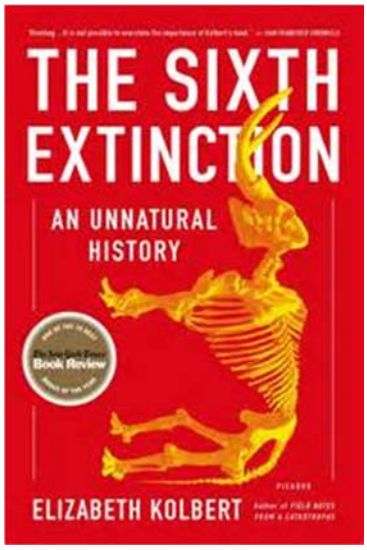
Saint Francis High School
Optional Reading Guide, *The Sixth Extinction*

Dear Saint Francis Students,

The Science Department, in conjunction with the Religious Studies department, is very proud and excited to sponsor this summer's all-school book: ***The Sixth Extinction* by Elizabeth Kolbert**. In June 2015 Pope Francis issued "On Care for Our Common Home", the encyclical *Laudato Si'*, which is a call to Catholics to be better, more active stewards of our environment through examining and changing personal habits and heeding the call for social justice. Over the course of the 2016-2017 academic year, you will be given opportunities to understand the science behind climate change, examine your lifestyle, and implement changes that allow you to live out this aspect of your faith. Our hope is that your generation will be leaders in the changes that are necessary for the care of our planet Earth and all of its inhabitants.

Your summer reading test on this book will be administered either in your science or religious studies class in the opening days of school. We would love for you to do well on this test! In order to achieve this, **you will be allowed to use notes that you've handwritten to both sides of an 8.5 x 11 sheet of white copy paper during the test .** We recommend you take notes in a chapter-by-chapter format. You will submit this note sheet to your teacher with the exam.



The following reading guide was written by some senior students in the 2015-2016 AP Environmental Science class and edited by science teachers (please excuse any imperfections). Our hope is that you will find the book as significant and important as we do. While the completion of the reading guide is optional, the key ideas and questions from this reading guide will form the basis for the questions on the reading test, and are intended to point out concepts of significance to you. The vocabulary lists are words that the APES students thought might be new to you. Additionally, you should take notes on anything that you think is interesting and significant.

Happy summer and enjoy the book! We look forward to discussing it with you in the fall.

Sincerely,
Jennifer Thomas
Science Department Chair

Please note: this book is available in multiple formats, i.e. paperback, Kindle, audiobook. More information available on Amazon.com

Many thanks to APES teachers Emily Thomas and Bob Lautenslager, APES students Lauren Roberts, Lauren Blake, Madilyn Vukcevich, Dagney Duncheon, Francesca LaBianca, and Madeleine Roman, the Science Department, Sal Chavez and Father Tony Mancuso for their assistance and support with this summer reading guide, video trailer and lesson plans.

Prologue

Key Ideas:

- Explanation of the story of *Homo sapiens* growth
- Human population expanded and contracted over thousands of years
- Humans overcome geographic boundaries to spread throughout the planet, altering biomes as they do so
- Human population expanded relatively quickly relative to the geologic history of the planet and evolution of species
- Human activities quickly affect biodiversity on the planet, the health of the atmosphere, and the chemistry of the world's oceans
- 5 Extinction events have occurred prior to the present each resulting in a massive decline in biodiversity
    - Each event so impactful they were put in their own category: The Big Five
        (see p. 271 - geological timeline with extinctions)
    - We are experiencing a sixth mass extinction which is driven by human activity

Questions:

1) What species is the author describing in the opening paragraphs?
2) What are some ways that this species affects the environments they inhabit (i.e. live in)?
3) How many major extinctions have there been before the current one? What happens to the planet during these?
4) What is the first part of the book concerned with? The second part?
5) What is the author's hope for her readers?

Chapter I: The Sixth Extinction

Key Ideas:

- Scientists observe that amphibians around the world are disappearing

- EVACC was an effort to preserve the remaining amphibians of the Panamanian rainforest
- Amphibians emerged as an animal class during the time of Pangaea 400 million years ago
- Amphibians have been among the planet's great animal survivors but now are among the most endangered
- Chytrid fungi (*Bd*) was determined to be the cause of the mass extinction of amphibians today
- Background extinctions are a normal loss of biodiversity, whereas mass extinctions are significant and massive loss of biodiversity

Vocabulary:

- Herpetologist (pg. 6, paragraph 3)
- Ambling gait (pg. 8, paragraph 3)
- Simulacrum (pg. 8, paragraph 3)
- Endemic (pg. 12, paragraph 3)
- Chytrids (pg. 13, paragraph 2)
- Speciation (pg. 15, paragraph 3)
- Geological epoch (pg. 15, paragraph 3)
- Etiology (pg. 18, paragraph 4)
- Progeny (pg. 22, paragraph 1)

Questions:

1) Explain how the "Frog Hotel" and EVACC are similar.
2) Explain the importance of the EVACC.
3) Why are amphibians knowns as the "planet's greatest survivors"? How have they evolved over time?
4) What is *Batrachochytrium dendrobatidis (Bd)*? What is it's effects on frogs? How it was discovered?
5) Explain why *Bd* is global a threat to amphibians. Is EVACC only a temporary solution? Justify your response with a quote.
6) Compare and contrast background extinction and mass extinction.
7) Identify and describe the two theories ("Out of Africa" and "frog-leg soup") behind the global spread of *Bd*.

Chapter II: The Mastodon's Molars

Key Ideas:

- The naturalist George Cuvier reconstructed fossilized remains of the American mastodon

- Extinction emerged as an idea in revolutionary France, and was not universally accepted
- Cuvier used similarities in body structures to classify organisms and prove extinction as a fact
- Cuvier proposed that catastrophic events cause extinction
- The American mastodon died out during the megafauna extinction 13,000 years ago caused by humans

Vocabulary:

- Binomial nomenclature (pg. 24, paragraph 3)
- Trilobites (pg. 24, paragraph 4)
- Belemnites (pg. 24, paragraph 4)
- Ammonites (pg. 24, paragraph 4)
- Anachronistically (pg. 25, paragraph 2)
- Conundrum (pg. 26, paragraph 2)
- Trepidation (pg. 27, paragraph 3)
- Desiccated (pg. 31, paragraph 2)
- Ungulates (pg. 34, paragraph 3)
- Antediluvian (pg. 35, paragraph 2)
- Protuberances (pg. 38, paragraph 1)
- Genus (pg. 38, paragraph 2)
- Cataclysm (pg. 44, paragraph 2)
- Megafauna (pg. 46, paragraph 1)

<u>Questions:</u>

1) Explain when, where, and how the first mastodon bones were discovered.
2) Who were the first naturalists to acknowledge the idea of extinction? How was it established as a fact?
3) Explain how Cuvier used the teeth of the fossil to figure out its species.
4) Explain the significance of Charles Willson Peale in the U.S.
5) How did fossilist Mary Anning challenge Cuvier?
6) Define the study of stratigraphy and explain its significance to understanding the geologic history
   of the planet.
7) What major insight did Cuvier gain after his discovery of different fossils in different layers of
   rock?

8) Explain Cuvier's stance on evolution, who challenged his anatomic viewpoint? Include a summary of both Cuvier's and his challenger's claim.
9) Identify and describe what Cuvier believed to be the causes of extinction. What sources did Cuvier cite to support his position?
10) What was responsible for the "revolution" Cuvier suggested wiped out the American mastadon along with other megafauna?

Chapter III: The Original Penguin

Key Ideas:

- Charles Lyell, a "uniformitarian", supported that change in Earth's geological landscape occurs over countless millennia
- Charles Darwin was influenced by Lyell and developed his theory of evolution by natural selection
- Lyell doesn't fully support Darwin's ideas of change in species, but Darwin believes that change occurs in both geology of Earth and its species of life
- Humans hunt the Great Auk to extinction in the 1800's
- Evolution and extinction are slow-acting processes unless humans get involved

Vocabulary:

- Pejorative (pg. 47, paragraph 1)
- Umbrageous (pg. 48, paragraph 3)
- Caricatured (pg. 50, paragraph 2)
- Natural Selection (pg. 51, paragraph 1)
- Supplanted (pg. 55, paragraph 2)
- Pestilence (pg. 55, paragraph 2)
- Foraminifera (pg. 56, paragraph 3)
- Depredation (pg. 61, paragraph 1)
- Extirpation (pg. 61, paragraph 2)
- Innards (pg 66, paragraph 2)

Questions:

1) Explain what Charles Lyell meant when saying, "The present is key to the past".
2) Identify and cite two examples in which Lyell influenced Darwin and his studies.
3) How did the coral reef draw Darwin's understanding of the interplay between biology and geology?
4) Explain Darwin's connective theory of extinction and evolution. Include a quote that supports your explanation.

5) Identity and explain one theory that Lyell and Darwin disagreed upon.
6) The example of the extinction of Auk sheds light on the issue of human-induced extinction, in your opinion do you think humans deserve a "special status" as a creature outside of nature? Justify your argument with a quote.

Chapter IV: The Luck of the Ammonites

Key Ideas:

- Walter Alvarez discovered evidence of a giant asteroid that ended the Cretaceous period (i.e. the fifth extinction which included dinosaurs)
- Scientific evidence for fifth extinction includes:
  - Iridium from asteroid found in rock layers in various locations around the world
  - Foraminifera serve as index fossils and vanish from fossil record at same time as dinosaurs
- Impact crater of an asteroid found in the Yucatan Peninsula of Mexico serves as evidence that "catastrophes" can cause mass extinction events
- Every organism alive today is descended from those that survived the impact

Vocabulary:

- Municipal fossil (pg. 70, paragraph 1)
- Gorge (pg. 70, paragraph 2)
- Attenuated (pg. 72, paragraph 1)
- Calcite (pg. 73, paragraph 2)
- Cretaceous period (pg. 73, paragraph 73)
- Uniformitarianism (pg. 74, paragraph 2)
- Impact hypothesis (pg. 75, paragraph 3)
- Extraterrestrial (pg. 76, paragraph 3)
- Paleontology (pg. 76, paragraph 3)
- Taxonomy (pg. 76, paragraph 4)
- Vehemence (pg. 77, paragraph 3)
- Faunal (pg. 78, paragraph 2)
- Lacuna (pg. 78 paragraph 2)
- K-T boundary (pg. 81, paragraph 1)
- Ammonites (pg. 83, paragraph 3)
- Bolide (pg. 86, paragraph 2)
- Incandesced (pg. 86, paragraph 4)
- Preservation potential (pg. 88, paragraph 3)

- Nautiluses (pg. 90, paragraph 2)

Questions:

1) Explain the importance of forams and how they were used in Alvarez's studies.
2) Explain the significance of the spike in iridium in the clay samples taken by Alvarez.
3) Explain the Alvarezes' hypothesis for such spikes in iridium. Include a quote to support your response.
4) In what way did the scientific community react to the Alvarezes' impact hypothesis?
5) Identify and describe the three "chapters of life".
6) How did the viewpoints on breaks in the fossil record differ between Phillips and Lyell?
7) Explain the significance of the Alverezes' challenging the "uniformitarian viewpoint".
8) What influences "preservation potential"? Include a definition in your response.
9) What are the Signor-Lipps and Lilliput effect?
10) Explain how catastrophes challenge Darwin's ideas of adaptation and fitness. Include a quote to justify your response.

Chapter V: Welcome to the Anthropocene

Key Ideas:

- The concept of extinction is a paradigm shift, or new way of thinking
- New conclusion - the geology of Earth and its life forms usually change at an extremely slow pace but also endure random catastrophes leading to rapid environmental change
- Fossil records help prove catastrophes and shows mass extinction events have occured
- There is no general theory to explain the Big Five, but records suggest climate change, due to various events (i.e. asteroid impact, glaciation, atmospheric composition change), is responsible
- New geological epoch proposed, the "Anthropocene" by Paul Crutzen
    - Arguments for new epoch include humans changing both the atmosphere and earth's geology at a rapid rate leaving behind distinct signs in sedimentary layers
    - The evolution of humans and their activity has significantly altered the earth on a global scale and should be recognized as a new epoch

Vocabulary:

- Incongruities (pg. 92, paragraph 1)
- Paradigmatic (pg. 93, paragraph 1)
- Anomaly (pg. 93, paragraph 1)
- Neocatastrophism (pg. 94, paragraph 4)

- Smirr (pg. 95, paragraph 1)
- Ordovician period (pg. 96, paragraph 1)
- Progenitors (pg. 96, paragraph 2)
- Graptolites (pg. 97, paragraph 3)
- Stratigrapher (pg. 98, paragraph 2)
- Successive species (pg. 98, paragraph 2)
- Isotope chemistry (pg. 99, paragraph 4)
- Monograph (pg. 100, paragraph 1)
- Chasm (pg. 101, paragraph 2)
- Infinitesimal (pg. 102, paragraph 2)
- Glaciation (pg. 102, paragraph 3)
- Ocean acidification (pg. 103, paragraph 2)
- Epidemic (pg. 105, paragraph 1)
- Ecospace (pg. 105, paragraph 1)
- Biota (pg. 105, paragraph 3)
- Vanguard (pg. 105, paragraph 3)
- Monoculture farming (pg. 107, paragraph 1)
- Entomologist (pg. 107, paragraph 3)

Questions:

1) Explain how "catastrophes" relate to the theories of both Darwin and Cuvier.
2) Explain the following quote on the Ordovician radiation, "Had the list of survivors been one jot different, then so would the world today." (pg. 97)
3) What qualities make graptolites a useful index fossil?
4) Explain the significance of the change in color of the stone studied by Zalasiewicz.
5) What did the two paleontologist from the University of Chicago discover about the possible cause and pattern of extinctions?
6) Identify the biggest extinction of the Big Five. Explain what caused it and why it was the biggest.
7) Explain the current theory for why fossil records show signs of extinction near the end of the Ordovician period.
8) Describe the theory of how glaciation caused the end-Ordovician extinction.
9) What does Zalasiewicz believe humans will leave in the sedimentary record?
10) What did Paul Crutzen discover and how is this discovery related to the "Anthropocene"?
11) Do you think we are in the "Anthropocene"? Why or why not?

Chapter VI: The Sea Around Us

Key Ideas:

- Since the Industrial Revolution, humans have significantly contributed to the increase in carbon dioxide (CO_2) in the atmosphere through the burning fossil fuels and deforestation
- Increased atmospheric carbon dioxide (CO_2) contributes to an increase in average global surface temperature and ocean acidification
- Carbon dioxide (CO_2) concentrations alter pH and temperature which causes major changes in aquatic ecosystems
- Aquatic life is nearly nonexistent in water with high carbon dioxide (CO_2) levels, which provides insight into the future of the world's oceans
- Ocean acidification is the "equally evil twin" to global warming (which causes climate change)
- Ocean acidification played a major role in at least two of the Big Five Extinctions
- Anthropogenic, or human-produced, carbon dioxide (CO_2) is a concern with regards to scale (amount) and speed of transfer and greatly influences Earth's global climate

Vocabulary:

- Hapless (pg. 113, paragraph 1)
- Limpets (pg. 113, paragraph 1)
- Logarithmic (pg. 114, paragraph 2)
- Lesions (pg. 116, paragraph 1)
- Physiology (pg. 116, paragraph 2)
- Mollusk (pg. 118, paragraph 1)
- Mesocosms (pg. 118, paragraph 3)
- Microbial (pg. 120, paragraph 5)
- Propagates (pg. 120, paragraph 5)
- Myriad (pg. 121, paragraph 2)
- Calcifiers (pg. 121, paragraph 2)
- Barnacles (pg. 121, paragraph 2)
- Crustaceans (pg. 121, paragraph 2)
- Calcification (pg. 121, paragraph 2)
- Geophysical (pg. 123, paragraph 2)
- Sequestered (pg. 124, paragraph 1)
- Cataclysmic (pg. 124, paragraph 2)

Questions:

1) What can happen when CO_2 dissolves in water?
2) What is expected to happen if CO_2 emissions continue at the current rate? Should these consequences be of concern?
3) Explain what happens when water and air come into contact. What is happening to cause the equilibrium to become lopsided?
4) How does Castello Aragonese exemplify what our future oceans could look like?
5) Explain the effects of ocean acidification on both organisms and entire aquatic ecosystems.
6) Which group of organisms will be most impacted by ocean acidification? In what ways are these organisms affected?
7) What is most significant about the rate in which CO_2 is currently entering the atmosphere? Why is this rate concerning?
8) Reflect on the following quote: "Continuing along this path for much longer, [...] 'is likely to leave a legacy of the Anthropocene as one of the most notable, if not cataclysmic events in the history of our planet'" (pg 124).

Chapter VII: Dropping Acid

Key Ideas:

- Ocean acidification is degrading coral reefs around the world as it interferes with the process of calcification
- Coral reefs are under threat from additional human activities including: overfishing, agricultural runoff, deforestation, dynamite fishing
- Coral reefs and rainforests show incredible biodiversity
- Coral reefs will likely be the first major ecosystem in the modern era to become ecologically extinct; this extinction will be driven by human activity

Vocabulary:

- Flummoxed (pg. 128, paragraph 1)
- Atoll (pg. 129, paragraph 1)
- Boisterous (pg. 132, paragraph 2)
- Prevailing (pg. 136, paragraph 3)
- Bazaar (pg. 140), paragraph 1)
- Bivalves (pg. 140, paragraph 5)
- Symbiotic relationship (pg. 142, paragraph 1)
- Caricature (pg. 142, paragraph 2)
- Monograph (pg. 142, paragraph 1)

- Scleractinian (pg. 145, paragraph 5)
- Mauve (pg. 147, paragraph 3)

Questions:

1) Compare Lyell's and Darwin's theory of coral reef formation.
2) Why are coral reefs an important aquatic ecosystem?
3) Explain the property of "saturation state with respect to calcium carbonate".
4) Explain the relationship between the growth rate of the corals and the saturation state of the water. Why is it important to keep saturation levels above 2?
5) What is predicted to happen to coral reefs if current emissions trends continue?
6) Explain how coral reefs support aquatic ecosystems.
7) Identify four human activities that are threatening corals.
8) How does the temperature of water affect the function of corals? (i.e. explain "coral bleaching")
9) Describe One Tree Island and the research that is being done there. What do you think about the messages left by research groups?

Chapter VIII: The Forest and the Trees

Key Ideas:

- Biodiversity decreases moving away from the equator
- Prior to the last 200 years, the Earth had been in a 40-million year cooling phase
- Increase in atmospheric temperature is currently estimated to take place at least ten times faster than it did at the end of the last glaciation
- Plants and animals respond to climate and temperature changes in one three ways: adaptation, migration, or extinction
- Climate change is a driving force to the extinction of many plant species and as a result many animals are losing their habitat
- Research suggests "global warming will restructure ecological communities" (pg. 169)

Vocabulary:

- Incongruously (pg. 148, paragraph 1)
- Insuperable (pg. 153, paragraph 3)
- Taxonomic (pg 154, paragraph 4)
- Bromeliads (pg. 156, paragraph 3)
- Talmudic (pg. 157, paragraph 1)
- Recensus (pg 157, paragraph 1)

- palmately (pg. 159, paragraph 3)
- Inflorescence (pg. 163, paragraph 2)
- Correlation (pg. 165, paragraph 2)

Questions:

1) Explain what is meant by "latitude diversity gradient".
2) Describe three theories that explain why biodiversity increases near the equator
3) What is the Birnam Wood Scenario?
4) Identify and explain the believed cause of the ice age
5) Why is the current rate of warming causing more impacts than previous warming periods? What is its effect on organisms?
6) In ecology, what is meant by "species-area relationship"?
7) How does Silman's work suggest that global warming will "reconstruct" ecological communities?

Chapter IX: Islands on Dry Land

Key Ideas:

- The Biological Dynamics of Forest Fragments Project (BDFFP) is one of the largest and longest-running ecological experiments:
  - Project analyzes changes in biodiversity through the use of forest fragments, or "land islands"
  - Project shows that land fragmentation results in significant loss of biodiversity
- Islands tend to be species-poor (not biodiverse) with re-colonization difficult after extinction events
- A defining feature of the Anthropocene is that human induced global environmental change compels species to migrate, yet humans also create barriers to this movement

Vocabulary:

- Archipelago (pg. 174, paragraph 3)
- Ornithologist (pg. 174, paragraph 3)
- Entomologist (pg. 174, paragraph 3)
- Depauperate (pg. 179, paragraph 5)
- Grandiloquently (pg. 182, paragraph 3)
- Voracious (pg. 184, paragraph 1)
- Hegemony (pg. 186, paragraph 2)
- Chastening (pg. 186, paragraph 3)

- Fragmentation (pg. 189, paragraph 3)
- Amplexus (pg. 190, paragraph 1)
- Obligate (pg. 190, paragraph 3)
- Bivouac (pg. 191, paragraph 2)
- Statary (pg. 191, paragraph 2)

Questions:

1) What happened between ranchers and the Brazilian government that resulted in the creation of the BDFFP?
2) Explain how "wild lands" are no longer truly "wild".
3) Why are islands typically less diverse?
4) What trend did Jared Diamond find when specializing with the birds of New Guinea? What did he deem was the main predator driving local extinction?
5) What is the given explanation for the phenomenon of "relaxation"?
6) Explain Cohn-Haft's theory for why life in the tropics is so diverse.
7) What are possible reasons that predictions on the number of species going extinct don't match observations in the field?
8) How has change in land use affected the atmosphere? What are the implications of this on a global scale?
9) Identify and describe two defining features of the Anthropocene.
10) Explain the significance in the relationship between army ants and ant-following birds and how it demonstrates ecosystem interconnectedness.

Chapter X: The New Pangaea

Key Ideas:

- An invasive species of fungi (psychrophile) from Europe is killing bats in North America
- Prior to the Anthropocene, plants and animals had limits to their dispersal due to geographic and climatic barriers
- A defining feature of the Anthropocene is the movement of plants and animals by humans as globalization has taken place
- *Homo sapiens* as a planet-wide invasive species have wildly succeeded at the expense of other species and entire ecosystems
- The increase in movement of invasive species leads to a decrease in global biodiversity and is creating the "New Pangea"

Vocabulary:

- Talcum (pg. 194, paragraph 2)
- Hibernacula (pg. 194, paragraph 3)
- Baroque (pg. 197, paragraph 1)
- Sepulchral (pg. 200, paragraph 1)
- Emaciated (pg. 201, paragraph 2)
- Proliferate (pg. 202, paragraph 2)
- Acclimatization (pg. 210, paragraph 2)
- Homogenization (pg. 213, paragraph 1)

Questions:

1) What was the reason for the white powder on the bats? Where did it come from?
2) What did Darwin's "theory of descent with modification" say about species origins? In what ways do humans challenge this theory?
3) Explain how physical isolation can result into biological disparity (i.e. species becoming different).
4) How have human affected geographic distribution and geographic separation of species?
5) How does the *Geomyces destructans* fungus kills bats?
6) Explain how the movement of species is a "high-stakes game". What are the possible outcomes?
7) Explain the term "enemy release" and how it relates to invasive species.
8) What are possible consequences of introducing an invasive species in order to kill off a previous invasive species?
9) Explain what biologists mean when referring to the "New Pangea".
10) Which species is "arguably the most successful invader in biological history"? Pick two distinct pieces of evidence from the book to support your claim.
11) Why do humans deliberately import "foreign varieties" of species?
12) What is the global effect of the sudden increase in movement of species?

Chapter XI: The Rhino Gets an Ultrasound

Key Ideas:

- Humans are the driving force behind current megafauna extinction
- Humans hold to the power to ultimately save or kill any species
- A consequence of habitat fragmentation caused by human land use is a loss of biodiversity, particularly of species that reproduce slowly
- "being large and slow to reproduce was a highly successful strategy" (pg. 235), but once humans evolved this quickly changed from an advantage to a disadvantage

Vocabulary:

- Inexorably (pg. 219, paragraph 3)
- Trypanosomiasis (pg. 219, paragraph 4)
- Progesterone (pg. 221, paragraph 1)
- Euphemistically (pg. 223, paragraph 2)
- Gambit (pg.224, paragraph 3)
- Colloquially (pg. 225, paragraph 1)
- Brobdingnagian (pg. 226, paragraph 1)
- Sporormiella (pg. 231, paragraph 4)
- Graptolites (pg 233, paragraph 1)

Questions:

1) What happened in 1984 that saved the Sumatran rhino from extinction? Was the effort successful?
2) Identify and explain two reasons for the mystery of the missing megafauna.
3) What did Wallace believe was the reason for the rapid extinction of large mammals? If true, how does this heighten the effects of current climate change?
4) With what other events have the sequence of megafauna extinction pulses been aligned?
5) What evidence was found that challenged the idea that climate drives extinction?
6) Explain how humans "challenged the rules of the survival game".
7) What was the evolutionary advantage of megafauna? (i.e. why did they grow so large)
8) What did paleontologist John Alroy and others find out about human actions using computer simulations?

<u>Chapter XII: The Madness Gene</u>

Key Ideas:

- Neanderthals lived in Europe for 100,000 years but abruptly vanished 30,000 years ago
- Ancestors of modern humans arrived in Europe 40,000 years ago
- Neanderthal DNA is found to be extremely similar to modern humans
- All great apes (gorillas, chimpanzees and orangutans) in the wild are facing rapid population decline which threatens the survival of multiple species
- A very small genetic variation distinguishes humans from Neanderthals, but has made all the difference in the success of our species

Vocabulary:

- Tumult (pg 241, paragraph 1)
- Brutishness (pg 243, paragraph 1)

- Archaic (pg 246, paragraph 2)
- Bequeathed (pg 247, paragraph 2)
- Pongid (pg 248, paragraph 1)
- Flummoxed (pg 249, paragraph 2)
- Diminutive (pg 253, paragraph 2)
- Dordogne (pg 255, paragraph 2)
- Parlance (pg 256, paragraph 3)

Questions:

1) What event is linked to the disappearance of Neanderthals?
2) Who invented the study of ancient DNA? Which ancient organisms did he study?
3) What happens to the genetic material of organisms after they die?
4) What was found when comparing the human genome to the Neanderthal genome?
5) Explain the "Out of Africa" theory of human evolution.
6) Explain the "leaky replacement" hypothesis? What does this hypothesis provide evidence for?
7) What characteristic do apes lack that is central to human society?
8) According to the archaeological record, in what location did Neanderthals evolve?
9) What did Paabo discover from the DNA of the fragment figure bone?
10) What are "the hobbits" and the "Denisovans"? How is their fate similar to the great apes of today?

Chapter XIII: The Thing with Feathers

Key Ideas:

- Humans are the "agents" (cause) and "victims" of the Sixth Extinction
- One defining feature of the Anthropocene is the rate of change in both climate and biodiversity
- Although "humans can be destructive and shortsighted; they can also be forward-thinking and altruistic" (pg. 261) and there are historical examples in which humans have taken action on behalf of the earth and all its creatures; this provides hope for the future
- Humans are taking action to save endangered animals and help them repopulate through programs such as the "Frozen Zoo"

Vocabulary

- Frigid (pg. 260, paragraph 2)
- Menageries (pg. 260, paragraph 2)

- Pachyderms (pg. 261, paragraph 1)
- *Silent Spring* (pg. 261, paragraph 3)
- DDT (pg. 261, paragraph 3)
- Chelation (pg. 262, paragraph 2)
- Hindquarters (pg. 263, paragraph 2)
- Phalluses (pg. 264, paragraph 1)
- Cloaca (pg. 264, paragraph 1)
- Avian (pg. 265, paragraph 1)
- Tragicomic (pg. 265, paragraph 2)
- Graptolites (pg. 268, paragraph 1)
- Ammonites (pg. 268, paragraph 1)
- Decamp (pg. 268, paragraph 2)

Questions:

1) What the is the Frozen Zoo? What is its importance?
2) How does the bird Kinohi exemplify how serious human take extinction?
3) What do the "ups and downs of history" reveal about life?
4) What is the sole cause of the sixth extinction?
5) Explain the logic behind the Hall of Biodiversity's idea that human will be undone by our "transformation of the ecological landscape".
6) Explain the quote, "In pushing other species to extinction, humanity is busy sawing off the limb on which it perches" .

Please take time to read and contemplate the following prayer--

A prayer for our earth

taken from *Laudato Si': On Care of Our Common Home*

Pope Francis May 2015

All-powerful God, you are present in the whole universe
and in the smallest of your creatures.
You embrace with your tenderness all that exists.
Pour out upon us the power of your love,
that we may protect life and beauty.

Fill us with peace, that we may live
as brothers and sisters, harming no one.
O God of the poor,
help us to rescue the abandoned and forgotten of this earth,
so precious in your eyes.
Bring healing to our lives,
that we may protect the world and not prey on it,
that we may sow beauty, not pollution and destruction.
Touch the hearts
of those who look only for gain
at the expense of the poor and the earth.
Teach us to discover the worth of each thing,
to be filled with awe and contemplation,
to recognize that we are profoundly united
with every creature
as we journey towards your infinite light.
We thank you for being with us each day.
Encourage us, we pray, in our struggle