Rutherford County Schools – Individual Learning Modules

Grade	Course
High School	Biology I

Unit Focus

Biological Change and Diversity (LS4)

Week of 4/27– 5/1

Standard(s)

BIO.LS4.1 – Evaluate scientific data collected from analysis of molecular sequences, fossil records, biogeography, and embryology. Identify chronological patterns of change and communicate that biological evolution is supported by multiple lines of empirical evidence that identify similarities inherited from a common ancestor (homologies).
4.LS4.2 – Using a model that demonstrates the change in allele frequencies resulting in evolution of a population over many generations, identify causative agents of change.

Resources

- **Digital Resources - BioInteractive/ HHMI - Evolution:** https://www.biointeractive.org/classroom-resources?f%5B0%5D=grade_levels%3A98&f%5B1%5D=topics%3A59&f%5B2%5D=topics%3A61
- **Textbook - Evaluating Evidence from the K-T Boundary: Pearson, 670-671**
- **SharePoint Folder from Bootcamp (ideas, video suggestions, additional resources):** https://rcschools.sharepoint.com/sites/bio/EOC%20Bootcamp/Forms/AllItems.aspx

Task/ Assignment

Scenario1: Evaluating Evidence from the K-T Boundary
(Source: Tennessee Biology, Miller & Levine, Pearson, pg. 670-671)

The fossil record shoes that dinosaurs once lived in nearly every habitable part of Earth. Fossils of widely known dinosaurs are particularly common in rocks dating from the Mesozoic Era, which ended around 66 million years ago. But after the Mesozoic, dinosaur fossils are nowhere to be found. What's more, many other Mesozoic species—plant and animal, terrestrial and marina—also disappeared.

What could have caused that mass extinction? Scientists have been debating for many years, and new data are being gathered to test two competing hypotheses.

The hypothesis that most people are familiar with was proposed by a father-son team: physicist Luis Alvarez and geologist Walter Alvarez. They were studying a layer of rocks called the K-T boundary, which marks the end of the Cretaceous Period ("K"), and the beginning of the Tertiary Period ("T"). (Recall that the Tertiary Period is now splint into the Paleogene and the Neogene Periods). They found that the K-T layer was rich in iridium, an element that is rate on Earth's surface, but common in objects from space such as meteorites. What could this mean?

Other studies showed that K-T boundary rocks from elsewhere, especially in North America, contain a type of deformed quartz called shocked quartz, along with glassy beads called spherules. Shocked quartz can form when powerful pressure waves move through rocks, and spherules form when spherules when rock vaporizes, then solidifies. They put these clues together with other evidence. In 1991, scientists discovered a huge crater just off the Yucatan peninsula, where an asteroid had punched through the floor of the Gulf of Mexico.

Some of the evidence from the K-T boundary is summarized in the table below.

Evidence from the K-T Boundary

Rock Layers	Observations
Beneath the K-T Boundary	• Contains fossils from a wide variety of dinosaurs, as well as other animals and plants • Thick rock layers are relatively uniform, indicating consistent conditions over millions of years
At the K-T Boundary	• Rocks are high in iridium • Rocks in North America contain shocked quartz and spherules
Above the K-T Boundary	• No fossils from 80% of Cretaceous animal species, including all dinosaur species • Fossil pollen shows 60% fewer plant species than during the Cretaceous period • Fossils of small animals are common

Based in part on this evidence, the Alvarez team and other scientists propose the following hypothesis for the K-T mass extinction.

- For millions of years near the end of the Cenozoic era, Earth's climate was relatively constant. Dinosaurs lived in many places around the world and were diverse and numerous.
- About 65 million years ago, an asteroid struck Earth, in the region that is now Mexico's Yucatan peninsula. The asteroid strike raised the world. Sudden changes to the climate and other environmental factors caused most species to go extinct.
- Within 10 million years of the asteroid strike, mammalian diversity exploded, as surviving mammals evolved and filled the ecological niches left empty by the extinct dinosaurs.

Final Product(s): What will you answer? What will you create? What will you communicate?

1. How do observations of the K-T boundary support the conclusion that an asteroid hit Earth about 65 million years ago?
2. Why might spherules and shocked quartz be common in the K-T Boundary rocks in North America, but not other continents?
3. Evaluate the evidence presented as support for the Alvarez hypothesis about the K-T extinction. Does this evidence support this hypothesis? Search for other scientific evidence about the K-T extinction that appears to support your alternate hypothesis. What does your research tell you about the current scientific consensus about this extinction?
4. After the extinction, mammals underwent a dramatic adaptive radiation from a few, mostly small species to the large-bodied, diverse forms we know today. Explain how a change in the environment made this possible.

Scenario 2:

Would the de-extinction of species always turn into "Jurassic Park"?

Adapted from Newsela.com By Washington Post, adapted by Newsela staff

Published:04/24/2019

A life-size skeleton model of a Tyrannosaurus rex dinosaur stands in a new exhibit called "T. Rex: The Ultimate Predator" at the American Museum of Natural History, March 4, 2019, in New York City. Photo by: Drew Angerer/Getty Images

On a cold night in January, a Harvard University professor stood on stage in a theater in New York City, with an iconic environmentalist beside him. Both men were staring down a problem. How could they convince their peers on the stage, along with the 300 people at Hunter College's Kaye Playhouse for a debate, that the world should bring back Velociraptors? Could they sway them to at least bring back an extinct pigeon?

The theme song from the 1993 blockbuster "Jurassic Park" was playing in the background, setting the scene. In the film, based on the 1990 Michael Crichton book, dinosaurs are brought back from extinction to fill a theme park. "That film took sides. The experiment blows up. People get hurt," moderator John Donvan told the crowd. "But not before actor Jeff Goldblum declares, 'Scientists were so preoccupied with whether or not they could that they didn't stop to think if they should.' And then, a dinosaur eats Jeff Goldblum."

Actually, a dinosaur does not eat Goldblum's character, but chaos certainly reigns in the movie and its sequels because of de-extinction. Those images are what George Church and Stewart Brand would need to overcome to win the debate.

Genetic Rescue

Brand started by saying controversy around de-extinction is "made up." He wasn't saying they should resurrect meat-eating dinosaurs. Instead, he said, de-extinction could be achieved through hybrids, or

animals created from living, endangered species and extinct ones, using CRISPR. The term is an acronym for a tool that has been likened to "playing God" because it allows scientists to remove and replace genes. Eventually, CRISPR could be used to boost agricultural production or to replace wildlife that's slowly disappearing. Which is the goal of the Revive & Restore project, a California nonprofit co-founded by Brand that seeks to use new methods of "genetic rescue for endangered and extinct species." The group is working to reintroduce the extinct passenger pigeon into the wild as well as something similar with woolly mammoths, editing the extinct creature's genes into those of modern Asian elephants. In that case, the goal is to increase the population of endangered Asian elephants, which has declined because of a virus. "We're not just curing extinction," Brand told the audience. "The technology that de-extinction is leading the way in is now being used by us and by others to prevent extinction."

In 2018, Brand and Church traveled to Siberia, where Russian scientists are attempting to re-create the grassland ecosystem where woolly mammoths once lived. As the number of mammoths declined, foliage took over grassland. To restore it, scientists have knocked down trees and shrubs and brought in plant eaters, including elk and moose, to graze and keep back the foliage. Church said mammoth-and-Asian-elephant hybrids could once again inhabit Russia.

A hybrid mammoth, roaming Russia today, raises all sorts of questions, opponents of Brand and Church, Rothschild and MacPhee said. Would this hybrid be released into a world with no natural predators? How would a mammoth know how to be a mammoth without other mammoths around? "You've got all the problems of not having a mom" and not having other animals to learn from, Rothschild said. These animals "will be suffering for something that we could be solving a different way," she said.

Ethics Concerns

An audience member asked if someone wealthy could be moving forward with the technology, possibly for commercial purposes, while scientists were debating whether they should. Brand said there was nothing happening in the de-extinction world that had commercial purposes. MacPhee, in response, asked, "You don't think there's a future in having saber-toothed tigers that you can use for hunting purposes?"

Rothschild took the argument further, wondering whether someone could attempt to de-extinct a Neanderthal for commerce or simply in the name of science. The idea, Rothschild said, was morally wrong. "We have enough trouble with humanity recognizing that we have roughly equal intellects across the races. And to purposefully re-create a species that we know is going to be inferior in some way is just asking for enormous trouble," she said. In the end, based on the votes tallied before and after the debate, more people came around to MacPhee and Rothschild's side than Church and Brand's. For once, the Jeff Goldblums won.

Final Product:

1. According to the article, the benefits of de-extinction could extend beyond just bringing back extinct animals. What would some of the benefits be? Use evidence from the text.

2. Choose one of the following questions and write a paragraph defending your opinion.

Adapted from http://sciencenetlinks.com/student-teacher-sheets/de-extinction-writing-assignment/

- Is it ethical to bring back an extinct organism and reintroduce it into the wild?
- Is right to focus on saving organisms that provide some value or benefit to humans?
- Is it more important to focus our effort on preventing future extinctions rather than resurrecting extinct animals?

Week Review/ Remediation/ Enrichment Options