

Reverse Evolution Machine Educator Guide



A resource for using QUEST video in the classroom

Watch online at <http://www.kqed.org/quest/television/view/547> | 8:56 minutes

QUEST SUBJECTS

Life Science	Biology Health Environment
Earth Science	Geology Weather Astronomy
Physical Science	Physics Chemistry Engineering

PROGRAM NOTES

Move over paleontologists, there's a new dinosaur detective in town. Dr. David Haussler of UC-Santa Cruz has created a new method of detecting dinosaur DNA, called "computational genomics." Join Dr. Haussler as he takes us on a dinosaur adventure of a different sort.



In this segment you will find...

- an innovative way of discovering dinosaur DNA.
- why Jurassic Park methods don't work.
- an explanation of the genome.

CA SCIENCE STANDARDS

Grade 9-12

Evolution

8. Evolution is the result of genetic changes that occur in constantly changing environments. (a, b, e, f)

TOPIC BACKGROUND

Traditional paleontologists use picks and shovels to dig up fossils and examine their form and structure, or morphology, over time. Now there's a new way to look at the past and discover information about the animals and plants that lived long ago.

This new tool is computational genomics. It uses DNA (deoxyribonucleic acid) and RNA (ribonucleic acid) to unravel the genomes of animals to discover how they have changed over time. The method entails looking at the DNA of animals living today and working backward to see what the DNA must have looked like millions of years ago.

A genome is all of the genetic material contained in an organism, including its DNA, genes and chromosomes. DNA is the building block of all living things. It carries the information needed to make the proteins that every organism requires for life. These proteins determine an organism's appearance, health and sometimes behavior. DNA is a molecule composed of two strands of many chemical compounds, called nucleotides, linked together to form a chain. The chains are arranged in the shape of a double helix, which resembles a twisted ladder. The nucleotides are made up of three units: a sugar molecule called deoxyribose, a phosphate group, which makes up the sides of the "ladder," and four bases, called adenine (A), guanine (G), thymine (T) and cytosine (C), which form the "rungs" of the ladder. The kind of organism, whether plant or animal, is determined by the arrangement of the four bases. It is the infinite number of possible combinations of these bases that give life on Earth so much variety.

Researchers like Dr. Haussler study not only the human genome but also the genomes of all kinds of organisms in order to reconstruct what their size, shape, behavior, and so forth might have been like in the past, in order to compare them to those characteristics in organisms today.

Media Enhance Education

Video and audio can be powerful tools for meaningful learning. It all depends on you, the educator. The key to using media effectively is preparation. Make the most of learning opportunities by encouraging students to become active viewers and listeners. Pick and choose from the suggested questions and activities to offer an engaging media experience.

Questioning

Oftentimes, teachers and students become frustrated during a media segment when students can't find the answers to a long list of questions. Provide a limited number of questions or topics for students. This focuses their attention during a media segment, helps to keep them engaged and generally results in higher quality answers. QUEST Ed. has provided a number of options for focus questions ranging from fact based to opinions, as well as "big picture" ideas.

PRE-VIEWING

- How do scientists find out information about dinosaurs and other fossils?
- What do you call scientists who dig for fossils?
- What is a genome?
- What tools do scientists like Dr. Haussler use in their search for dinosaur DNA?

VIEWING FOCUS

NOTE: You may choose to watch the television segment twice with your students: once to elicit emotional responses and get an overview of the topic and again to focus on facts and draw out opinions.

- What is paleontology?
- What is computational genomics?
- How is the traditional study of paleontology different from computational genomics?
- What is the aim of Dr. Haussler's research?
- What tools does he use in his search for dinosaur DNA?

POST-VIEWING Links to activities mentioned here can be found on the following page.

- **Review** students' answers to the Viewing Focus Questions.
- **Read** "A New Method Can Reveal Ancestry of All Genes Across Many Different Genomes" **Science Daily**
<http://www.sciencedaily.com/releases/2007/09/070911155206.htm>
- **Watch** the video "Cracking the Code of Life" to discover insights into the race to map the entire human genome.
- **Learn** about the segments of genomes from various animals by reading the article "Comparing Genomes" by George Johnson. Discuss the similarities and differences among the animals.

Real dinosaur DNA from the Jurassic period is too fragile to survive for 200 million years.

LESSON PLANS / ACTIVITIES

Dinosaur Detectives Discovery Education

<http://school.discoveryeducation.com/lessonplans/programs/dinosaurdetectives/index.html>

- Find out how paleontologists add their own work to the evidence of the fossil record.

The Human Role in Dog Evolution National Geographic Xpeditions

<http://www.nationalgeographic.com/xpeditions/lessons/08/g912/dogsevolution.html>

- Students look at the genetic similarities and differences between wolves and dogs and the role of humans in their domestication.

WEB SITES



University of California Museum of Paleontology

<http://www.ucmp.berkeley.edu/>

- Find lots of information about evolution, paleontology and the latest research on this Web site.

The Gee! In Genome

http://nature.ca/genome/index_e.cfm

- This Web site has a variety of lessons and activities on genomics, including "We Are All Alike" and "The Basics."

ARTICLES / READING

Schweitzer's Dangerous Discovery Discover Magazine

<http://discovermagazine.com/2006/apr/dinosaur-dna>

- This article details what happened when a paleontologist found soft, fresh-looking tissue inside a T-rex femur.

Comparing Genomes Dr. George Johnson's Backgrounders

<http://txtwriter.com/Backgrounders/Compgenomes/compgenomes1.html>






- Backgrounders provide a detailed introduction to issues of current interest. They are intended to allow you to explore topics of particular interest to you in depth, without getting lost in technical jargon or having to wade through a textbook.

Look for the



indicating resources from QUEST partner organizations

QUEST QUAD

FIELD NOTES 	FIELD TRIP 
<p>Go outside and ...</p> <ul style="list-style-type: none">Go on a scavenger hunt for dinosaurs http://www.uwm.edu/People/skurutz/Index.htm	<p>Visit ...</p> <ul style="list-style-type: none">The University of California's Museum of Paleontology <ul style="list-style-type: none">To better understand paleontologists and how they work, you can take a virtual visit here: http://www.ucmp.berkeley.eduA local museum that has a dinosaur exhibit
FIELD RESEARCH 	FIELD TEST 
<p>Find out more about...</p> <ul style="list-style-type: none">Paleontology<ul style="list-style-type: none">Check out the frequently asked questions page on the University of California Museum of Paleontology's Web site. http://www.ucmp.berkeley.edu/faq.php	<p>Experiment with...</p> <ul style="list-style-type: none">Placing various dinosaur bones in sand and exploring what it's like to hunt for dinosaurs.<ul style="list-style-type: none">Compare their similarities and differences.

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www.bay.org

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www.calacademy.org

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www.chabotspace.org

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www.ebparks.org

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www.exploratorium.edu

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www.girlscoutsnorcal.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

The J. David Gladstone Institutes
www.gladstone.ucsf.edu

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Monterey Bay Aquarium
www.mbayaq.org

Monterey Bay Aquarium Research Institute
www.mbari.org

Oakland Zoo
www.oaklandzoo.org

The Tech Museum of Innovation
www.thetech.org

UC Berkeley Natural History Museums
<http://bnhm.berkeley.edu/>

U.S. Geological Survey
www.usgs.gov

MORE EDUCATIONAL RESOURCES FOR USING QUEST MULTIMEDIA TO ENHANCE 21ST CENTURY SKILLS IN TEACHING AND LEARNING

Why Use Multimedia in Science Education?

<http://www.kqed.org/quest/downloads/QUESTWhyMedia.pdf>

- Read about the importance of using multimedia in the 21st century science classroom.

How to Use Science Media for Teaching and Learning

<http://www.kqed.org/quest/downloads/QUESTMediaTips.pdf>

- A collection of tips, activities and handouts to actively engage students with multimedia.

Science Multimedia Analysis

<http://www.kqed.org/quest/downloads/QUESTMediaAnalysis.pdf>

- Give your students the tools to recognize the purposes and messages of science multimedia.

Create Online Science Hikes with Google Maps

http://www.kqed.org/quest/files/download/52/QUEST_ExplorationCreation.pdf

- Do you like the science hike Explorations on the QUEST site? Use this place-based educational guide to create similar science-based maps with youth.

OTHER WAYS TO PARTICIPATE IN QUEST



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www.kqed.org/quest



LISTEN

KQED 88.5 FM San Francisco &
89.3 FM Sacramento
Mondays at 6:30am and 8:30am



WATCH

KQED Channel 9
Tuesdays at 7:30pm

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