Biozone p. 191

Divergent evolution should be taught in the context of genetic variation of a species with the understanding that the species did not completely change into something else. Convergent evolution is a theory with little research. Each species is made uniquely but their similarities do not necessarily mean they come from similar source.

191 Patterns of Evolution

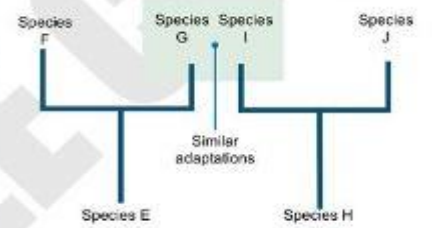
Key Question: What particular patterns of evolution might be seen in populations moving into a new environment?

- The diversification of one **species** into one or more separate species can follow particular patterns.
- Divergent **evolution** occurs when two species diverge from a common ancestor. Divergence is common in evolution and is responsible for evolutionary radiations. When divergent evolution involves the formation of a large number of species to occupy different niches, this is called an adaptive radiation. When unrelated species evolve similar forms as a result of similar **selection pressures**, it is called convergent evolution (convergence).

Divergent evolution
A lineage splits and evolves independently due to different selection pressures in different environments. Species may later occupy the same environment, e.g. black swan and mute swan.

Sequential evolution
A species accumulates enough genetic changes over time to form new species (remaining interbreeding).

Convergent evolution
Unrelated or distantly related species in similar environments and under similar selection pressures evolve similar features, e.g. streamlined swimming form in aquatic birds and mammals.



Adaptive radiation

- The earliest true mammals evolved about 195 million years ago, long before they underwent their major adaptive radiation some 65-50 million years ago. Most ancestors to the modern forms were very small (12 cm) with a similar form to modern shrews. Many were nocturnal and fed on insects and other invertebrates. *Megazostrodon* is a typical example. This animal is known from fossil remains in South Africa and first appeared in the Early Jurassic period, about 195 million years ago.
- Climatic change, as well as the extinction of the dinosaurs and their related forms, suddenly left many niches vacant for exploitation by such adaptable 'generalists'. All modern mammal orders developed relatively quickly.

Megazostrodon: one of the first mammals

1. What is the difference between divergent evolution and adaptive radiation? _____

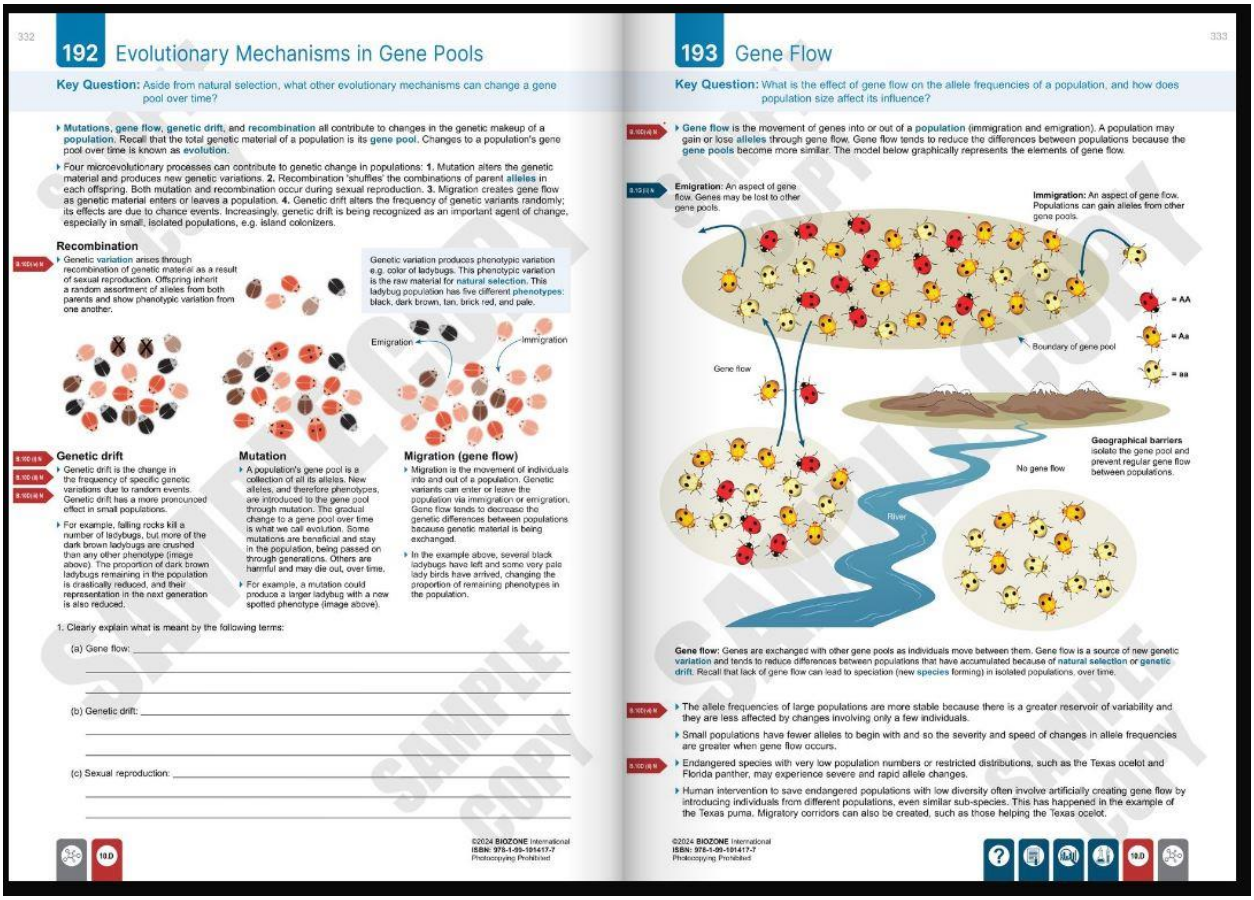
2. What is the difference between divergence and sequential evolution? _____

3. Penguins and dolphins have converged on a streamlined body form for moving through the water. What other groups of animals have also converged on this body shape?

ISBN: 978-1-99-101417-7

Biozone

Gene variation is variation within species and not evolution. This concept can be discussed without mentioning evolution.



192 Evolutionary Mechanisms in Gene Pools

Key Question: Aside from natural selection, what other evolutionary mechanisms can change a gene pool over time?

- **Mutations**, **gene flow**, **genetic drift**, and **recombination** all contribute to changes in the genetic makeup of a **population**. Recall that the total genetic material of a population is its **gene pool**. Changes to a population's gene pool over time is known as **evolution**.
- Four microevolutionary processes can contribute to genetic change in populations: **1.** Mutation alters the genetic material and produces new genetic variations. **2.** Recombination 'shuffles' the combinations of parent **alleles** in each offspring. Both mutation and recombination occur during sexual reproduction. **3.** Migration creates gene flow as genetic material enters or leaves a population. **4.** Genetic drift alters the frequency of genetic variants randomly; its effects are due to chance events. Increasingly, genetic drift is being recognized as an important agent of change, especially in small, isolated populations, e.g. island colonizers.

Recombination

- Genetic **variation** arises through recombination of genetic material as a result of sexual reproduction. Offspring inherit a random assortment of alleles from both parents and show phenotypic variation from one another.

Genetic variation produces phenotypic variation e.g. color of ladybugs. This phenotypic variation is the raw material for **natural selection**. This ladybug population has five different **phenotypes**: black, dark brown, tan, brick red, and pale.

Emigration

Immigration

Genetic drift

- Genetic drift is the change in the frequency of specific genetic variations due to random events. Genetic drift has a more pronounced effect in small populations.
- For example, falling rocks kill a number of ladybugs, but more of the dark brown ladybugs are crushed than any other phenotype (image above). The proportion of dark brown ladybugs remaining in the population is drastically reduced, and their representation in the next generation is also reduced.

Mutation

- A population's gene pool is a collection of all its alleles. New alleles, and therefore phenotypes, are introduced to the gene pool through mutation. The gradual change to a gene pool over time is what we call evolution. Some mutations are beneficial and stay in the population, being passed on through generations. Others are harmful and may die out, over time.
- For example, a mutation could produce a larger ladybug with a new spotted phenotype (image above).

Migration (gene flow)

- Migration is the movement of individuals into and out of a population. Genetic variants can enter or leave the population via immigration or emigration. Gene flow tends to decrease the genetic differences between populations because genetic material is being exchanged.
- In the example above, several black ladybugs have left and some very pale lady birds have arrived, changing the proportion of remaining phenotypes in the population.

1. Clearly explain what is meant by the following terms:

(a) Gene flow: _____

(b) Genetic drift: _____

(c) Sexual reproduction: _____

193 Gene Flow

Key Question: What is the effect of gene flow on the allele frequencies of a population, and how does population size affect its influence?

- **Gene flow** is the movement of genes into or out of a **population** (immigration and emigration). A population may gain or lose **alleles** through gene flow. Gene flow tends to reduce the differences between populations because the **gene pools** become more similar. The model below graphically represents the elements of gene flow.

Emigration: An aspect of gene flow. Genes may be lost to other gene pools.

Immigration: An aspect of gene flow. Populations can gain alleles from other gene pools.

= AA

= Aa

= aa

Boundary of gene pool

Gene flow

No gene flow

River

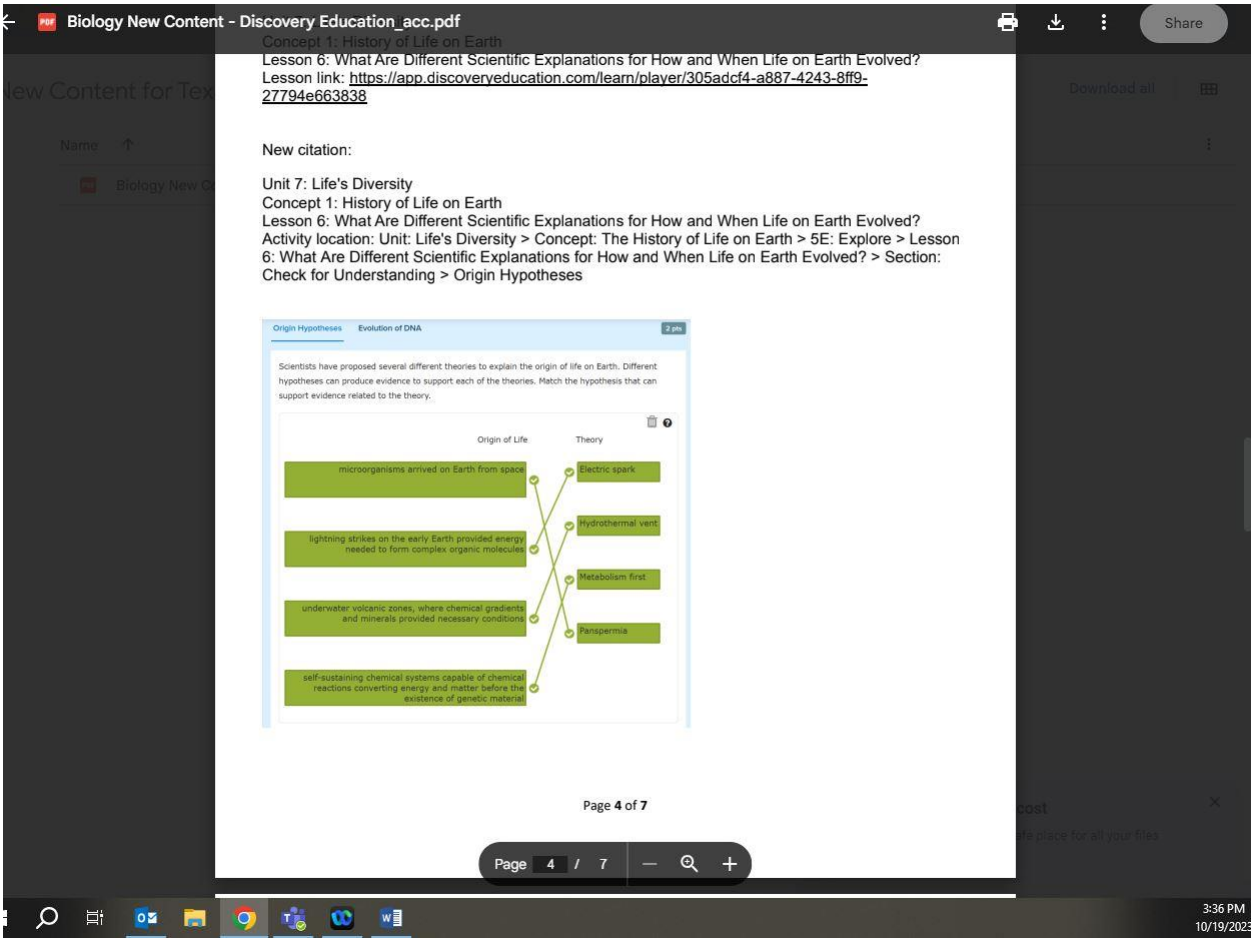
Geographical barriers isolate the gene pool and prevent regular gene flow between populations.

Gene flow: Genes are exchanged with other gene pools as individuals move between them. Gene flow is a source of new genetic **variation** and tends to reduce differences between populations that have accumulated because of **natural selection** or **genetic drift**. Recall that lack of gene flow can lead to speciation (new **species** forming) in isolated populations, over time.

- The allele frequencies of large populations are more stable because there is a greater reservoir of variability and they are less affected by changes involving only a few individuals.
- Small populations have fewer alleles to begin with and so the severity and speed of changes in allele frequencies are greater when gene flow occurs.
- Endangered species with very low population numbers or restricted distributions, such as the Texas ocelot and Florida panther, may experience severe and rapid allele changes.
- Human intervention to save endangered populations with low diversity often involve artificially creating gene flow by introducing individuals from different populations, even similar sub-species. This has happened in the example of the Texas puma. Migratory corridors can also be created, such as those helping the Texas ocelot.

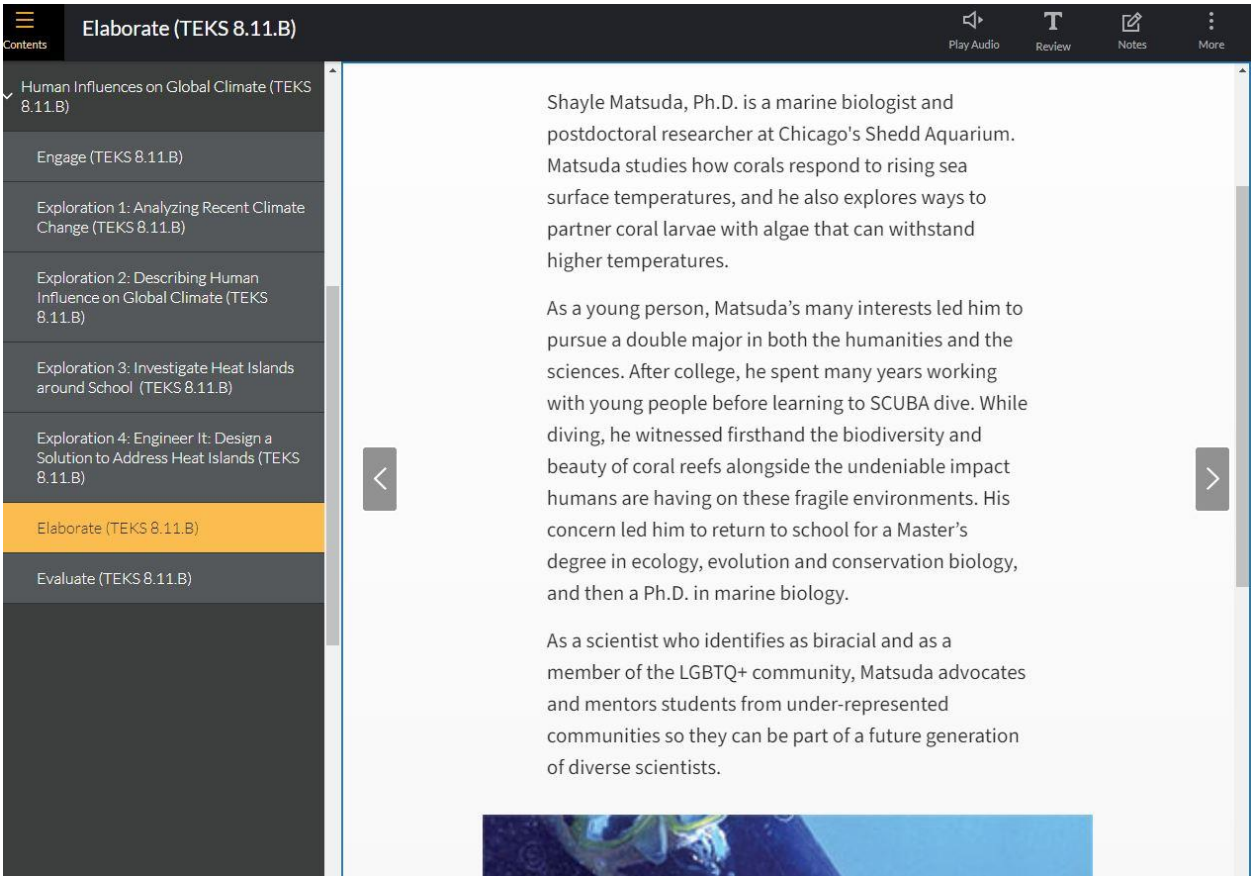
Discovery, Biology, P. 4

This lesson gives several theories for evolution as explanations of how life began on earth, but no mention of creation.



Houghton 8th Grade, Human Influences on Global Climate, TEKS 8.11.B

Mentioning of a scientist's sexual identity is not relevant to the subject. This fact should be deleted and just focus on Shayle Matsuda's contribution to Science.



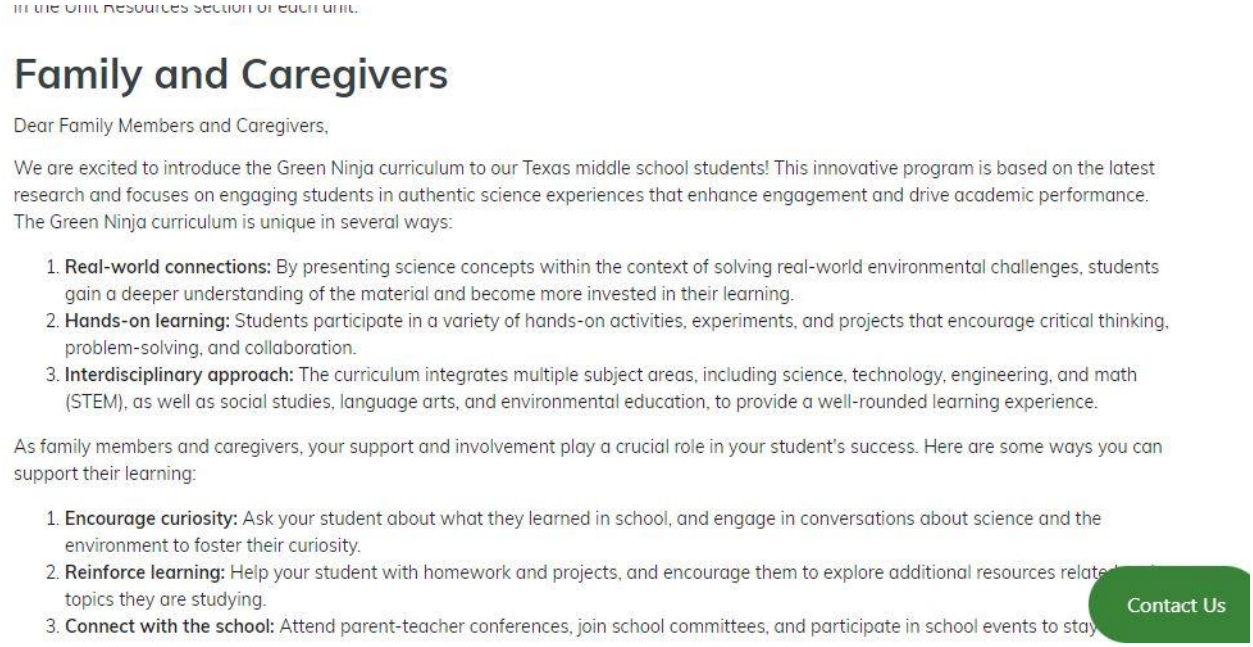
e-Dynamics Learning

Lesson 02, The Origin of the Universe

The lesson mentions the "Big Bang Theory" as the predominant theory for how the universe was created. However, no other theories are mentioned to balance out this opinion.

Green Ninja, Introductory letter

The introductory letter for these Science materials addresses “Family members” and “Caregivers”. This letter is over politicized by refusing to use the word “parent” and could give kids the wrong idea of who should be responsible for their learning. Letter should read “Parents and Caregivers”.



in the Unit Resources section of each unit.

Family and Caregivers

Dear Family Members and Caregivers,

We are excited to introduce the Green Ninja curriculum to our Texas middle school students! This innovative program is based on the latest research and focuses on engaging students in authentic science experiences that enhance engagement and drive academic performance. The Green Ninja curriculum is unique in several ways:

1. **Real-world connections:** By presenting science concepts within the context of solving real-world environmental challenges, students gain a deeper understanding of the material and become more invested in their learning.
2. **Hands-on learning:** Students participate in a variety of hands-on activities, experiments, and projects that encourage critical thinking, problem-solving, and collaboration.
3. **Interdisciplinary approach:** The curriculum integrates multiple subject areas, including science, technology, engineering, and math (STEM), as well as social studies, language arts, and environmental education, to provide a well-rounded learning experience.

As family members and caregivers, your support and involvement play a crucial role in your student's success. Here are some ways you can support their learning:

1. **Encourage curiosity:** Ask your student about what they learned in school, and engage in conversations about science and the environment to foster their curiosity.
2. **Reinforce learning:** Help your student with homework and projects, and encourage them to explore additional resources relate
topics they are studying.
3. **Connect with the school:** Attend parent-teacher conferences, join school committees, and participate in school events to stay

Contact Us

HMH 8th Grade p. 207, 210-211

The lesson lists Big Bang Theory as an explanation for the beginning of the universe but does not explore in detail other theories for the existence of the universe. The quiz on pp. 210-211 mentions one other possible theory, the Steady State, but the questions suggest that students should accept the Big Bang Theory over any other theory.

TEKS 8.9.C

Lesson Summary

Lesson Objective

Research and analyze scientific data used as evidence to develop scientific theories to describe the origin of the universe.

Lesson Vocabulary

hypothesis: a testable idea or explanation that leads to scientific investigation

law: a descriptive statement or equation that reliably predicts events under certain conditions

theory: a system of ideas that explains many related observations and is supported by a large body of evidence acquired through scientific investigation

universe: space and all the matter and energy in it

Key Points

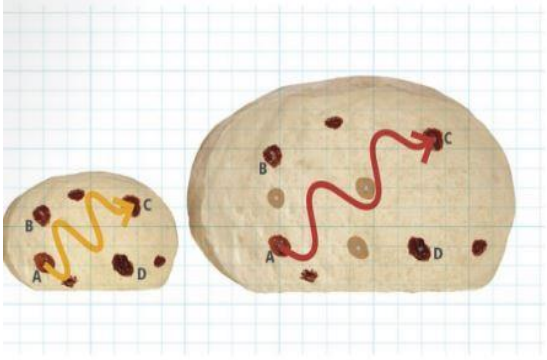
- In 1929, scientists discovered that most galaxies were moving away from each other.
- Hubble's law implied the universe is expanding. Scientists developed theories to explain why the universe is expanding.
- Then scientists tested hypotheses suggested by theories.
- A theory becomes more widely accepted when its predictions are verified.
- There is much data to support the Big Bang theory about the origin of the universe.

Notes

nswer these questions to review the lesson and practice for the lesson quiz.

. Match the term with the definition.

hypothesis	prediction that can be tested
theory	pattern in nature always found to be true
scientific law	system of ideas to explain observations



sing bread: As the bread rises, raisins in the bread move farther apart. This bread could be considered a model of e universe. The raisins represent the galaxies.

. Consider the rising bread model of the universe. Which statements describe the expansion of the universe? Select all that apply.

A. The galaxies are growing larger.

B. Our galaxy is in the center of the universe.

C. The space between the galaxies is stretching.

D. Galaxies appear to be moving apart from each other.

Answer these questions to review the lesson and practice for the lesson quiz.

5. For many decades, the Steady State and Big Bang theories claimed to explain the expanding universe. Why was it difficult for astronomers to decide which was correct?

A. Different laws applied to the two theories.

B. Astronomers were not able to test predictions of the theories.

C. The two theories both appeared to be true.

D. Equal numbers of astronomers favored each theory.

6. Which of the following investigations provided evidence that disproved the Steady State theory?

A. redshift of distant galaxies

B. process by which new stars are born

C. speed with which the universe is expanding

D. comparison of galaxies in the modern and early universe

7. Which pieces of evidence supported the Big Bang theory of the origin of the universe? Select all that apply.

A. discovery of black holes

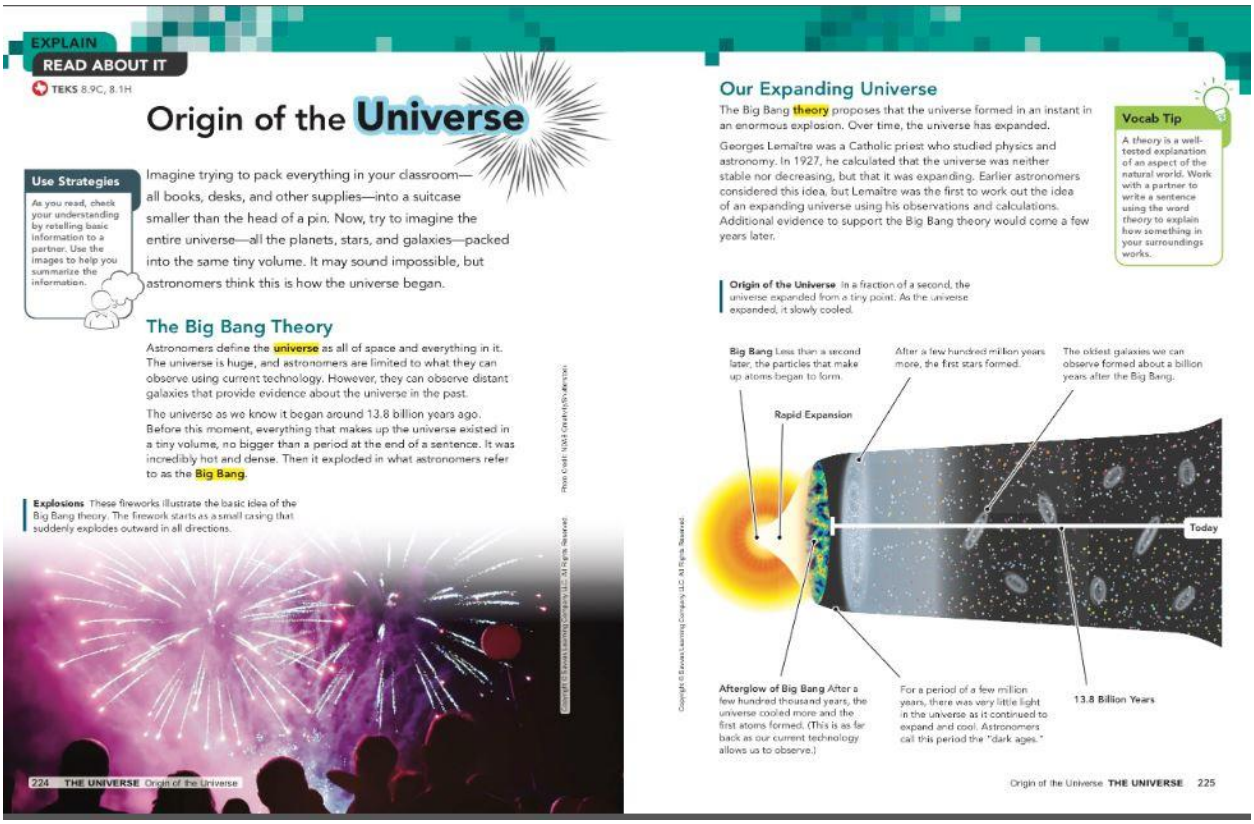
B. Cosmic Microwave Background

C. relative amounts of hydrogen and helium in the universe

D. use of Hubble's law to estimate backward to when galaxies were together

Savaas, 8th grade, pp. 224- 225

The Big Bang Theory is presented as fact and the only explanation/ theory of how the universe began without listing other theories as possible alternatives.



EXPLAIN

READ ABOUT IT

TEKS 8.9C, 8.1H

Origin of the Universe

Use Strategies

As you read, check your understanding by retelling basic information to a partner. Use the images to help you summarize the information.

Imagine trying to pack everything in your classroom—all books, desks, and other supplies—into a suitcase smaller than the head of a pin. Now, try to imagine the entire universe—all the planets, stars, and galaxies—packed into the same tiny volume. It may sound impossible, but astronomers think this is how the universe began.

The Big Bang Theory

Astronomers define the universe as all of space and everything in it. The universe is huge, and astronomers are limited to what they can observe using current technology. However, they can observe distant galaxies that provide evidence about the universe in the past.

The universe as we know it began around 13.8 billion years ago. Before this moment, everything that makes up the universe existed in a tiny volume, no bigger than a period at the end of a sentence. It was incredibly hot and dense. Then it exploded in what astronomers refer to as the Big Bang.

Explosions These fireworks illustrate the basic idea of the Big Bang theory. The firework starts as a small casing that suddenly explodes outward in all directions.

Our Expanding Universe

The Big Bang theory proposes that the universe formed in an instant in an enormous explosion. Over time, the universe has expanded.

Georges Lemaître was a Catholic priest who studied physics and astronomy. In 1927, he calculated that the universe was neither stable nor decreasing, but that it was expanding. Earlier astronomers considered this idea, but Lemaître was the first to work out the idea of an expanding universe using his observations and calculations. Additional evidence to support the Big Bang theory would come a few years later.

Vocab Tip

A theory is a well-tested explanation of an aspect of the natural world. Work with a partner to write a sentence using the word theory to explain how something in your surroundings works.

Origin of the Universe In a fraction of a second, the universe expanded from a tiny point. As the universe expanded, it slowly cooled.

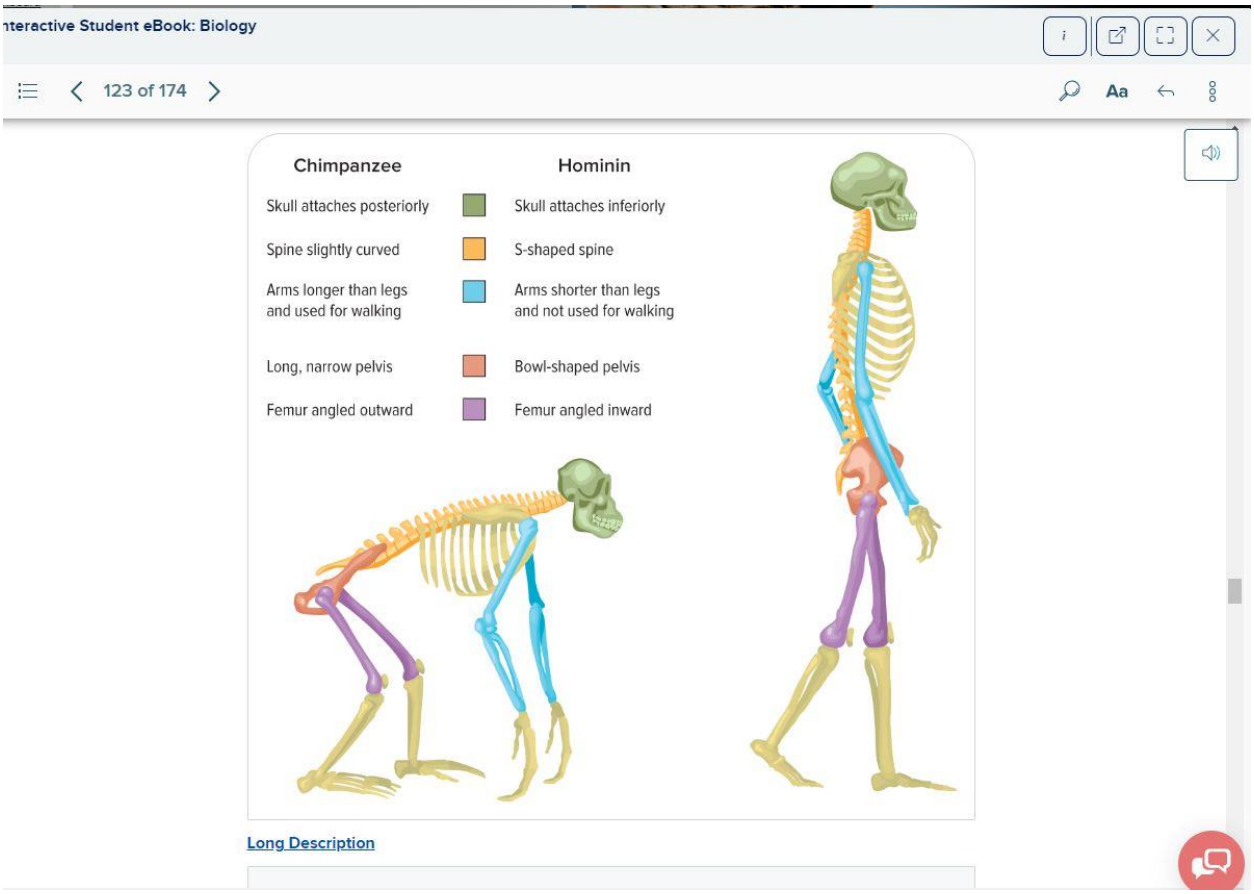
Kiddom Biology Unit 4, Chapters 18-20

Much emphasis is placed on Evolution throughout the textbook. Textbook should be more balanced with multiple theories.

McGraw Hill, Texas Biology Student e Book, Chapter 19

Chapter 19 places major emphasis on a disputed theory of the evolution of humans from primates, specifically chimpanzees. As seen below references are made to suggest that humans are a part of the “ape” family. The chapter points

out the many physical differences between humans and apes which would seem to disprove the theory of common ancestry. The chapter presents all evidence as fact when common belief and theory is that humans did not evolve from primates.



Hominins

DRIVING QUESTION CONNECTION Humans are included in the great ape or hominid family. However, they are further classified in a separate subcategory of hominids called hominins. Hominins are the lineage that most likely led to humans split off from the other African apes sometime between 8 and 5 mya.

LESSON 3

Primate Evolution

In 1868 near the village of Les Eyzies, France, road construction revealed a cave. In the cave were the remains of four adult skeletons and one infant. This site, Cro-Magnon, is one of the key historic sites in France. The skeletons at the site, including the skull shown in **Figure 18**, represent some of the oldest populations of the primate species *Homo sapiens* or humans. Yet, these skeletons are considered relatively young in our primate lineage. This lesson takes you through how primates evolved from our earliest ancestor to the *Homo sapiens* species of today.

Essential Question

How do the characteristics and features of primates compare?

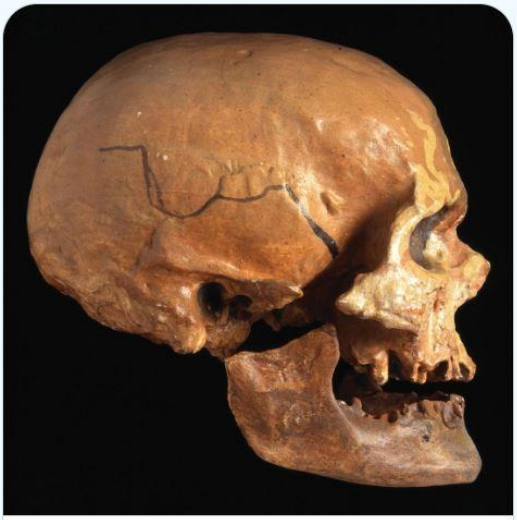


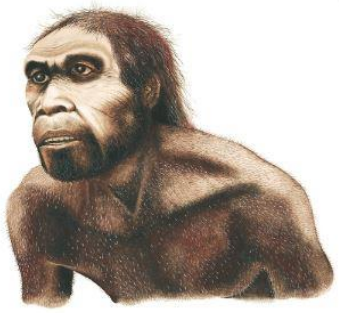
Figure 18 A cast of a skull of a male skeleton found at Cro-Magnon in France. Scientists estimate the male was less than

Advantages of bipedalism

There is no single answer to the question of why bipedalism developed. Bipedalism may have been selected for because it uses less energy than walking on all fours over long distances. Standing upright could have made it easier to see food sources. In addition, walking upright for long distances might also have reduced the total area of the body exposed to sunlight and increased the area exposed to cooling winds.

30, and *Homo ergaster, Homo erectus,* shown in Figure 31, *Homo floresiensis, Homo heidelbergensis,* and *Homo neanderthalensis.*

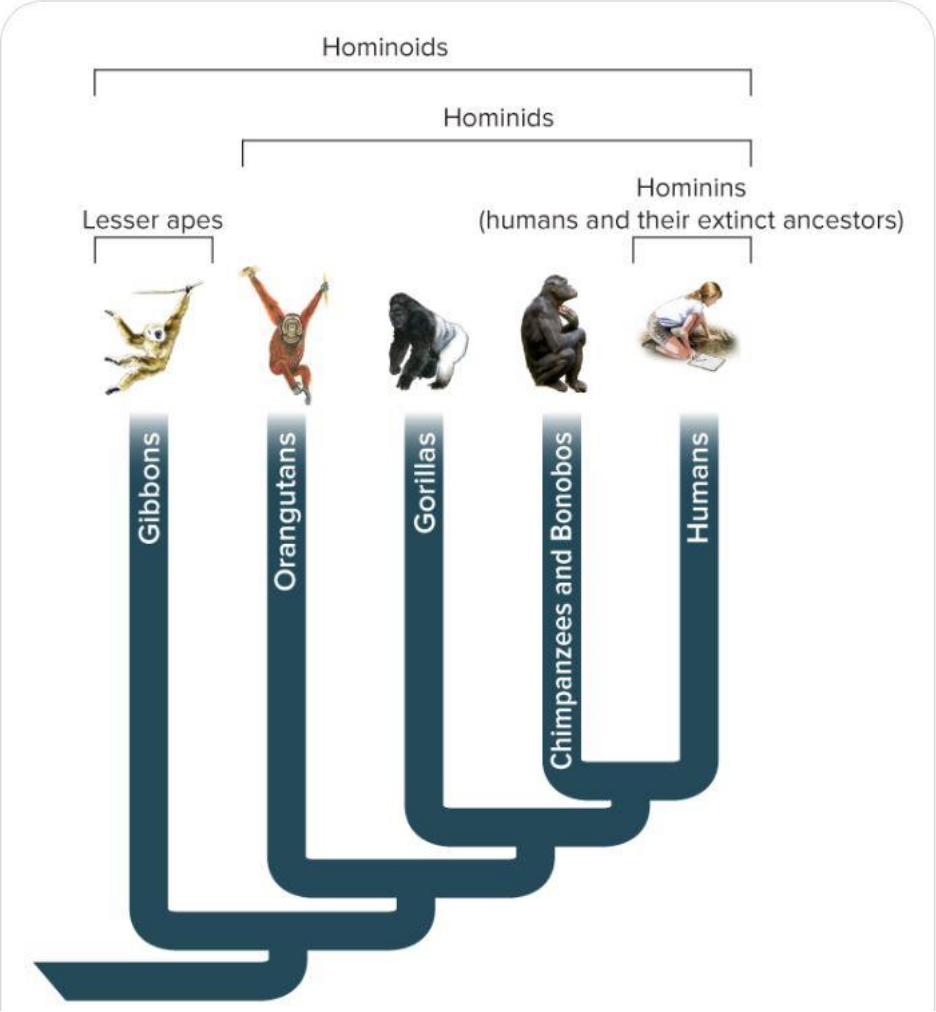
Figure 30 Illustration of how *Homo habilis* may have appeared.



Homo ergaster

Homo erectus

Figure 31 *H. ergaster* appeared only briefly in the fossil record, from about 1.8 to 1.3 mya. It had a rounded skull, reduced teeth, and what many scientists think was the first human nose (with the nostrils facing downward). *H. erectus,* lived between 1.8 million and 400,000 years ago and appears to have evolved from *H. ergaster* as it migrated out of Africa. Evidence indicates that *H. erectus* made sophisticated tools, used fire, and sometimes lived in caves.


Hominoids
Hominids
Hominins
(humans and their extinct ancestors)
Lesser apes
Gibbons
Orangutans
Gorillas
Chimpanzees and Bonobos
Humans

Interactive Student eBook: Biology

123 of 174

Aa

Human Evolution

A natural question to ask after reading about hominins is, "When did humans appear in primate lineage?" Currently, it is thought that the genus ***Homo***, which includes living and extinct humans appeared somewhere between 3 and 2.5 mya in Africa, as the environment became cooler. During this time, forests became smaller in size, and the range of grasslands was extended. Although the fossil record is lacking fossils, many scientists infer that they evolved from an ancestor of the australopithecines, a hominin that lived in the east-central and southern parts of Africa between 4.2 and 1 mya.

DRIVING QUESTION CONNECTION *Homo* species had bigger brains, lighter skeletons, flatter faces, and smaller teeth than their australopithecine ancestors. They are also the first species known to control fire and to modify stones for tool use. As they evolved, they developed language and culture. Early *Homo* species include *Homo habilis,* shown in **Figure 30**, and *Homo ergaster, Homo erectus,* shown in **Figure 31**, *Homo floresiensis, Homo heidelbergensis,* and *Homo neanderthalensis.*

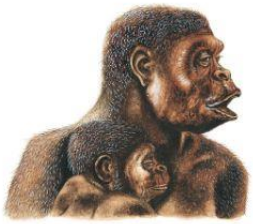


Figure 30 Illustration of how *Homo habilis* may have appeared.

TPS Publishing, Biology, Student Textbook, p. 309

This publisher does a good job of balancing religious belief with Science. More textbooks should follow this model and this textbook should be approved.

Whilst all major religions have a creation story as one of their key tenets, most scientists believed that there had been gradual and observable changes in species over very long time periods as had been demonstrated in the discovery of fossilized remains, which were starting to be organized into a fossil record. It is also true to say that many scientists did not see any disparity between a traditionally Christian belief in the creation of life and the fossil evidence which suggested there were similarities between specimens which could be used to organize and classify organisms into particular groups such as mammals and reptiles and even into much smaller groups such as primates. Observed similarities in both fossil and living species was greatly influential in the development of ideas about evolution and these similarities between different species had been organized into a hierarchical system of placing living things in groups by **Carl Linnaeus** in the mid-1700s.

Evidence of Common Ancestry

Linnaeus had classified organisms due to their structural similarities into (at the time) one of 3