هيكل الصف الثامن منهج انسباير

Inspire Science Grade 8 "Exam lessons"

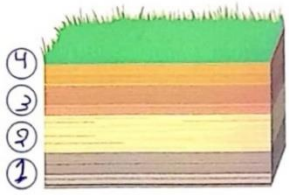
Module 1 {Geologic time}

Lesson 1- Analyzing the rock and fossil records

- **Relative age** → is the age of rocks and geologic features compared with other rocks and features nearby.

- Using the principles of relative age dating→ geologists can determine if rocks or features are younger or older than the rocks of features around them.

✓ ***The principles of Relative Age Dating:***

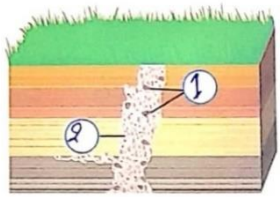


1) *Superposition* →The oldest rocks are on the bottom and the newest layers are on the top.

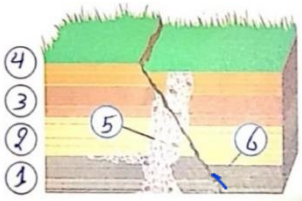
2) *Original horizontality* →Most rock forming materials are deposited in horizontal layers.

3) *Lateral continuity* →The principle that sediments are deposited in large sheets in all lateral direction.

4) *Inclusion* →If one rock contains pieces of another rock, the rock containing the pieces is younger than the pieces.



5) *Cross- cutting relationships* →If one geologic feature cuts across another feature, the feature that it cuts across is oldest.



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- ✓ ***Fossils*** → the remains of ancient living things.

- Fossils also gives us clues about the relative -age rocks.

- **Fossil record**

  a. Fossils found in the **oldest** layers of rock are relatively **simple organisms**

  b. Fossils found in the **younger** layers of rock are more **complex organisms**

  c. Types of fossils that appear in one layer of rock doesn't appear in the younger layers above it.

  d. The sudden disappearances in the fossil record of many types of organisms called **mass extinction.**

  e. Fossils and rocks they are within can determine what the environment was look like long ago.

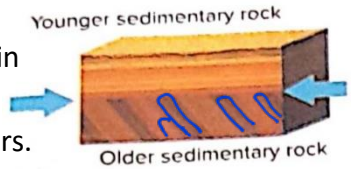
➢ ***What happens when the rock and fossil records are not complete?***

- ✓ **Weathering**, **erosion**, **volcanism** and other processes are constantly changing earth's surface → this makes it difficult to find a sequence of rock layers that haven't been disturbed.
  Sometimes, the rock record of a past event is completely eroded away.

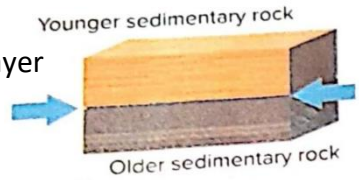
➢ ***Unconformities*** → breaks or gaps in the rock record

- **There are 3 types of unconformities:**

  1) **Angular unconformities**
  when horizontal layers of sedimentary rock are deformed during mountain building or other geologic events → they usually uplifted or tilted
  → later, layers of sedimentary rock are laid down on top of the tilted layers.

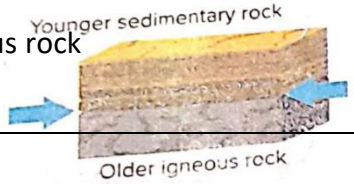


  2) **Disconformities**
  when horizontal layer of sedimentary rock overlies another horizontal layer of sedimentary rock that have been eroded.



Nonconformity

when a layer of sedimentary rock overlies a layer of igneous rock



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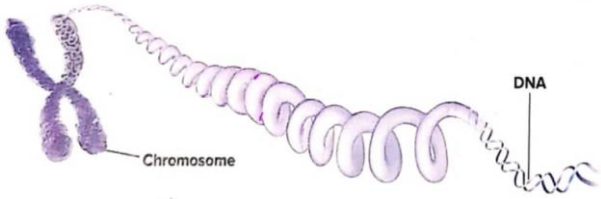
or metamorphic rock.

Module 2 {Natural Selection and adaptations}

Lesson 1- How traits change

The structure of DNA:



- Most of cells contain chromosome.
- chromosomes are made of proteins and DNA.
- DNA: "an organisms genetic material"
- A gene: is a segment of DNA on a chromosome.
- Genes provide directions for a cell to express traits.

  - Strands of DNA in a chromosome, are tightly coiled like a telephone cord coiled spring.

  - This coiling allows more genes to fit in a small space. (Picture page 63)
- DNA is like a twisted zipper.
- Twisted zipper is called a double helix. (Picture page 64)

DNA shape:

- DNA twisted zipper shape is because of **"nucleotides"**
- Nucleotides is a molecule made of a nitrogen base, a sugar and phosphate group.
  - Sugar called: "deoxyribose in DNA" and "ribose in RNA".
  - **Four nitrogen bases in DNA:**

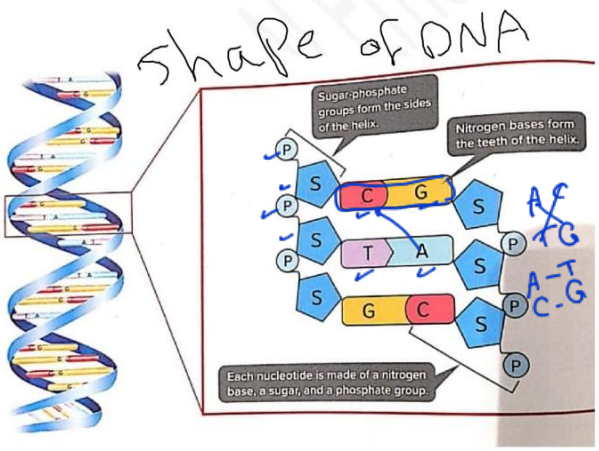
    - adenine(A) -Thymine(T).

    - guanine(G) - Cytosine(C).

in RNA:

- adenine(A) -Uracil(U).

- guanine(G) - Cytosine(C).



- A and T always bond together.
- C and G always bond together.

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Difference between DNA and RNA:

	DNA	RNA
-Nitrogen base	4 nitrogen bases: - adenine(A) -Thymine(T). - guanine(G) - Cytosine(C).	4 nitrogen bases: -adenine(A) -Uracil(U). - guanine(G) - Cytosine(C).
Sugar	deoxyribose	Ribose
Strands	Double strands "double helix"	Single strands
Types		mRNA – tRNA- rRNA
Definition	a type of a nucleic acid that carries genetic material	a type of a nucleic acid that carries the code for making proteins

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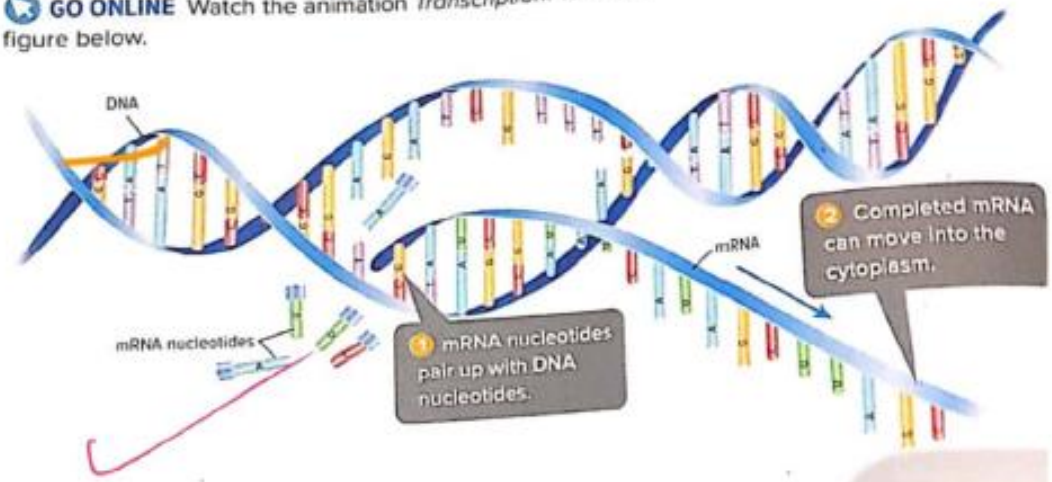
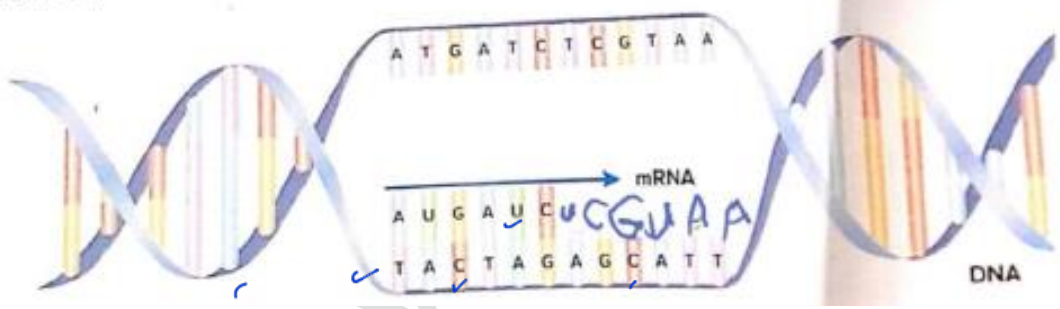
Transcription

GO ONLINE Watch the animation *Transcription*. Then examine the figure below.



Based on the animation and the figure, complete the DNA to mRNA transcription below. Use the blue lines to write your answer.



- ✓ The process of making mRNA from DNA is called **"Transcription"**.

How does the transcription happen?

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Mutation:

- a permanent change in the sequence of DNA.
- Mutation occurs due to:
  - change in genetic material "DNA".
  - or by environmental factors such as exposure to x-rays, ultraviolet, radioactive, materials and some chemicals.

Types of mutations:

1. **Substitution:**

   The C-G base pair has been replaced with a T-A pair.

2. **INSERTION:**

   Three base pair have been added.

3. **Deletion:**

   Three base pair have been removed.

   Other base pair will move in to take their place.

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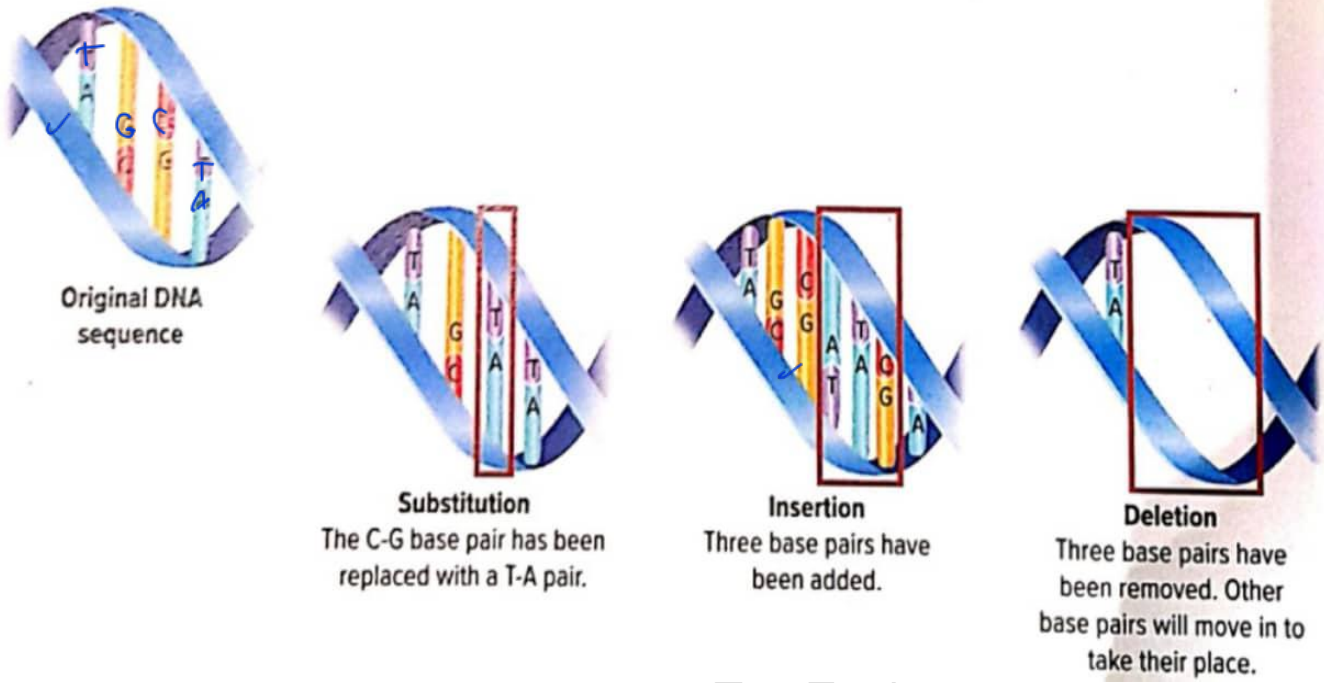

What happens when a mutation occurs?

1. The effect of a mutation depends on where in the DNA sequence the mutation happens and the type of mutation.
2. Proteins express traits because mutation can change proteins, they can cause changes in traits, some mutations might cause a trait to change in a way that benefits the organisms, while others cause genetic disorders.

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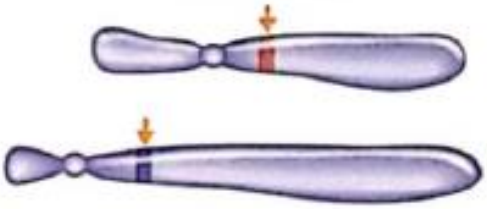
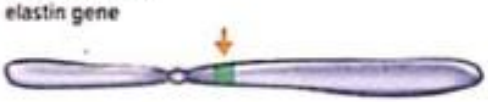
Example:

Genetic Disorders

Defective Gene or Chromosome	Disorder	Description
Chromosome 7, CFTR gene	Cystic fibrosis	In people with defective *CFTR* genes, salt cannot move in and out of cells normally. Mucus builds up outside cells. The mucus can block airways in lungs and affect digestion.
Chromosome 17, BRCA1; Chromosome 13, BRCA2 	Breast cancer and ovarian cancer	People with defective *BRCA1* or *BRCA2* genes have an increased risk of developing breast cancer and ovarian cancer.
Chromosome 7, elastin gene 	Williams Syndrome	People with Williams syndrome are missing part of chromosome 7, including the elastin gene. The protein made from the elastin gene makes blood vessels strong and stretchy.
Chromosome 12, PAH gene	Phenylketonuria (PKU)	People with defective *PAH* genes cannot break down the amino acid phenylalanine. If phenylalanine builds up in the blood, it poisons nerve cells.

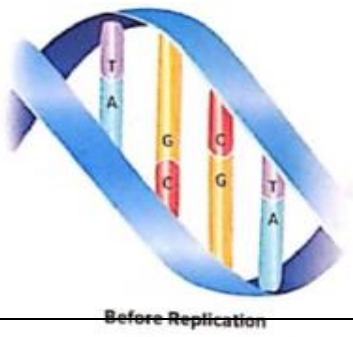
❖ Mutation Classification:

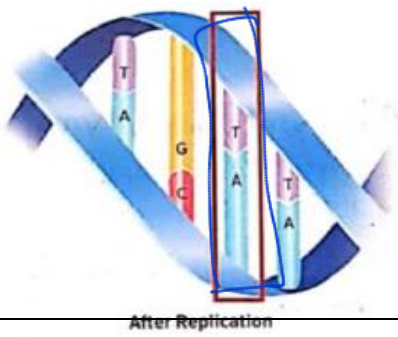
- A mutation can be negative, positive, or neutral.
- **Positive mutation**: is beneficial to an organism.
- **Negative mutation**: is harmful to an organism.
- **Neutral mutation**: is neither beneficial nor harmful.

Example:

Mutation	Effects	positive	Negative	Neutral
Eye color	Genes for brown eyes are mutated and the individual has blue eyes.			✔
Lactose tolerance	Due to a mutation, human adults can process lactose unlike other mammals.	✔		
Color Blinders	Due to a mutation on the x chromosome, a person can not see certain colors.		✔	

✓ **Questions: use the diagram below to answer the following questions.**





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2. The diagram above shows a segment of DNA before and after the replicant, which could have occurred as a result of this change in structure?

- **A.** changes to the genotype of the organism
- **B.** changes to the traits of the organism
- **C.** changes in the production of the organism
- **D.** all of the above

3. The mutation shown above resulted in muscle degeneration, The effect of this mutation is that muscles become progressively weaker. What type of mutation is this?

- **A.** Positive
- **B.** Neutral
- **C.** Negative
- **D.** None of the above

Variations:

- Difference in inherited traits among individual members of a species are "**variations**".
- Variations can occur through mutations; a mutation might harm an organism's chances of survival.
- Many mutations, such as those that cause the unique pattern of spots on a giraffe, cause no harm.
- Mutations produce traits that help an organism survive.

Questions:

2. No two tigers have the same stripe pattern, such slight differences in inherited traits among individual members of a species occur through mutation. Which term best identifies these differences?

- **A.** mimicry
- **B.** natural selection
- **C.** adaptation
- **D.** Variation

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3. A bat's heart rate can fall dramatically during hibernation. Its breathing rate is also affected, and it may not breath for an entire hour. Hibernation supports the bat's survival in its environment. What types of adaptation is hibernation?

A. Functional
B. Structural
C. Behavioral
D. None of the above

4. Which structural genetic change in the finches can be identified as the one most influenced by feeding habits, as proposed by Charles Darwin?

A. ability to fly from island to island to find the food they prefer.

B. beak size and shape to take advantage of the food they had.

C. claw shapes for perching on limbs while catching insects in their beaks.

D. cooperative behavior so they could share limited seeds and nectar.

How can traits be directly influenced?

Adaptations provide evidence of how closely Earth's species match their environments. Darwin's theory of evolution by natural selection predicted. When humans influence traits in other organisms. It is called artificial selection.

The selection and breeding of organisms with desired traits is selective breeding. Selective breeding, sometimes referred to as artificial selection, is similar to natural selection except that humans, instead of nature, do the selecting. By breeding organisms with desired traits. Humans change traits just as natural selection does. Cows with increased levels of milk production, dogs of different sizes, and roses of unique colors are products of selective breeding.

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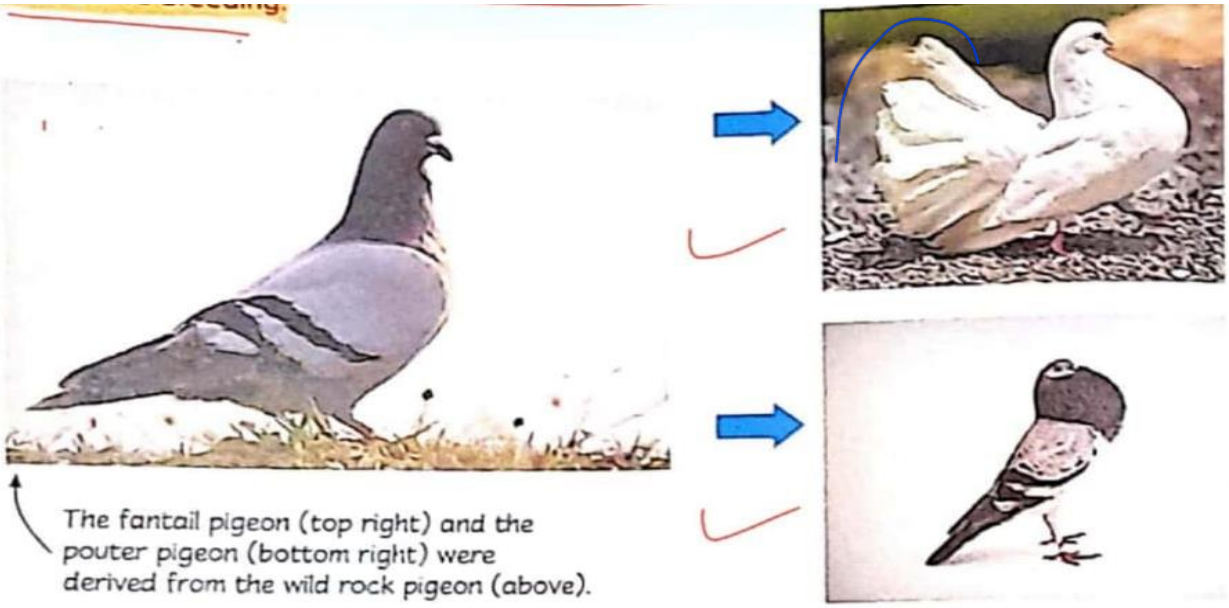

The fantail pigeon (top right) and the pouter pigeon (bottom right) were derived from the wild rock pigeon (above).

What is genetic engineering ?

Scientists are experimenting with genetic engineering, which refers to the biological and chemical methods that change the arrangement of DNA that makes up a gene. Genetic engineering already is used to help produce large volumes of medicine. Genes also can be inserted into cells to change how those cells perform their normal functions.

Recombinant DNA making recombinant DNA is one method of genetic engineering. Recombinant DNA is made by inserting a useful segment of DNA from one organism into a bacterium, large quantities of human insulin are made by some genetically engineered organisms.

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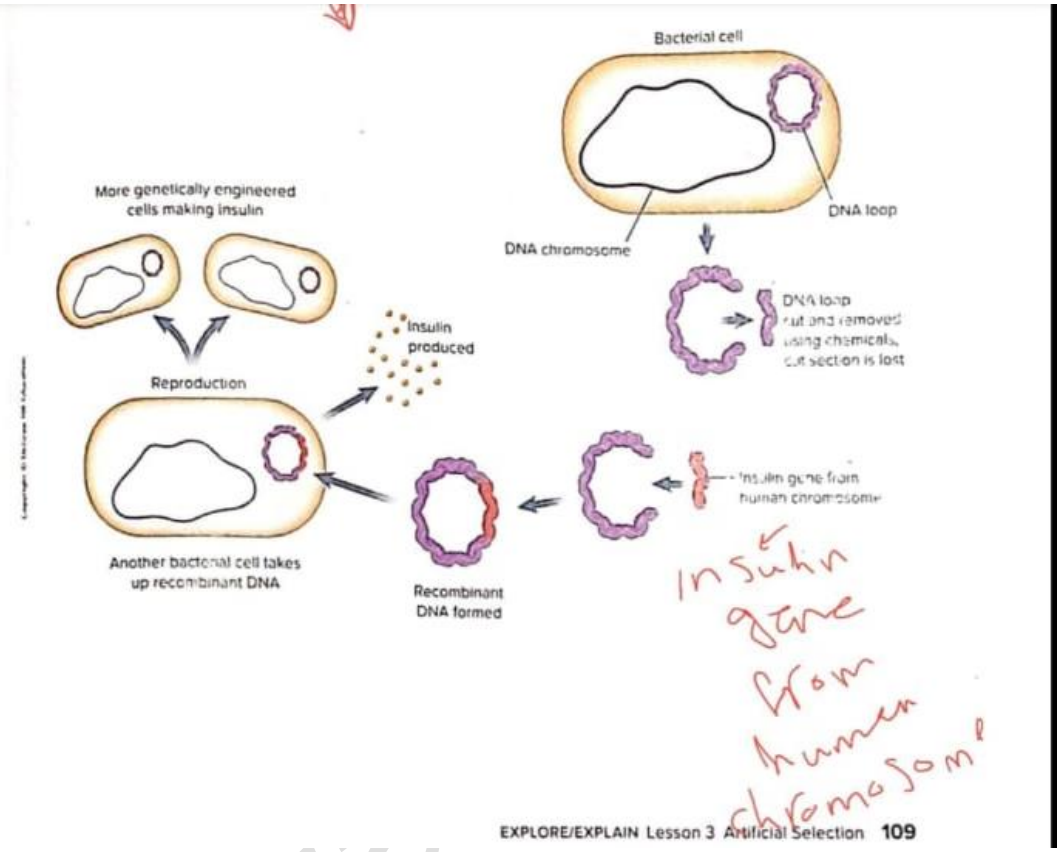
People with tybe 1 diabetes need this insulin because their pancreases produce little to no insulin. Another use includes the production of chemicals to treat cancer.



What is a genetically modified organism ?

Genetic engineering can produce improvments in crop plants. Such as corn, wheat, and rice. Food products that have been genetically engineered are commonly referred to as genetically modified organisms. Or GMOs. Scientists have made genetically engineered tomatoes with a gene that allows tomatoes to be picked while green and transported great distances before they ripen completely. Ripe, firm tomatoes are then available in the local market. Some crops are even engineered to be toxic to particular insects and pests.

Module 3

Evidence of evolution

Fossil Type	Description	Example
Mineralization	Rock-forming minerals, such as calcium carbonate ($CaCO_3$). In water filled in the small spaces in the tissue of these pieces of petrified wood. Water also replaces some of the wood's tissue. Mineralization can preserve the internal structures o an organism.	
Carbonization	In carbonization, pressure drives off a dead organism's liquids and gases. Only the carbon outline, or film, of the organism remains. Fossil films made by carbonization are usually black or dark brown. Fish, insects, and plant leaves, such as these fern fronds, are often preserved as carbon films.	
Molds and Casts	When sediments hardened around this buried trilobite, a mold formed. Molds usually show hard parts, such as shells or bone. If a~~n~~ mold is later filled with more sediments that harden, the mold can form a cast.	
Trace Fossils	A trace fossil is the preserved evidence of the activity of an organism. These footprints were made when a dinosaur walked across mud that later hardened. This trace fossil might provide evidence of the speed and weight of the dinosaur.	
Original Material	If original tissues of organisms are buried in the absence of oxygen for long periods of time, they can fossilize. The insect in this amber became stuck in tree sap that later hardened.	

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What can fossils tell us about time?

If you were to travel back in time you may see different species of organisms. That is because species change over time.

INVESTIGATION

Analyze the Age

In the image you can see fossils buried in rock layers. Examine the image and answer the questions below.

If the topmost rock layer of the image is present day, then what is the relative age of the areas that are indicated by the arrows to each other? Infer the age of the areas by writing older or younger in the boxes provided.

Younger

Older

The Fossil Record

The fossil record is made up of all the fossils ever discovered on Earth. It contains millions of fossils that represent thousands of species. Most of these species are no longer alive on Earth.

Scientists cannot date most fossils directly. Instead, they date the rocks the fossils are embedded inside. Rocks erode or are recycled over time. However, scientists can determine ages for most of Earth's rocks.

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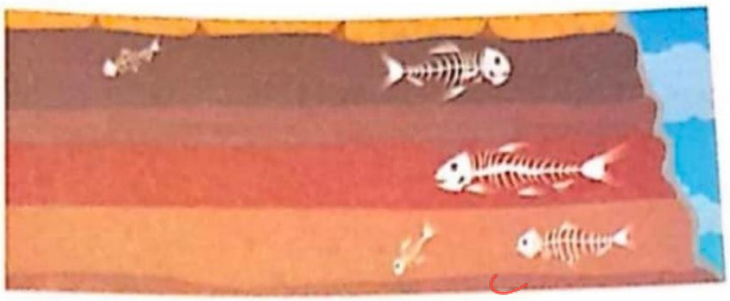
Relative-Age Dating	Absolute-Age Dating
• In relative-age dating, scientists determine the relative order in which rock layer were deposited. In an undisturbed rock formation, they know that the bottom layers are oldest and the top layers aye youngest. • Relative-age dating helps scientists determine the relative order in which species have appeared on Earth over time.	• Absolute-age dating is more precise than relative-age dating. Scientists take advantage of radioactive decay, a natural clock-like process in rocks, to learn a rock's absolute age, or its age in years. • In radioactive decay, unstable isotopes in rocks change into stable isotopes over time. Scientists measure the ratio of unstable isotopes to stable isotopes to find the age of a rock.

- **Use the figure below t answer questions 2.**



2. **What method can scientists use to analyze and interpret when the fossils in the bottom of the figure appeared on Earth?**

A. Relative-age dating
B. Trace fossils
C. Mineralization
D. Carbonization

3. **What pattern can scientists use to interpret the information about the fossils shown in the rock layers?**

A. Rock layers all contain different sets of fossils.
B. Older fossils are located closet to Earth's surface.
C. Fossils are younger the closer they are to surface.
D. Each fossil is younger than the rock layer in which it is found.

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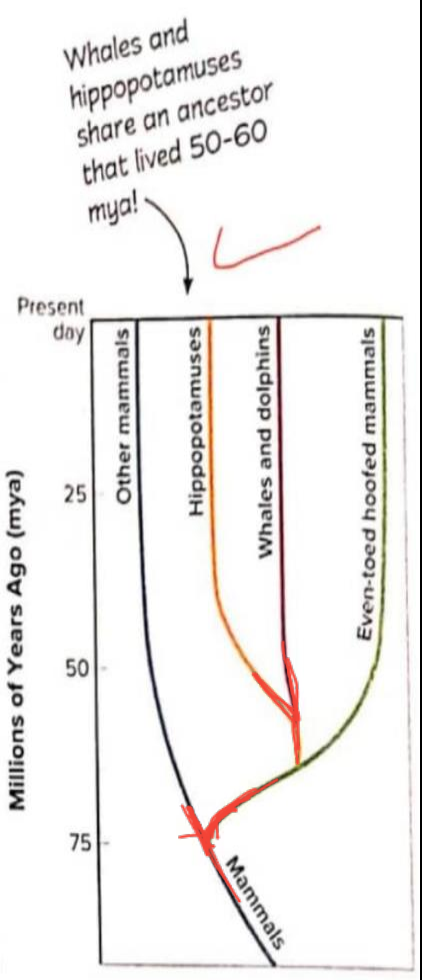
Molecular Biology

The study of fossils, comparative anatomy, and embryology provides support for Darwin's theory of evolution by natural selection. Molecular biology is the study of gene structure and function.

Comparing sequences	All organisms on Earth have genes that are made of DNA and work in similar ways. This supports the theory that all organisms are related. Scientists can study relatedness of organisms by comparing genes and proteins among living species. For example, nearly all organisms contain a gene that codes for cytochrome c. a protein required for cellular respiration. Some species, such as humans and rhesus monkey, have nearly identical cytochrome c. the more closely related two species are, the more similar their genes and proteins are.
Divergence	Scientists have found that some stretches of shared DNA mutate at regular, predictable rates. Scientists use this "molecular clock" to estimate at what time in the past living species diverged from common ancestors. For example, as shown in the figure, molecular data indicate that whales and dolphins are more closely related to hippopotamuses than they are to any other living species.



The Study of Evolution Today

The theory of evolution by natural selection is the cornerstone of modern biology. Since Darwin published his theory, scientists have confirmed, refined, and extended Darwin's work. They have observed natural selection in hundreds of living species. Their studies of fossils, anatomy, embryology, and molecular biology have all provided evidence of relatedness among living and extinct species.

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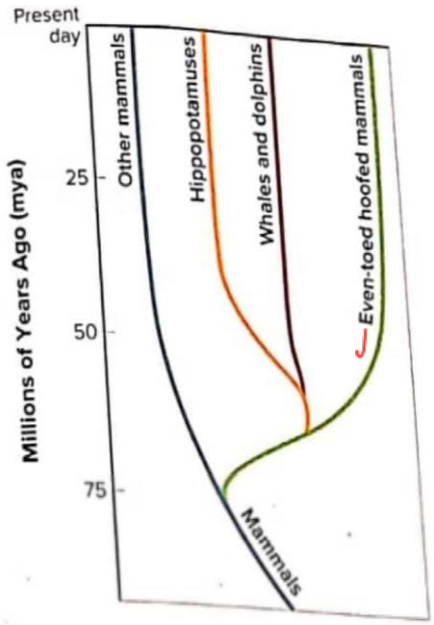

2. **Analyze the image above that shows even-toed hoofed mammals and other mammals shared a common ancestor. When did this ancestor live?**

A. 25 million years ago
B. 50 million years ago
C. 60 million years ago
D. 75 million years ago

3. **Which pattern of development among vertebrates is evidence that they share a common ancestor?**

A. All vertebrates have a vestigial structure called gills.
B. All vertebrate embryos have pharyngeal pouches during development.
C. All vertebrates have tails as both embryos and adults.
D. All vertebrates have identical embryos but differences among structures as adults.

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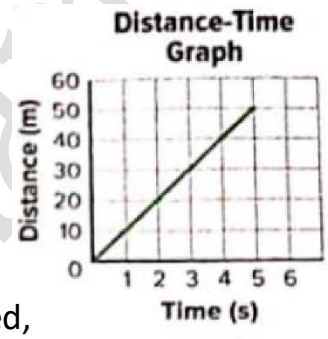
Module

Force and motion

Distance-Time Graphs



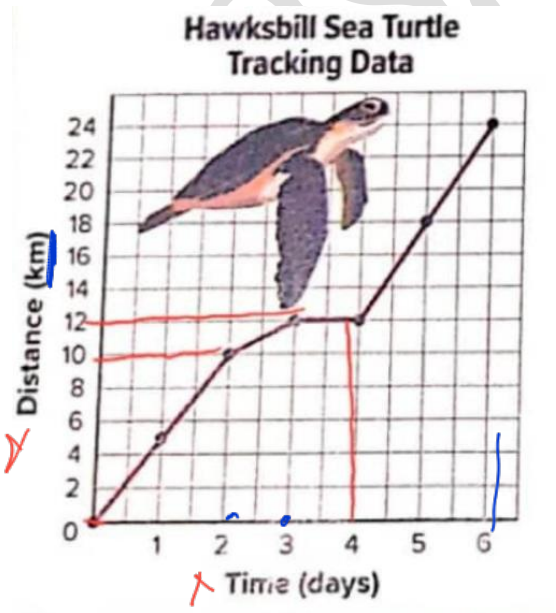
The plot you made in the investigation Plot it is a distance- time graph. This type of graph shows how an object's position changes during each time interval. A distance-time graph does not show you the actual path the object took.

Did you notice that the line through the points in the investigation wasn't completely straight? When an object is moving at a constant speed, the line will be straight. The steeper the line, the greater the slope, which means the greater the speed of the object.

If the slope of the line changes, this means the speed of the object has changed. Even if the speed has changed, the average speed can still be calculated.

Analyze the data **on the plot below. Determine the speed of the hawksbill sea turtle during each interval listed below**.

speed = $\frac{\text{Distance}}{\text{Time}}$ = _____



2 - 0 2

Day 0 to day 2: $\frac{10}{2}$ = 5 km/day

Day 2 to day 3: $\frac{12-10}{3-2}$ = 2 km/day

Day 3 to day 4: 0 km/day

Day 4 to day 6: $\frac{24-12}{6-4}$ = 6 km/day

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Analyze the data table below. Use the table to answer questions 2 and 3.

Green sea Turtle's Distance and Time Data

Time (days)	Distance (km)
0	0
1	16
2	32
3	48
4	64
5	80
6	96

2. **The data in the table above shows how far asea turtle travels over several days. What would the line on a plot of this data look like?**

A. The line would curve upward and to the right.
B. The line would go up and down.
C. The line would point straight upward to right.
D. The line would point upward then downward.

3. **If the turtle continued the motion recorded in the data table above, what would his distance be at ten days?**

1	1	1	1		1
2	2	2	2		2
3	3	3	3		3
4	4	4	4		4
5	5	5	5		5
6	6	6	6		6
7	7	7	7		7
8	8	8	8		8
9	9	9	9		9

Day 7 = day 6 + 16 = 96 + 16 = 112 km/day

Day 8 = 112 + 16 = 128 km/day

Day 9 = 128 + 16 = 144 km/day

Day 10 = 144 + 16 = 160 km/day

Answer:

160 km/day

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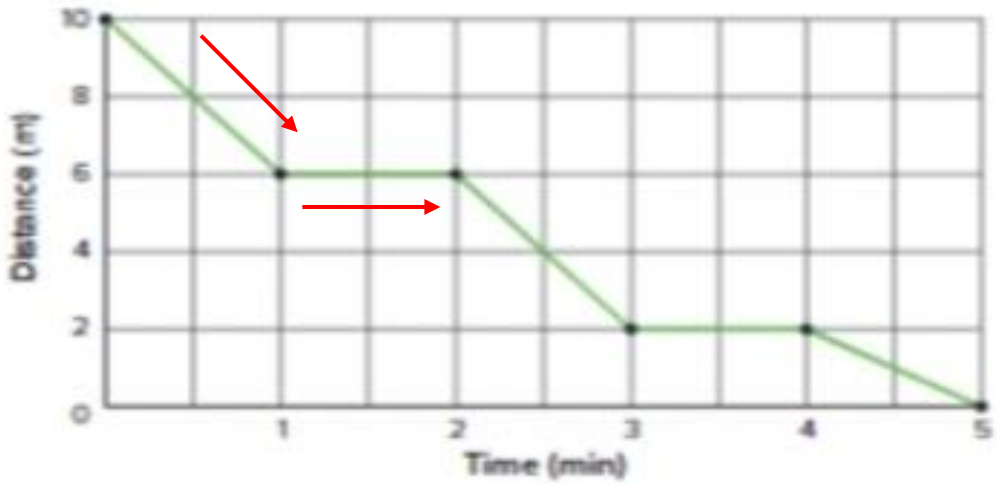
Real-World Connection

4. **Interpret Data The plot below shows the motion of an elevator. Explain its motion.**



The elevator went down 4 m at a constant speed for 1 min, it then stopped for 1 min. It went down 4 m in 1 min, stopped for 1 min, and went down 2 m in the final minute.

5. **Calculate A driver travels 55 km in 1 hour. He then drives at a speed of 35 km/h for 2 hours. Next, he drives 175 km in3 hours. What was his average speed?**

Answer

- Average speed = $\frac{55+(35\times2)+175}{6} = 50\ km/s$

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Mathematical Model

Newton's second law of motion states that the acceleration of an object equals the net force on the object divided by the object's mass.

$$\text{Acceleration (in m/s}^2\text{)} = \frac{force\ (in\ N)}{mass\ (in\ kg)}$$

Ex. What is the acceleration when a force of 2.0 N is applied to a ball that has a mass of 0.60 kg?

Answer

F = 20 N

M = 0.60 kg

$$a = \frac{f\ (in\ N)}{m\ (in\ kg)} = \frac{2}{0.60} = 3\ m/s^2$$

Friction and newton's law

Think about how friction affects an object's movement. Imagine a book sitting on a table. When you push the book. The force you apply to the book is greater than the friction between the book and the table. The book moves in the direction of the greater force. If you stop pushing, friction stops the book just like the friction between tired and the road stops a car.

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What would happen if there were no friction between the book and the table?

According to Newton's second law, the book would continue to move at the same speed in the same direction because no force changed its motion. The book stopping is evidence that friction must be acting on the book. On Earth, friction can be reduced but not totally removed. For an object t start moving, a force greater than friction must be applied to it. This is why all objects on Earth come to a stop after some time. To keep the object in motion, a force at least as strong as friction must be continuously applied. Objects stop moving because friction or another force acts on them.

How do multiple forces change motion?

Just as you can use arrows to show the size and direction of velocity and acceleration, arrows can show the size and direction of a force. It is very common that more than one force is acting on an object at a time.

A free-body diagram

Is a simple model to understand systems of objects with any amount of applied forces.

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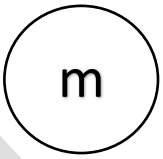
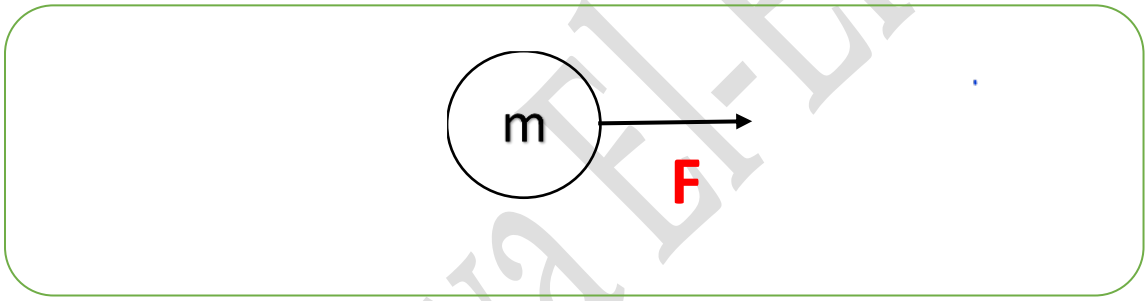
INVESTIGATION

Diagram a Force

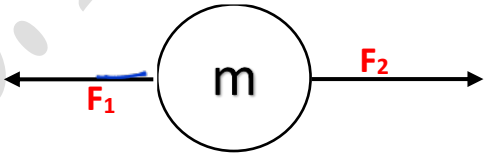


A circle is drawn to represent the object as shown to the right.
An m is placed inside to represent the mass of the object. Next,
an arrow is drawn to represent the direction that the force is applied.
The size of the arrow indicates how strong the push or pull is.

1. *Sketch* **a free-body diagram of an object being pushed to the right.**



To model an object with multiple forces, simply add one arrow to the circle in the direction of each force as shown below.



2. **In the free-body diagram above, the force to the left (F_1) is less than the force to the right (F_2). Which direction do you think the object will begin to move?**

The object will move to the right

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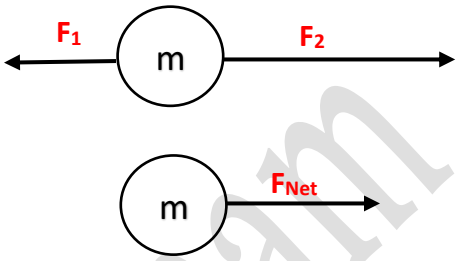
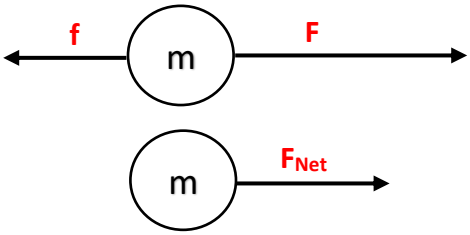
Net force

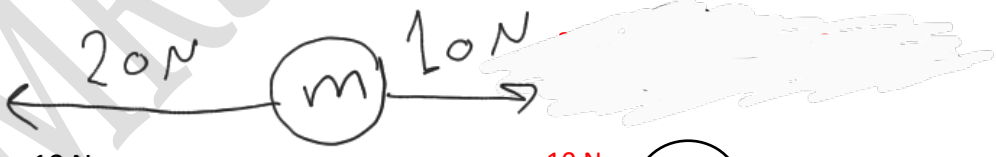
Is the sum of all the forces acting on an object. To model the net force, simply add together the forces in the same direction and subtract the forces in the opposite direction.



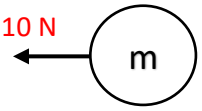
3. Make a free-body diagram for the net force on the object shown below. The object is sliding across a surface with friction.



4. **An object is pushed to the right with 10 Newtons of force, and pulled to the left with 20 Newtons. Sketch a free-body diagram of this system, and draw a diagram with the net force. Ignoring friction, identify the direction and motion of the object.**



20 – 10 = 10 N



The motion of an object is determined by the sum of the forces acting on it. If the total force on the object is not zero, its motion will change.

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Newton's First Law Of motion

States that an object in motion will stay in motion, and an object at rest will stay at rest unless acted on by a force.

An object has a force acting on it to the right and has a frictional force to the left as shown below. Use the model below to answer question2 and 3.

2. **What change in motion will result from the forces modeled?**

A. There will be no change in motion because the forces are in opposite direction.

B. The object will slow down because of the friction force.

C. The object will accelerate to the right.

D. The object will accelerate to the left.

3. **What would a model of the net force look like?**

A. The arrow would be to the right at the same length as before, because friction is a different force.

B. The arrow would be to the right but shorter than before to account for the friction force.

C. There would be no net force because the two forces are in opposite directions.

D. The arrow would be to the left because friction is slowing the object down.

4. **A train moves at a constant speed down a straight track. Which of the following scientific explanations is true?**

A. No forces act on the train as it moves

B. The train moves because no forces are acting against it.

C. The forces of the train's engine balance the force of friction opposing it.

D. An unbalanced force keeps the train moving.

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Force pair

A force pair is the forces two objects apply to each other.

Force pairs are not the same as balanced forces. Balanced forces act on the same object. The force from gravity and the force from the floor act on the same object--you-- and are balanced. In force pairs, each force acts on a different object. Look at the ball and the tennis racket below.
The ball has the force of the racket pushing it.
The racket has the force of the ball pushing on it.
The forces don't result in a net force of zero because they act on different objects. Adding forces can only result in a net force of zero if the forces act on the same object.

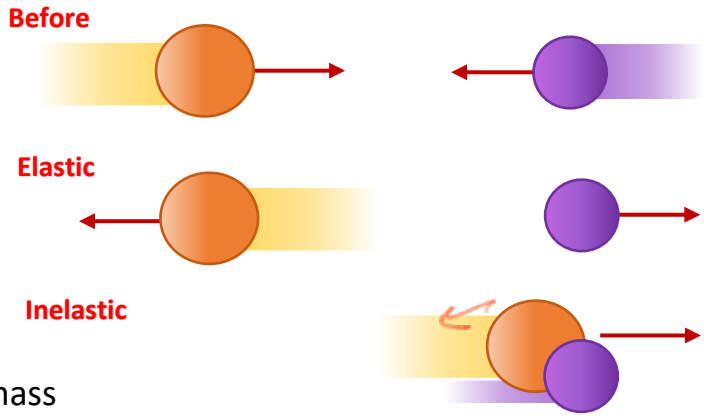
Normal force

Is the force that pushes perpendicular to the object's surface. When you push on the wall, the wall has a normal force that is pushing straight out from the wall. When a tennis ball hits a tennis racket, the racket applies a normal force perpendicular to the racket.

Newton's third law

states that when an object applies a force on another object, the second object applies a force of the same strength on the first object, but the force is in the opposite direction.

Collision Forces



When one object collides with another object, a force is applied to the second object.
The second object accelerates in the direction of the force. However, because of Newton's third law, a force is also applied to the first object, when the balls collided, they accelerated in the opposite direction or slowed down. If the mass of the balls was exactly the same, one may have even stopped moving.

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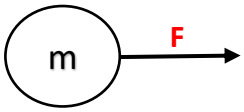
Types of collision

When colliding objects bounce off each other, it is an elastic collision if objects collide and stick together, such as when one football player tackles another, the collision is inelastic.

A person is applying a force to the right on an object as shown. Use the model below to answer questions 2 and 3.



2. **What forces are acting on the person?**

A. a slightly smaller force to the left because the object is accelerating

B. a force equal to the force applied going to the left

C. a force to the right to apply the force to the object

D. a force to the right because the object is accelerating

3. **The person is standing on ice with little to no friction. What will be the motion of the person applying the force to the object?**

A. begin to move to the right because that is the direction of the push

B. no change in motion because the person is pushing the object

C. begin to move to the left because the object pushes on the person

D. begin to move to the right with the object

4. **Which of the following systems does NOT represent a force pair?**

A. When you push on a bike's brakes, the friction between the tires and the road increases.

B. When a diver jumps off a diving board, the board pushes the diver up.

C. When an ice skater pushes off a wall, the wall pushes the skater off of the wall.

D. When a boy pulls a wagon, the wagon pulls back on the boy.

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Contact and Noncontact force:

	Contact force	Noncontact force
Definition	Is a push or a pull on one object by another object that is touching it.	Is a force that one object can apply to another object without touching it.
Example	**EARTH SCIENCE Connection**: Contact forces can be weak, like: 1. when you press the keys on a computer keyboard. They also can be strong. 2. such as when large sections of underground rock suddenly move, resulting in an earthquake. 3. The large sections of Earth's crust called plates also apply strong contact forces against each other. Over long periods of time, these forces can create mountain.	1. Electric forces can cause someone's hair to change direction when a charged balloon is brought near the hair. The balloon does not have to touch the hair to cause it to move. 2. Magnets can move paper clips even though the magnet is not in contact with the paper clip.

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Gravitational Force

Gravity is an attractive force that exists between all objects that have mass. **Mass** is the amount of matter in an object.

Example:

Both the pencil and earth have mass, so both the pencil and earth exert a gravitational pull on each other. Because an object does not have to be touching Earth for gravity to act on it, the force of gravity must be exerted through space as a field. A **field** is a region of space that has a physical quantity (such as a force) at every point. The gravitational field of Earth surrounds Earth at all points. A small gravitational field also surrounds the pencil.

Gravitational Acceleration

When you divide the force of gravity on the washers by the mass of the washers, you can find the gravitational acceleration.
When the only force acting on a falling object is gravity,
all objects fall with the same acceleration.
Close to Earth's surface, the acceleration of these objects is $9.8\ m/s^2$.
This is gravitational acceleration (g).

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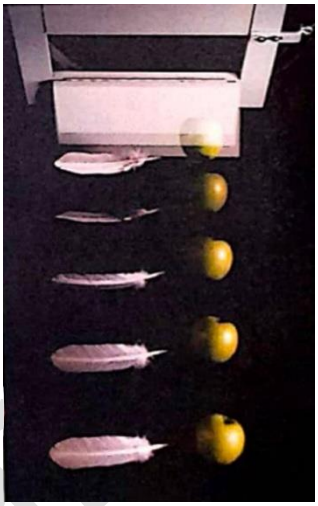
If the mass of an object increases, the force of gravity between the object and Earth will also increase by the same amount. This is why the acceleration is always the same if no additional forces are acting on the object. The time-lapse photograph on the right shows a feather and a ball with two different masses dropped at the same time.
This will only happen in a vacuum when there is no air resistance. Air resistance opposes gravity as an object falls.



Weight

Is the gravitational force exerted on an object. Near Earth's surface, an object's weight is the gravitational force exerted on the object by Earth. Because weight is a force, it is measured in newtons (N).

The weight of an object can be calculated by using the following equation:

Weight Equation

Weight (N) = mass (kg) x gravitational acceleration (m/s^2)

$$W = mg$$

Normal Force

A pencil sitting on a table is acted on by gravity. This force in the downward direction is equal to its weight. Because gravity is acting on the pencil, the pencil is pushing down on the table. Recall, **Newton's third law** of motion states that for every force there is an opposite equal force.
The table pushes up on the pencil with an equal but opposite force. The force of the table on the pencil is referred to as the normal force.

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Module

Mechanical Energy

Kinetic energy
Potential energy

Kinetic energy (KE)

Is the energy due to motion. When the baseball flies across the field, it also has kinetic energy associated with its motion. All moving objects have kinetic energy. You may have changed how much speed the sphere had before it hit the cup or you may have used a sphere with a different mass.
You will investigate how these factors affect the kinetic energy of an object.

Kinetic Energy and Mass

A moving object's kinetic energy depends on its mass. If a baseball and a tennis ball move at the same speed. the object with more mass has more kinetic energy

Look at the figure below. Note the vertical bars. These are energy bars. Energy bars show relative amounts of energy. The more full the bar, the more energy the object has. The tennis ball and the baseball are traveling at the same speed, but the baseball has a greater mass. For objects traveling at the same speed, the more mass an object has, the greater its kinetic energy.

The relationship between mass and kinetic energy is a proportional, linear relationship that can be described mathematically.

$K.E \propto m$

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$K.E \propto m$

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Potential energy

Is the energy due to interactions between objects or particles when distance changes. The amount of potential energy an object has depends on the positions of objects or particles. When you stretch a rubber band, you are increasing a form of potential energy called elastic potential energy.

Elastic potential energy is energy stored in objects that are compressed or stretched, such as springs and rubber bands.

Types of Potential Energy

- **Gravitational potential energy**
- **electric potential energy**
- **magnetic potential energy**

these are examples of potential energy due to forces in fields

Gravitational potential energy

Is stored energy due to the interactions of objects in a gravitational field Gravitational potential energy exists between all objects but is only significant when at least one very large object is Involved, such as Earth.

Recall that objects can be located anywhere inside a gravitational field. The farther away the object is from the center of the gravitational field, the more gravitational potential energy the object has in relation to the field. The difference in gravitational potential energy depends on the change in position of the object and the object's mass.

Change In Position Examine the figure of the girl and the backpack on the right. The girl in the figure increases the gravitational potential energy between her backpack and Earth by lifting the backpack.
To Increase the gravitational potential energy of the backpack, she exerts a force on the backpack that opposes the force of gravity. When she applies this force, she increases the energy of the backpack. The potential energy of the backpack increases as its height increases.

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