worth the variation in their offspring. Most complex organisms rely on sexual reproduction.

17

- ☐ sperm - ovule
- ☐ pollen - egg
- ☐ pollen - sperm
- ☐ pollen - ovule

17

- ☐ sperm - ovule
- ☐ pollen - egg
- ☐ pollen - sperm
- ☐ pollen - ovule

Answer

D

18

- ☐ vegetative propagation
- ☐ fertilization
- ☐ binary fission
- ☐ cloning

18

- ☐ vegetative propagation
- ☐ fertilization
- ☐ binary fission
- ☐ cloning

Answer

B

19

- ☐ Vegetative Propagation
- ☐ Fertilization
- ☐ Binary Fission
- ☐ Cloning



19

- ☐ Vegetative Propagation
- ☐ Fertilization
- ☐ Binary Fission
- ☐ Cloning

Answer

B

20

- ☐ Four offspring cells
- ☐ Genetic Variation
- ☐ Cloning
- ☐ Both A and B are true
- ☐ A, B, and C are true

20

- ☐ Four offspring cells
- ☐ Genetic Variation
- ☐ Cloning
- ☐ Both A and B are true
- ☐ A, B, and C are true

Answer

D

21

- ☐ True
- ☐ False

21

- ☐ True
- ☐ False

Answer

False

Animal Behaviors and Reproduction

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Reproductive Strategies

There are two extreme strategies to creating offspring that survive.

The first strategy is to have a few offspring, and give lots of parental care.

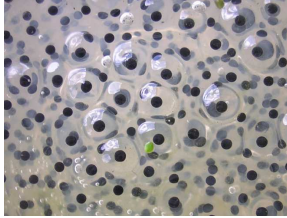


Elephants, whales and humans are great examples, giving many years of parental care to a few offspring. These are called the "k-selected species."

Reproductive Strategies

The second strategy is to have no parental care, but to produce as many offspring as possible. The eggs and sperm are released to the water, fertilization is external.

Most fish and amphibians are examples. These are called "r-selected species."



Fertilized frog eggs. Each dark spot will grow into a tadpole.

Reproductive Strategies

There are many species that fall between those extreme strategies.

There are also many exceptions to every rule!



The seahorse is a unique fish in many ways. This male carries the eggs in a pouch until they hatch.

After he releases them, there is no parental care.

Requirements for Reproduction

There are three requirements for successful reproduction:

1. Finding a mate
2. Fertilization
3. Creating the offspring



Requirement #1 - Find a Mate

It is beneficial for the species for a selection process to take place.

Animals that have solitary lifestyles must attract a mate. Breeding is the only time they associate with others of their species.

Often, animals go to extremes in behavior and body form to attract a mate.

[Click here for a short video of the male stalk-eyed fly transformation.](#)

Displays to Attract Mates

Many animals have features and behaviors to attract a mate.

In birds, exotic plumage, dancing, vocalizations and nest making are examples of displays.



[Click here to watch a video showing how these "Birds of Paradise" use their extreme feathers to attract females.](#)

Bioluminescence

Some animals literally glow to attract mates.



This deep sea relative of jellyfish, the firefly, and this dinoflagellate have biochemistry that they activate to glow.

Displays

Bright colors, large antlers and tusks are examples of displays. The antlers fall off after mating season. Both tusks and antlers are used to defend females from other suitors.



Walrus



Elk



Moose



Mandrill

Scent

All animals that can sense smell use scent to attract a mate. This helps males and females find each other, sometimes over great distances.



Insects, reptiles and mammals all attract potential mates with scent.

22

- ☐ Obtaining food
- ☐ A mating display
- ☐ Releasing scent
- ☐ Guarding young



This 5 minute TedTalk shows the cuttlefish in action, as well as bioluminescence.



22

- ☐ Obtaining food
- ☐ A mating display
- ☐ Releasing scent
- ☐ Guarding young

Answer

B

This 5 minute TedTalk shows the cuttlefish in action, as well as bioluminescence.



23

- ☐ create offspring that are identical
- ☐ create offspring to feed predators
- ☐ waste energy
- ☐ create offspring that have variation from the parents

23

- ☐ create offspring that
- ☐ create offspring to
- ☐ waste energy
- ☐ create offspring that

Answer

D

24

- ☐ Yes
- ☐ No

24

- ☐ Yes
- ☐ No

Answer

Yes

25

- ☐ True
- ☐ False



25

- ☐ True
- ☐ False



Answer

True

26 Wood ducks lay 6-15 eggs per year and give parental care. What type of selection strategy is this?

- ☐ A K-selection
- ☐ B R-selection
- ☐ C They show traits of both.



26 Wood ducks lay 6-15 eggs per year and give parental care. What type of selection strategy is this?

- ☐ A K-selection
- ☐ B R-selection
- ☐ C They show traits of both.

Answer

C

27

- ☐ Individual survival
- ☐ Protect young
- ☐ Attract a mate
- ☐ Defend from predators



27

- ☐ Individual survival
- ☐ Protect young
- ☐ Attract a mate
- ☐ Defend from predators

Answer

C

Requirement # 2 - Fertilization

In animals, fertilization can be internal or external. That is, the sperm meets the egg inside or outside of the female's body.

If sperm dries, it dies. Aquatic animals can have external fertilization because the sperm will be surrounded by water. Land animals had to overcome this problem. They did so by depositing sperm inside the female's body (internal fertilization).

Fish, Amphibians, Aquatic Invertebrates

Nearly all of these release sperm and eggs into the water after they find a mate. The male and female stay near each other during the release to ensure that the sperm will find the eggs.



Fish, Amphibians, Aquatic Invertebrates

Animals that do not move (like clams, sponges and mussels) release the sperm and eggs at a seasonal signal. When the water reaches a certain temperature, or during a full moon, they all release the sperm and eggs.



Why is it important that they release them at the same time?

Mollusks and Crustaceans

Mollusks include squid, octopi and snails. Crustaceans include crabs and lobsters. These are complex invertebrates, and have internal fertilization.



A marine snail



Crab

Insects, Spiders, Reptiles, Birds and Mammals

All of these land animals have evolved a method to have internal fertilization.

These firebugs attach abdomens, the male deposits the sperm inside the female.



Requirement #3 - Creating the Offspring

The development of the offspring can be either internal or external.

For the vast majority of animals, it is external in the form of an egg.



Only mammals have internal development.



Requirement #3 - Creating the Offspring

The development of the offspring can be either internal or external.

For the vast majority of animals, it is external in the form of an egg.

Only mammals have internal development.

Teacher Notes

Of course, there are exceptions. The platypus is a mammal that lays eggs. Also, there is some evidence that sharks have a placental connection to their young.



Aquatic and Reptile Eggs

Aquatic animals have membranes around their eggs. If eggs dry out, they die. There is little chance of that in water.

Reptiles have a pliable, leathery egg. Most reptiles make their nests under ground. More eggs survive if they do not have rigid shells. Why is this?

Most reptiles lay their eggs and leave their young unattended.



Sea Turtle egg

Bird Eggs

Birds lay rigid, hard shelled eggs. Birds must tend to the eggs, keeping them warm. They also give parental care to the baby birds.

Most baby birds are helpless and featherless.

Some birds are called precocious, and can walk and feed themselves as soon as they are dry. Ducks, chickens, and swans are examples.



Just hatched baby longspur.

5 day old cygnets



Parenting

Tending to the offspring means many things for different animals.

Parenting begins with building a den or nest for many animals. These animal homes will keep the young warm and protected from predators.



Two bird nests and a beaver dam.

Feeding

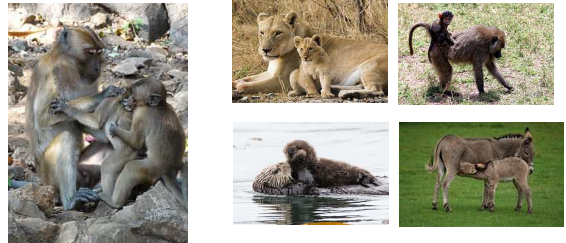
Animals that give parental care feed their young.



Birds have evolved to respond to their young's open beak by regurgitating food.

Mammals

Mammals give the most parental care of all the species. Fertilization and development of young in mammals are both internal. Mammals have mammary glands which produce milk for the young. Mammals feed, groom and teach their young how to survive.



Parents Protect Their Offspring

Parents must protect their offspring from predators and dangerous situations. Birds will mob a predator to protect their young. These crows are chasing a hawk who might eat their young.



Herding animals often keep their young to the inside of the herd.

[Click here to watch a lion attack on a water buffalo herd.](#)

[Click here to watch what happens when a baby elephant gets stuck in the mud.](#)

28

☐ True

☐ False

28

☐ True

☐ False

Answer

True

29

☐ True

☐ False



29

- ☐ True
- ☐ False



False

30

- ☐ A new individual offspring
- ☐ Variation in the genetics
- ☐ A mix of parental DNA
- ☐ All of the above

30

- ☐ A new individual of
- ☐ Variation in the ge
- ☐ A mix of parenta
- ☐ All of the above



D

31

- ☐ Turtle
- ☐ Fish
- ☐ Snake
- ☐ Bird



31

- ☐ Turtle
- ☐ Fish
- ☐ Snake
- ☐ Bird



B

32

- ☐ Mammal
- ☐ Reptile
- ☐ Crustacean
- ☐ Bird

32

- ☐ Mammal
- ☐ Reptile
- ☐ Crustacean
- ☐ Bird

Answer

A

Plant Structures and Reproduction

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Asexual Reproduction and Plants

As we have stated earlier, plants have a form of asexual reproduction called vegetative propagation.

Most plants can propagate from a leaf, root or stem if they get enough water, minerals and sunlight.

Plants also can reproduce sexually. The male sex cell is the pollen. The female is the ovule. When fertilization takes place, DNA from both parents is mixed and there is variation among the offspring.

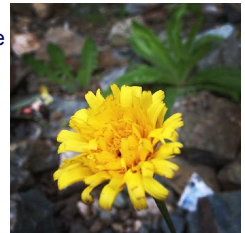
Plant Requirements for Sexual Reproduction

Like animals, plants have conditions necessary for the creation of new offspring.

Yes, they must "find a mate". But, plants cannot move or communicate. Getting the pollen to the female part of the flower, is the first order of business for the plant. This is called pollination.

Plants must create a seed, the plant equivalent of an egg.

Plants must increase the odds of that seed sprouting in some way.

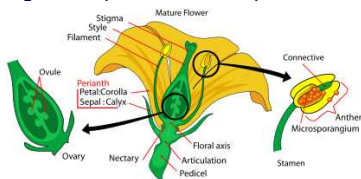


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Plant Sexual Structures

The organ of reproduction for a plant is the flower.

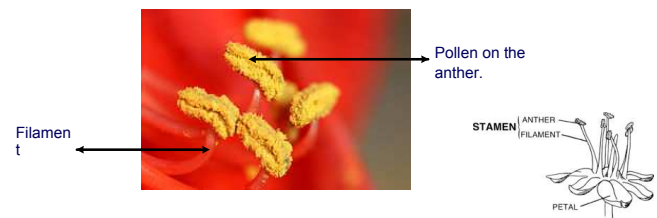


The male part of the flower is the stamen, which is made up of the filament and anther.

The female part of the flower is the pistil, which includes the stigma, style and ovary, which contains the ovules.

Male Flower Structures

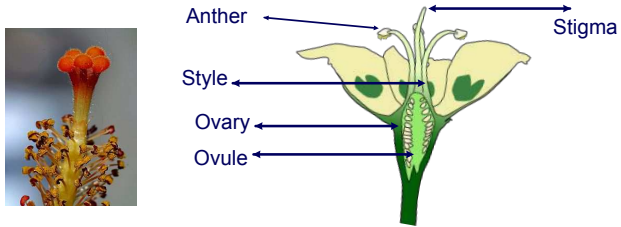
The filament is a stalk which lifts the pollen high on the flower. The anther makes the pollen. Together they are called the stamen.



Stamen = filament + anther

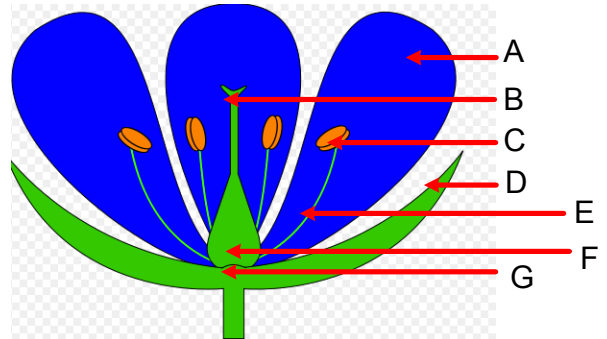
Female Flower Structures

Female flower structures include the stigma, which is sticky, to catch pollen. The style is a long tube which pollen goes through to meet the ovules in the ovary. Each ovule can become a seed. Together, they are called the pistil.

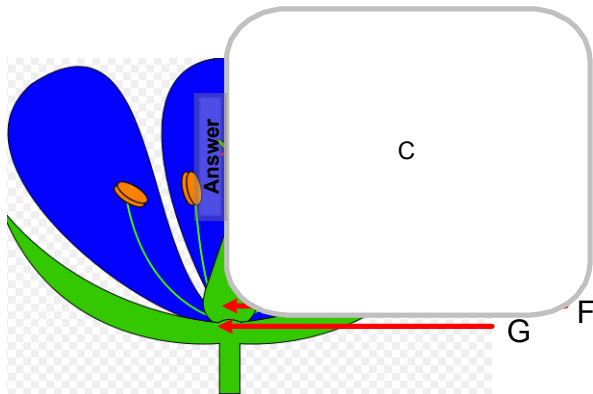


Pistil = stigma + style + ovary

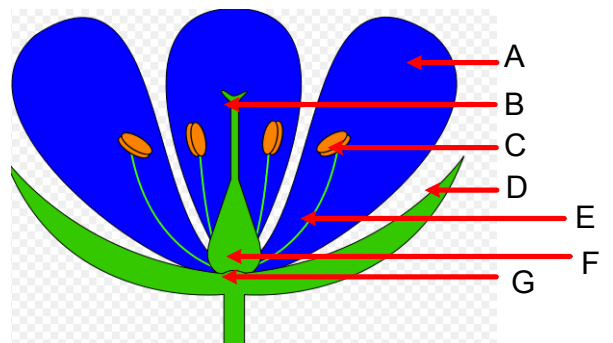
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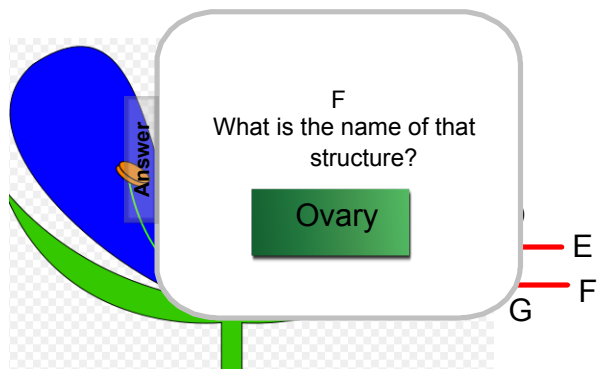
33



34



34



35

- ☐ pistil
- ☐ stamen
- ☐ petals
- ☐ sepals



35

- ☐ pistil
- ☐ stamen
- ☐ petals
- ☐ sepals

Answer

A

Requirement #1 - Pollination

Many flowers have both male and female structures. It does not increase variation unless the pollen and ovules come from two different individuals.



In some plants, the pollen and ovules do not mature at the same time. All the pollen must go to another plant, all the ovules must be fertilized from another plant.



Some flowers or plants have only male or female structures. They cannot self pollinate.

Loblolly pine trees have separate male and female structures.
Pine trees have cones instead of flowers.

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Pollination

Pollination, specifically, is the transfer of pollen from an anther to the stigma of the flower. The stigma is often sticky, or has tiny hairs, to catch pollen when it lands.

This photo shows self-pollination. If the pollen goes to a different flower it is called cross-pollination.

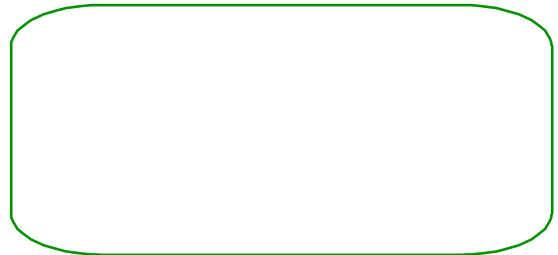


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Pollination

Pollination requires outside help. There are many forms of pollinators which carry pollen from one plant to another.

Brainstorm as many types of pollinators as you can at your table. (Hint: Pollinators can be living or non-living.)



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Random Pollinators

Wind and water are random carriers of pollen. Success can only be increased if a large amount of pollen is released.



This floating pollen from the nearby trees missed reaching flowers. Hopefully for the trees, some pollen got to flowers.

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Pollination

To get pollinators to come to a flower, the plant needs to provide an incentive for the animal.

The most well known pollinators are bees. Bees use the pollen as food and to make honey. They fly from flower to flower collecting the food. Some pollen falls off and fertilizes the flower.



The Cost of Pollination

Providing food or shelter for animals is a high energy cost for the plant. Lots of pollen, or showy fragrant flowers require energy to produce.

This ant gets sweet nectar and flowers get pollinated.



Mimicry

Male wasps carry females when they mate.

This Hammer Orchid takes advantage of this fact to help its pollination. The orchid has petals that look like a female wasp. It also releases a scent that is like the female wasp.

When the wasp tries to grab the petal, the hammer snaps and he gets pollen on his back. If he moves on and does the same thing to another orchid, that flower will be pollinated.



[Click here to watch a short video about the orchid/wasp behavior.](#)

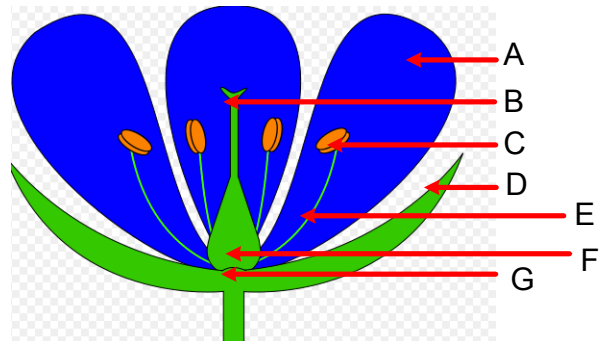
Mimicry

This Carrion Flower smells like rotten meat. Flies need to lay eggs in meat. They go from flower to flower looking for dead meat.

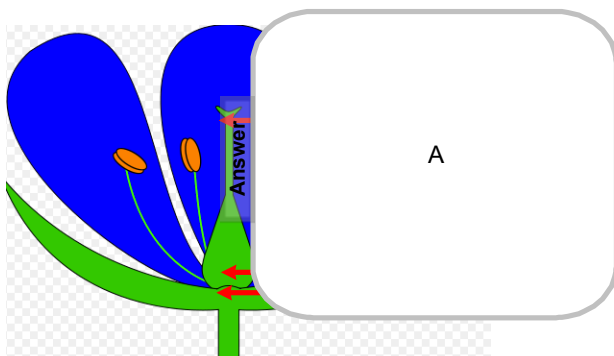
How is this an example of pollination?



36



36



37

- ☐ Wind
- ☐ Rain
- ☐ Running water
- ☐ Bees
- ☐ Mice
- ☐ Large mammals, like elk

37

- ☐ Wind
- ☐ Rain
- ☐ Running water
- ☐ Bees
- ☐ Mice
- ☐ Large mammals, l

Answer

A - E

38

- ☐ True
- ☐ False

38

- ☐ True
- ☐ False

Answer

True

Name the female plant sex cell.

Ovule

39

- ☐ Many pollinators will be attracted.
- ☐ More likelihood of variation of offspring.
- ☐ High cost of energy.
- ☐ The offspring will have no genetic variation.

39

- ☐ Many pollinators v
- ☐ More likelihood of
- ☐ High cost of ene
- ☐ The offspring will

Answer

C

40

- ☐ self pollination
- ☐ cross pollination
- ☐ both of the above
- ☐ D none of the above

40

- ☐ self pollination
- ☐ cross pollination
- ☐ both of the above
- ☐ D none of the above

Answer

A

Requirement #2 Seed Formation

Requirement #3 Seed Dispersal

Seed formation and dispersal are completely linked, so we will consider them at the same time.

Every fertilized ovule becomes a seed.

Dispersal is important, because the young plants must sprout away from the parent plants.

Wind, water and animals are agents of dispersal.

Wind

Wind does not need an incentive to carry seeds.
The plant must form its seed in a shape that will let it fly.



Maples, the crown flower and dandelions all produce flying seeds.

Wind

When Russian thistle dries out, the whole plant rolls in the winds, dropping seeds everywhere.



This gives it its common name: tumbleweed.

Water Carries Seeds

Many aquatic plants rely on water. There are also many land plants that rely on water for dispersal of their seeds.

Palm trees release coconuts which can float for days at sea. Mangrove trees live seaside. Their seed float away from the parents too. When they touch land, a root shoots out and anchors the seed.



Animals Carry Seeds

Animals carry seeds in many ways. Some seeds stick to fur and feathers and are carried wherever the animal travels. They fall (or are scratched) off and sprout where they land.



Explain how the bison's head is covered with burrs.
What is special about those seeds?

Animals Bury Seeds

Many animals store nuts for the winter. A nut is a hard, woodlike seed. The plant makes them difficult to eat. Some of the buried seeds sprout in spring, far from the parent plant.

Squirrels and chipmunks eat and store nuts.



41

- ☐ pollination
- ☐ dispersal
- ☐ both A and B
- ☐ neither A nor B

41

- ☐ pollination
- ☐ dispersal
- ☐ both A and B
- ☐ neither A nor B

Answer

C

42

- ☐ a specific insect
- ☐ any insect that lands on it
- ☐ wind
- ☐ rain



42

- ☐ a specific insect
- ☐ any insect that lands on it
- ☐ wind
- ☐ rain

Answer

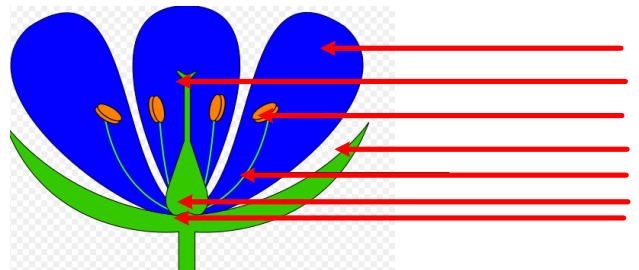
A



Fruit

In terms of energy, the most expensive structure for a plant to create is fruit.

Label the parts below for a quick flower structure review.
Go back in the chapter to find answers if you get stuck.



Fruit

When a plant creates a fruit, it hides the fertilized ovules (which are now seeds) inside an enticing treat. Why is this? What type of seed dispersal does this use?

Discuss with a classmate and write your thoughts below.



Each seed is an ovule. This orange is composed of many ovules.

Real World Question

What might explain why watermelons have mature black seeds and immature white seeds?



Double Advantage

Fruit are able to meet requirement 3 and requirement 4.

Requirement 3 - Seeds Require Dispersal

When animals eat fruit, the seeds are dispersed to new areas.



Fruit

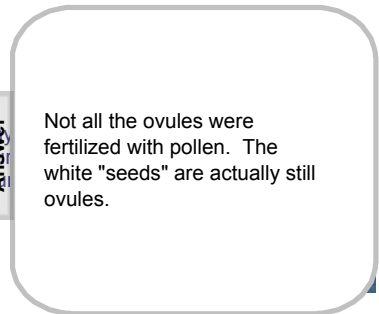
This is animal dispersal. Animals eat the sweet fruit, including the seeds. The seeds travel through their digestive tracts. The seeds will exit the animal in the feces. The seed can then grow, having been moved away from the parent plant.



Real World Question

What might explain why watermelons have mature black seeds and immature white seeds?

Not all the ovules were fertilized with pollen. The white "seeds" are actually still ovules.



Double Advantage

Requirement # 4 - Seed can germinate (sprout) in good soil. The fruit that is uneaten drops to the ground and rots. This adds nutrients to the soil that the baby plant will need. This is really the best a plant can do for its offspring.



Tomatoes and squash rot and amend the soil for the seeds.

Summary

Plants are organisms that lack locomotion. They cannot move from place to place.

Asexual reproduction is possible but not the most favored. There is no genetic variation between the parent plant and all offspring. Populations are at risk of dying out from disease or other factors.

Plants can reproduce sexually but need outside help. Plants evolved various mechanisms to ensure the highest rate of success of their offspring. These mechanisms promote fertilization, dispersal and germination of new offspring.

43 An example of germination is:

- ☐ getting pollen to a stigma.
- ☐ getting pollen to an ovule.
- ☐ dispersal of seeds.
- ☐ sprouting of a new plant.

43 An example of germination is:

- ☐ getting pollen to a
- ☐ getting pollen to
- ☐ dispersal of seeds
- ☐ sprouting of a new

Answer

D

44 Oak trees are distributed throughout the US and Canada. Oak trees are pollinated by wind and create acorns as their seeds. This strategy:

- ☐ is a heavy energy burden.
- ☐ has been a successful strategy for oaks.
- ☐ has been an unsuccessful strategy.
- ☐ no way to know.



44 Oak trees are distributed throughout the US and Canada. Oak trees are pollinated by wind and create acorns as their seeds. This strategy:

- ☐ is a heavy energy
- ☐ has been a suc
- ☐ has been an unsu
- ☐ no way to know.

Answer

B



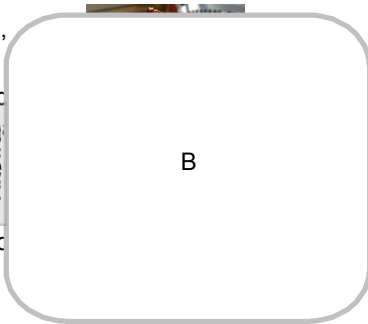
45 Look at the pictures of the pomegranate flower and fruit. Which is the true statement?

- ☐ Fertilized by wind, dispersal by wind
- ☐ Fertilized by insects, dispersal by animals
- ☐ Fertilized by water, dispersal by wind
- ☐ Fertilized by insects, dispersal by wind



45 Look at the pictures of the pomegranate flower and fruit. Which is the true statement?

- ☐ Fertilized by wind, dispersal by wind
- ☐ Fertilized by insect, dispersal by animal
- ☐ Fertilized by water, dispersal by wind
- ☐ Fertilized by insect, dispersal by wind



Environmental and Genetic Factors

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Sponges

Think back to those sponges...

They are genetically identical, because they were "buds" off a single sponge.

However, they aren't actually identical. They are somewhat different in shape and size.

They also did not grow straight up, as sponges prefer.



Sponge Growth

The environment affected the sponges' growth.

We can only guess that water currents or position of the sponge relative to the rest changed the pattern of growth.

The top three are in a better position to catch falling food. They have grown much larger.



Sponge Genetics

Sponges are filter feeders. They have tiny cells that sweep water through their body.

They are able to digest any organic pieces that are floating in the water. Therefore, most sponges have "mouths" that point upwards to catch any of these organic pieces.

These sponges have grown as expected, for the most part.



Sponge Genetics

The genetics of these sponges also said, "grow straight up."

The environment influenced the growth in a way different than their genetic code.

How do you think this will affect the survival of these sponges?



The Environment Plays a Role

The environment plays a role in gene expression. Traits do not always appear in the expected way.

This tree should have grown straight up also. Can you hypothesize what caused this tree to grow like this?



The Environment Plays a Role

Both alligators and sea turtles are affected by the environment in an interesting way. The temperature of the nest determines if the hatchlings are male or female!

Cool temperatures produce male turtles and higher temperatures produce female turtles. (The pattern is reversed in alligators.)



46

- ☐ chemical factors
- ☐ physical factors
- ☐ biological factors
- ☐ none of the above

46

- ☐ chemical factors
- ☐ physical factors
- ☐ biological factors
- ☐ none of the above

Answer

B

Nurture vs Nature

Scientists have argued for years about which is more important: nature (your genetic traits) or nurture (the conditions of your surroundings). Nature and nurture affect all living things.



Hydrangea is a bush with many flowers. They grow pink or purple depending on the soil. Iron in the soil is responsible for changing the color. In the same bush, we see a different expression of genes.



The Environment Plays a Role

If the environment lacks certain nutrients, genes are not expressed.

This chicken is lacking a vitamin. A prolonged drought is causing these children to starve.



FIGURE 51—Japanese war orphans with dependent children having typical appearance of malnutrition. New Bilibid Prison, September–October 1945.

47

- ☐ chemical factors
- ☐ physical factors
- ☐ biological factors
- ☐ none of the above

47

- ☐ chemical factors
- ☐ physical factors
- ☐ biological factors
- ☐ none of the above

Answer

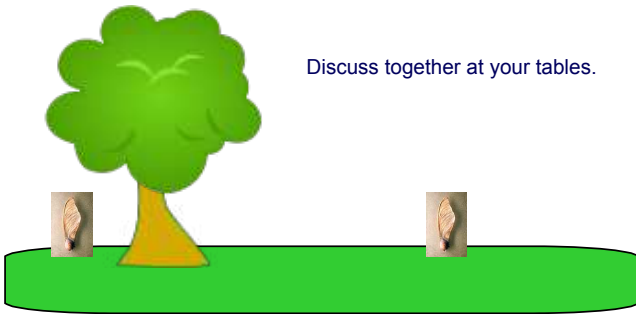
A

The Environment Plays a Role

Plants grow where the seed lands. Sometimes the environment the seed lands on changes the growth pattern. Consider these maple seeds landing as shown.

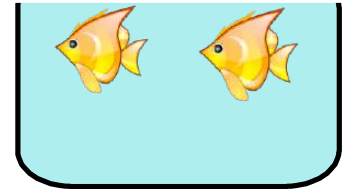
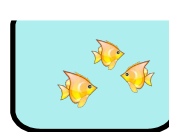
Which seed do you think has a better chance at survival and why?

Discuss together at your tables.



The Environment Plays a Role

Open space for organisms to grow changes the size of the organism. For example, fish of the same species grow much larger in lakes than they do in ponds. You can see this effect in fish tanks too!



48

- ☐ chemical
- ☐ physical
- ☐ biological
- ☐ none of the above

48

- ☐ chemical
- ☐ physical
- ☐ biological
- ☐ none of the above

Answer

C

Yellowstone National Park: A Case Study

A carefully documented case of cause and effect between living organisms and the environment is Yellowstone N.P.



Yellowstone is over 2 million acres. It was the first national park in the world.

It has a complicated ecosystem and many animals, including wolves, bear, elk and bison.

Yellowstone National Park: A Case Study



In the beginning, people didn't know how to act around wild animals.

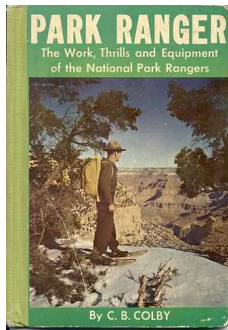
They fed the bears.

They tried to find and play with the baby wolves.

The people were injured and even killed.

Note

Yellowstone National Park: A Case Study



The first park rangers knew more about law enforcement than they did about ecosystems and science.

To protect the tourists, they decided to get rid of all the predators in the park.

They killed *all* the wolves, coyote, bear and mountain lions. By 1926, there were no predators in Yellowstone.

Yellowstone National Park: A Case Study

This was a major change in the environment. Without predators, the elk and bison could eat and reproduce more than before.



What do you think happened to their food sources?

49

- ☐ It increased.
- ☐ It decreased a little.
- ☐ It increased radically.
- ☐ It decreased radically.

49

- ☐ It increased.
- ☐ It decreased a little.
- ☐ It increased radically.
- ☐ It decreased radically.

Answer

D

Yellowstone National Park: A Case Study

Elk, bison and deer have summer food and winter food. Summer food is green plants. Winter food includes bark and small branches.

Within a few years the Park was almost *plant-less*.

The herds were so large, they finished the summer food in July and they began to eat the winter food.

Yellowstone National Park: A Case Study

When winter came, many animals died a slow death of starvation. The scavenger population (crows and badger) grew very large.

The soil, once held tight by plant roots, became loose. When the rains came the soil washed away.

The elk had eaten the aspen trees that beaver need to make their dams.



What happened next to the beaver and the streams they built in? Make a prediction with a partner. Be prepared to share your idea.

50

- ☐ adapted and used different trees
- ☐ moved downstream to where there were aspens
- ☐ died
- ☐ adults lived, babies were washed away when the dams broke
- ☐ the streams moved more slowly with all the debris in them
- ☐ the streams moved more swiftly without the dams

50

- ☐ adapted and used
- ☐ moved downstream
- ☐ died
- ☐ adults lived, babies were washed away when the dams broke
- ☐ the streams moved more slowly with all the debris in them
- ☐ the streams moved more swiftly without the dams

Answer

B, C, D, F

Yellowstone National Park: A Case Study

The beavers could not build or maintain the dams. The dams broke, washing away baby beavers. The population of beavers dwindled.



Directly connected to this was the change in streams. What were once slow moving streams became swift rivers. The aquatic plant and animal life were washed away.

Hundreds of thousands of birds migrate to Yellowstone for the summer. But, now their food was gone. They could not build nests near swift water.



What happened to the birds?

Yellowstone National Park: A Case Study

The birds died or flew to other places. The population dwindled.

The rangers tried to plant aspen and grasses, but the soil did not support the plants as well. The herds ate any new plant right away.

Yellowstone Park was nearly a disaster.

Yellowstone National Park: A Case Study

As a result of all this, the predators started to come back into Yellowstone. Bear and mountain lions migrated back into the park. Foxes and birds of prey such as eagles came back.

They thinned the herds.



Rangers taught people to leave the wildlife alone.
Never feed the bears!

Yellowstone National Park: A Case Study

As we have talked about earlier, bears often eat whole fruit, dropping seeds in their feces.

How did this help the recovery of Yellowstone?



Yellowstone National Park: A Case Study

In 1995 wolves were reintroduced to Yellowstone. Gradually the following happened....

Elk and deer populations leveled out.

Willow, cottonwood and aspen trees returned.

Beaver returned and built dams.

Rivers became slow streams.

Migrating birds returned.

Moose, otter and mink thrived in the new marsh habitats.

Fish returned.



Organisms and the Environment

The environment affects those that live in it, *AND* the organisms affect the environment.

[Click here to watch a video about how wolves change rivers.](#)

Nurture vs Nature

What do you think is more important?

We have seen how the environment can limit the expression of genetic traits.

How does a beneficial environment affect the genetic traits?

Write your ideas below.

51 The expression of the genes of this tree were affected by the environment.

☐ True

☐ False



51 The expression of the genes of this tree were affected by the environment.

- ☐ True
☐ False



True

52 The expression of the genes of this tree were affected by the environment.

- ☐ True
☐ False



52 The expression of the genes of this tree were affected by the environment.

- ☐ True
☐ False

Answer

True
No organisms are
separate from the
environment.
All of them are affected,
positively or negatively.

