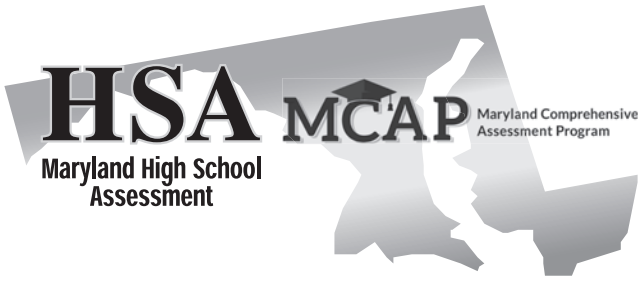


MISA

Maryland Integrated Science Assessment

2018 Sample Items

measured progress.

Developed and published under contract with the Maryland State Department of Education by Measured Progress.

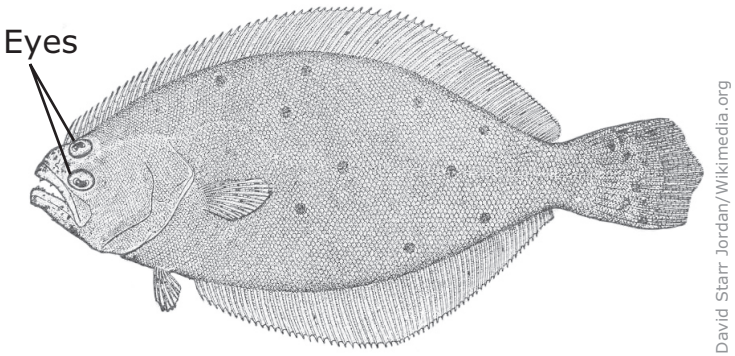
Read the information. Use the information to answer the questions.

Flatfish

The summer flounder is an important commercial and recreational fish found in the Chesapeake Bay. It is part of a group of vertebrates called flatfish that are found throughout the world. The most obvious characteristic of the flatfish is its asymmetry. Each side of the flatfish, when divided by a central line, is not identical.

Flatfish are born as symmetrical larvae swimming upright; however, as the flatfish develop into juveniles, they undergo many body changes during a process called metamorphosis. One significant change is the migration of one eye from one side of the head to the other. An adult flatfish has both eyes on the same side of its head. Adult flatfish usually lay flat on the ocean floor with both eyes on the upward-facing side of the head. Another change is in the coloration on the side of the body facing upward; it darkens to match the ocean floor. Adult flatfish swim with a sideways flapping motion. A diagram of an adult flatfish is shown.

Adult Flatfish

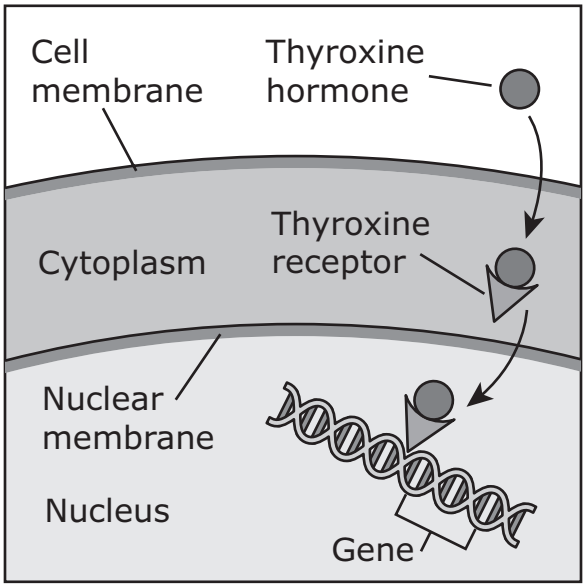


David Starr Jordan/Wikimedia.org

GO ON

Eye migration in flatfish is controlled in part by the hormone thyroxine, produced by the thyroid gland. Thyroxine is produced by all vertebrates, but it causes eye migration only in flatfish. Thyroxine binds to molecules called thyroid receptors on the nuclear membrane of a cell and enters the nucleus of the cell. In the nucleus, it activates specific genes. The model shows what happens when thyroxine binds to its receptor.

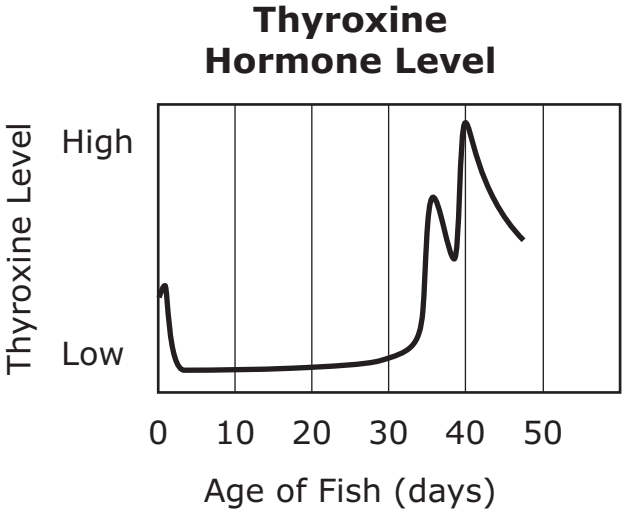
Cell Response to Thyroxine

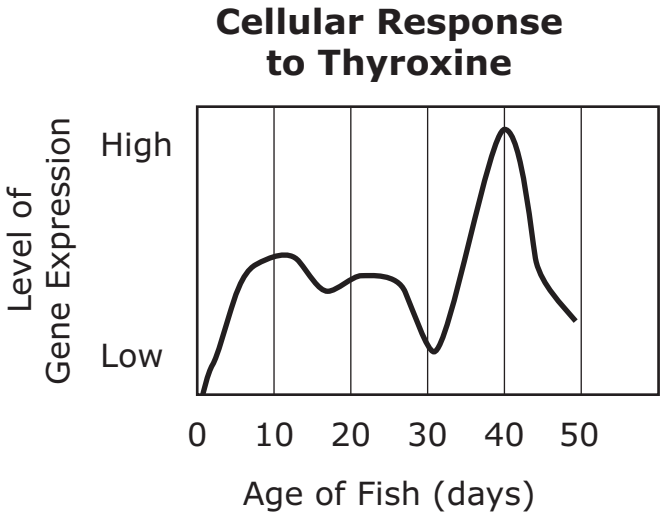


GO ON

Thyroxine Hormone

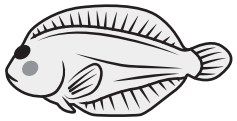
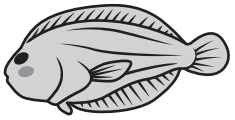
Scientists have extensively studied the metamorphosis in flatfish to understand the way in which thyroxine influences this process. The graphs show the relationship between thyroxine levels and the levels of gene expression during the flatfish larval stage. The migration of the eye occurs between day 25 and day 40. The coloration change in the upper side of the body occurs between day 40 and day 47. At day 47 metamorphosis is complete and the flatfish is now a juvenile.





The diagrams shows the physical changes flatfish undergo during metamorphosis.

Flatfish Metamorphosis

Age (Days)	Eye Migration	Swimming Position	Body Form
21			
30			
50			

KEY

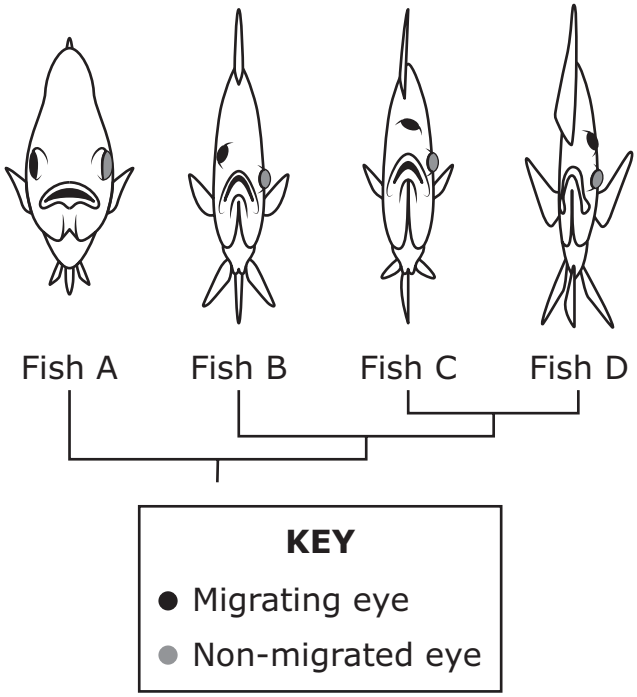
- Migrating eye
- Non-migrated eye

GO ON

History of Flatfish

Scientists studied fossils from 50 million years ago to determine if there were transitional forms between symmetrical fish and asymmetrical flatfish. Transitional forms would have traits common to both ancestral fish and present-day flatfish. The phylogenetic tree shows the relationship between living flatfishes (Fishes C and D), a symmetrical fish (Fish A), and an extinct transitional form (Fish B) that was discovered.

Phylogenetic Tree



GO ON

Scientists compared certain genes in the symmetric fish and the flatfish. They compared these genes in symmetric stickleback, puffer fish, and zebra fish to two species of flatfish. A portion of the data from the scientific study are shown.

Amino Acid Differences

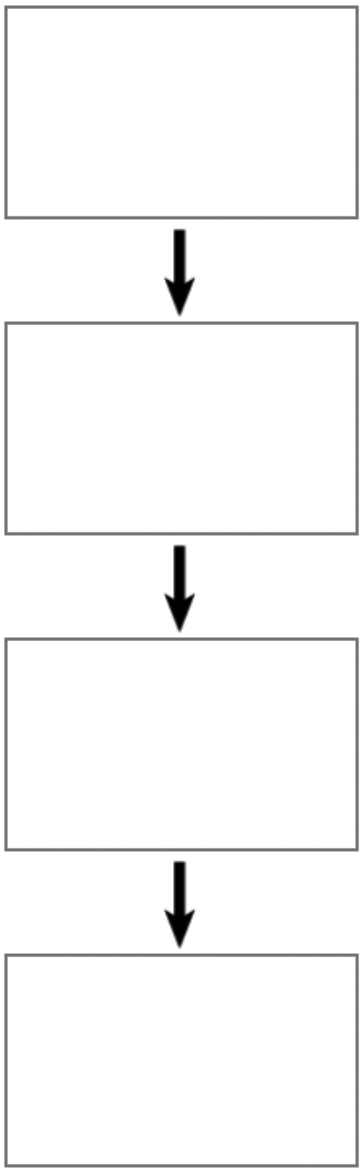
Fish Species	Amino Acid Positions 255–258	Amino Acid Positions 334–337
stickleback	RHAE	APLT
puffer fish	RHAE	APLT
zebra fish	RHVE	SPLT
Japanese flounder (flatfish)	RYAE	APLS
tongue sole (flatfish)	RYAE	APLS

KEY

A– Alanine
E– Glutamate
H– Histidine
L– Leucine
P– Proline
R– Arginine
S– Serine
T– Threonine
Y– Tyrosine

1

Create a sequence to show what happens when the thyroxine hormone activates a gene. Select the processes and drag them into the correct positions.



The eye migration protein is created.

DNA is transcribed into mRNA.

The hormone and receptor bind to the gene.

The amino acid sequence is created.

GO ON

2 Which statement **best** explains how genes cause eye migration in flatfish?

A Genes are transferred to the tissue around the eye and produce proteins that cause migration.

B Genes located in the tissue around the eye produce proteins to cause migration.

C Genes in the thyroid gland produce proteins that move to the tissue around the eye and cause migration.

D Genes that are newly made produce proteins in the tissue around the eye and cause migration.

3 Which paragraph **best** describes the impact of thyroxine levels during eye migration in flatfish metamorphosis?

A Thyroxine levels decrease while the amount of gene expression decreases. By the end of the eye migration, the sequence of the gene will have changed.

B Thyroxine levels stay the same while the amount of gene expression increases. By the end of the eye migration, the sequence of the gene will have changed.

C Thyroxine levels increase while the amount of gene expression increases. By the end of the eye migration, the sequence of the gene will have remained the same.

D Thyroxine levels stay the same while the amount of gene expression stays the same. By the end of the eye migration, the sequence of the gene will have remained the same.

4 Which explanation is **best** supported by the Amino Acid Differences table?

A Both Japanese flounder and tongue sole are missing portions of DNA.

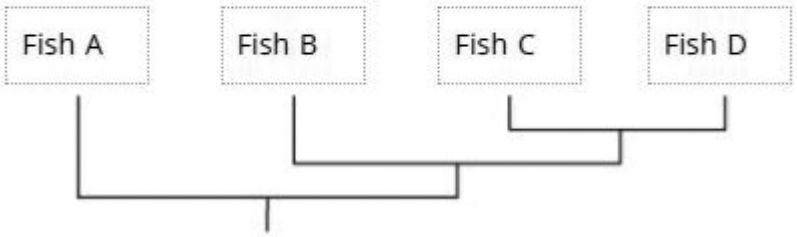
B The zebra fish is different from other symmetrical fish because it is evolving into a flatfish.

C Amino acids in the stickleback and tongue sole are similar to each other because they have the same DNA.

D Amino acids in Japanese flounder and tongue sole are similar to each other because they both undergo metamorphosis.

5

The Phylogenetic Tree diagram can be used to show relatedness. Select the two fishes that are most closely related to each other.



6
CR

Describe evidence that supports a relationship between biological evolution and the common ancestry of flatfish.

Type your answer in the space provided.

Read the information. Use the information to answer the questions.

Falling from Trees

Three friends are hiking through an area of trees in late October. Some leaves and fruits are falling from the trees. Others are lying on the ground or still on trees. The fruit of a walnut tree falls and just misses one of the hikers. The hikers wonder whether it is more dangerous to be struck by some falling fruits than others. One hiker asks, "Which object falling from a tree would have more energy: an acorn falling from about 18 meters (m) or an apple falling from about 3 m?" The hikers find this table about tree heights and fruit masses on a park information sheet. For comparison, they estimate each object would fall from about halfway up each type of tree.

Falling Objects

Tree Species	Object Height (m)	Object	Average Mass (kg)
white oak	18	acorn	0.004
pin oak	14	acorn	0.001
McIntosh apple	3	apple	0.182

The hikers know Newton's second law of motion is $F_{(net)} = ma$. They also discover that they can calculate potential energy (PE) of the fruit with the formula $PE = mgh$, where m = mass, g = acceleration due to gravity, and h = height above ground. The fruit's kinetic energy (KE) can be calculated with the formula $KE = \frac{1}{2}mv^2$, where m = mass, and v = velocity. For these calculations, the hikers ignore the possible effects of air resistance and assume that the objects drop straight to the ground with no initial velocity and with an acceleration due to gravity of $9.8 m/s^2$.

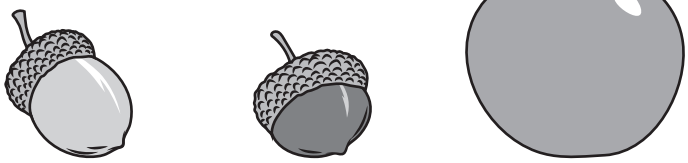
Launch Testing

The hikers decide to estimate the energy of a falling apple. They launch an apple straight up to the same height as a target in the trees that is 19.6 m above the starting point. They design the launch so that the potential energy and kinetic energy of the apple are zero at the start. They also want the apple to fall back to the same spot it was launched from. The hikers perform several launches. The table shows the average height and velocity of the data collected.

Launch Test Data

Time (s)	Average Height (m)	Velocity (m/s)
0.0	0.0	19.6
0.5	8.6	14.7
1.0	14.7	9.8
1.5	18.4	4.9
2.0	19.6	0.0
2.5	18.4	–4.9
3.0	14.7	–9.8
3.5	8.6	–14.7
4.0	0.0	–19.6

7 One of the hikers drops the white oak acorn, pin oak acorn, and McIntosh apple from the same height. The diagrams show these fruits.



White Oak Acorn

Pin Oak Acorn

McIntosh Apple

Which set shows the fruits in order from the fruit with the least amount of force to the fruit with the greatest amount of force when it hits the ground?

A McIntosh apple → pin oak acorn → white oak acorn

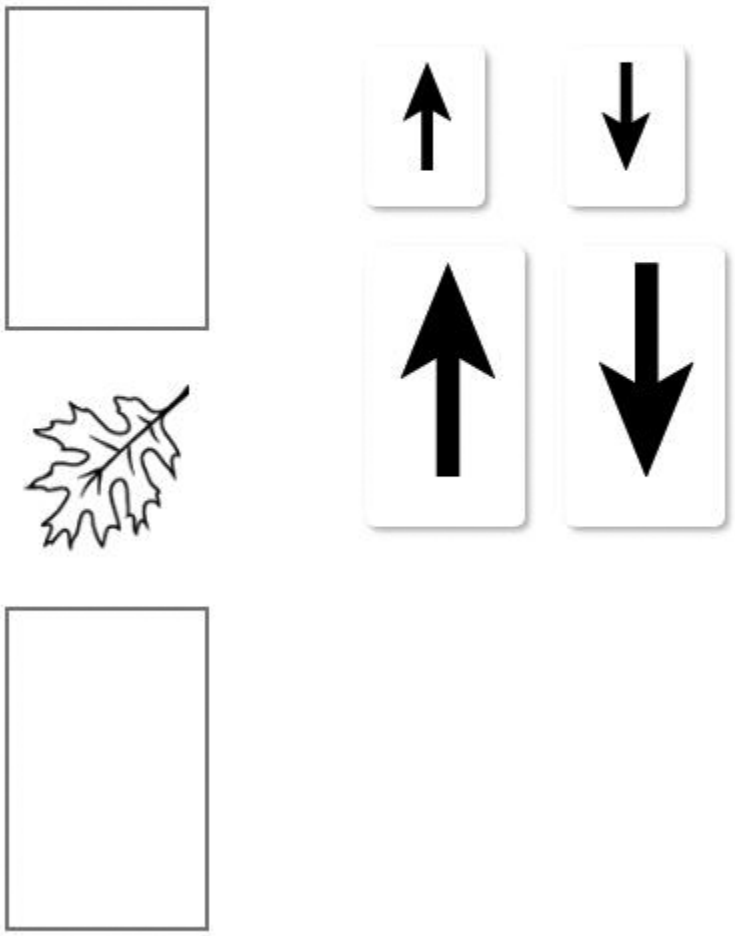
B McIntosh apple → white oak acorn → pin oak acorn

C white oak acorn → pin oak acorn → McIntosh apple

D pin oak acorn → white oak acorn → McIntosh apple

8 **Part A**

The hikers wonder how air resistance affects a falling leaf. Select the arrows and drag them into the boxes to show the relative force from the weight of the leaf and the relative force of air resistance acting on the leaf as it falls. Each arrow will be used once or not at all.



Part B

Select the terms to describe how air resistance affects the net force and acceleration of a falling leaf.

The additional force of air resistance [decreases, increases, does not change] the net force and [decreases, increases, does not change] the acceleration.

9 An apple is thrown upward with an initial velocity of 20 m/s. What is the force on the apple when it reaches its maximum height of 19.6 meters?

A 1.78 N upward

B 1.78 N downward

C half the force that is on the apple at 10 meters

D twice the force that is on the apple at 10 meters

10 The hikers want to know more about the changes in energy during free fall motion. They consider an apple, a pin oak acorn, and a white oak acorn falling from a height of 3 m above the ground. Which fruit would have 5.35 J of energy just before hitting the ground?

A The pin oak acorn has 5.35 J of energy just before hitting the ground.

B The white oak acorn has 5.35 J of energy just before hitting the ground.

C The apple has 5.35 J of energy just before hitting the ground.

D All have 5.35 J of energy just before hitting the ground.

11 Pin oak acorns can grow in clusters of two or three. Which statement **best** describes the force affecting a cluster of two acorns falling compared to a single acorn falling?

A The force would be the same.

B The force would be twice as great.

C The force would be half as great.

D The force would be four times as great.

12
CR

The hikers are targeting a spot in a tree that is 6 m from the ground. One hiker throws a pin oak acorn straight up into the air and another hiker throws an apple straight up into the air.

Write an equation to calculate the energy needed to launch the apple to a height of 6 m. Compare energy needed to launch the apple as compared to the pin oak to the same height. Use the calculations to explain the answer.

Type your answer in the space provided.

2018 Sample Items ANSWER KEY
MISA

Item Number	Key	Evidence Statements
1	TEI*	**HS-LS1-1/1.a:** Students construct an explanation that includes the idea that regions of DNA called genes determine the structure of proteins, which carry out the essential functions of life through systems of specialized cells.
2	B	**HS-LS1-1/3.a.i:** Students use reasoning to connect evidence, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to construct the explanation. Students describe the following chain of reasoning in their explanation: because all cells contain DNA, all cells contain genes that can code for the formation of proteins.
3	C	**HS-LS1-1/2.a.iv:** Students identify and describe the evidence to construct their explanation, including that: groups of specialized cells (tissues) use proteins to carry out functions that are essential to the organism.
4	D	**HS-LS1-1/3.a.iv:** Students use reasoning to connect evidence, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to construct the explanation. Students describe the following chain of reasoning in their explanation: gene sequence affects protein function, which in turn affects the function of body tissues.
5	TEI*	**HS-LS4-1/2.a.iii:** Students identify and communicate evidence for common ancestry and biological evolution, including: patterns in the fossil record (e.g., presence, location, and inferences possible in lines of evolutionary descent for multiple specimens).
6	CR-4	**HS-LS4-1/2.c:** Students communicate that together, the patterns observed at multiple spatial and temporal scales (e.g., DNA sequences, embryological development, fossil records) provide evidence for causal relationships relating to biological evolution and common ancestry.
7	D	**HS-PS2-1/2.a.i:** Students use tools, technologies, and/or models to analyze the data and identify relationships within the datasets, including: a more massive object experiencing the same net force as a less massive object has a smaller acceleration, and a larger net force on a given object produces a correspondingly larger acceleration.
8	TEI*	**HS-PS2-1/1.a:** Students organize data that represent the net force on a macroscopic object, its mass (which is held constant), and its acceleration (e.g., via tables, graphs, charts vector drawings).
9	B	**HS-PS2-1/2.a.ii:** Students use tools, technologies, and/or models to analyze the data and identify relationships within the datasets, including: the result of gravitation is a constant acceleration on macroscopic objects as evidenced by the fact that the ratio of net force to mass remains constant.

☐ = Written response.

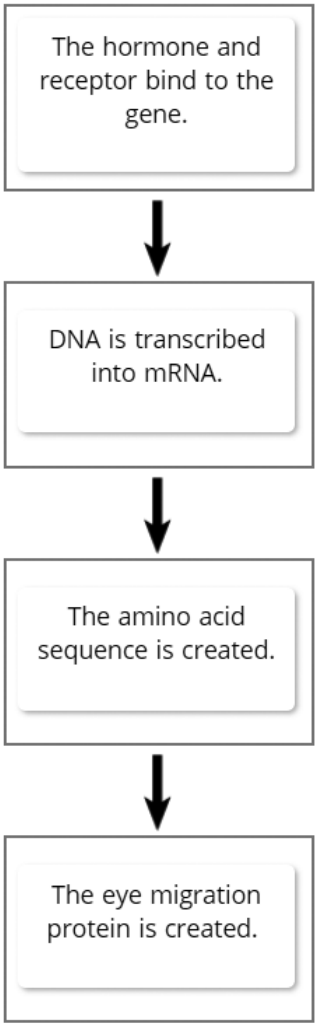
* Technology Enhanced Item – Correct responses shown on the following pages.

Item Number	Key	Evidence Statements
10	C	**HS-PS3-1/1.a.iv:** Students identify and describe the components to be computationally modeled, including: the final energies of the system components, including a quantification in an algebraic description to calculate the total final energy of the system.
11	B	**HS-PS2-1/3.a:** Students use the analyzed data as evidence to describe that the relationship between the observed quantities is accurately modeled across the range of data by the formula $a = F_{net}/m$ (e.g., double force yields double acceleration, etc.).
12	CR-3	**HS-PS3-1/2.b:** Students use the computational model to calculate changes in the energy of one component of the system when changes in the energy of the other components and the energy flows are known.

☐ = Written response.

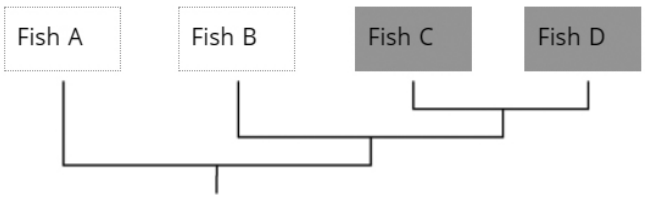
Item 1. TEI correct response:

Create a sequence to show what happens when the thyroxine hormone activates a gene. Select the processes and drag them into the correct positions.



Item 5. TEI correct response:

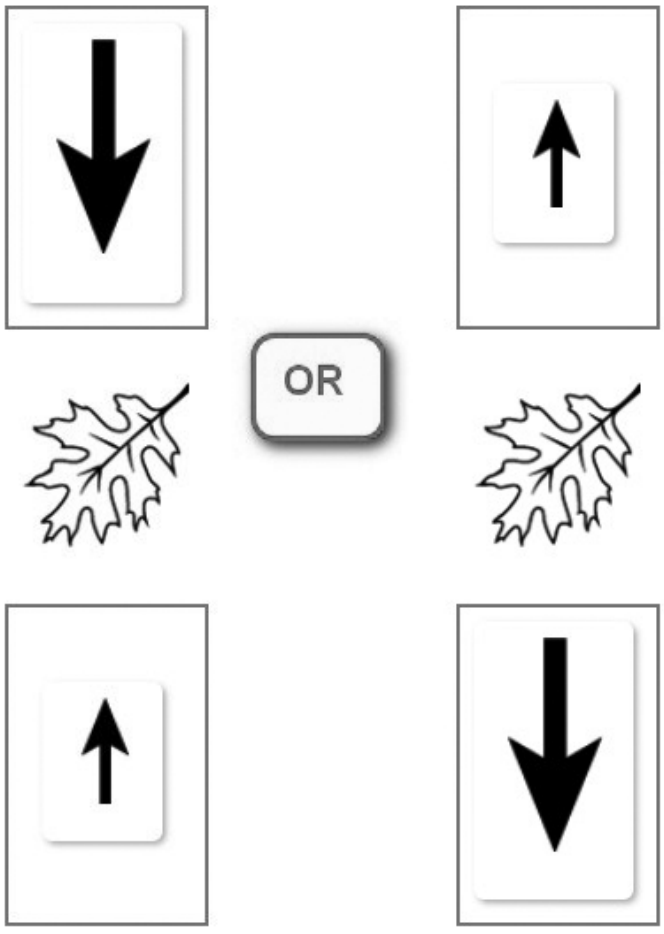
The Phylogenetic Tree diagram can be used to show relatedness. Select the two fishes that are most closely related to each other.



Item 8. TEI correct response:

Part A

The hikers wonder how air resistance affects a falling leaf. Select the arrows and drag them into the boxes to show the relative force from the weight of the leaf and the relative force of air resistance acting on the leaf as it falls. Each arrow will be used once or not at all.



Part B

(Responses in **bold** are the correct selections.)

The additional force of air resistance [**decreases**, increases, does not change] the net force and [**decreases**, increases, does not change] the acceleration.