

The Rap Guide to Evolution

Key concepts:

- **Natural selection** is an algorithm with three parts: **variation, differential reproduction, heredity. (Differential reproduction is often referred to as “selection”)**
- **Unity of common descent** means that all living things share a single-celled common ancestor billions of years in the past. All living things are therefore “cousins” or branches on the tree of life.
- **We are all Africans**, since humans are all part of one species which has its roots in Africa less than 100,000 years ago. Hence, racial differences are literally skin-deep.
- **Cultural Evolution** works very similarly to biological evolution, with hip-hop culture being one example. The artists that become famous (ie the most “fit” in terms of success in reaching an audience) do so because of the “selections” made by their fans.
- **Sexual Selection** is the product of competition for mates rather than for survival. In nature, competition for mates produces ornaments like elaborate feathers and antlers. In culture, it produces fashion ornaments like bling and high heels.
- **Violence can be adaptive**, since many forms of violence are specifically intended to dominate rivals, take their resources, and defeat them in a competition for mating opportunities, all of which would be selected by evolution.
- **Non-violence and cooperation can also be adaptive**, and the difference has to do with environmental context, and which strategy best promotes the interests of the organisms involved.
- **Knowledge is power**, since a clear understanding of evolution can help us to avoid the pitfalls and vicious cycles that are part of its legacy, while steering ourselves towards the innovation, cooperation, and increasing human wellbeing that are also part of its legacy.

Excercises

Artificial Selection

Show the class this video: <http://rapguidetoevolution.co.uk/artificial-selection>

1. **Variation** is found in the styles on display
Rappers all have different techniques when they're on stage
And the results can be seen in the audience's face

Question: What kind of “results” are seen in the faces (or consumer behavior) of hip-hop audiences, and how does this influence the styles and techniques and ultimate success of rappers?

2. This is the rap version of the “Doctrine of Malthus”
The proportion of hungry mouths to food resources
In the form of captive audiences

Question: What is the “Doctrine of Malthus” and how did it influence Darwin's work? The hip-hop analogy Baba makes is to the Fugees' observation that there are “Too many MCs, not enough mics.” How is this similar to Darwin's insight? How is it different?

Bonus exercise: assign students to add their own original “annotations” and explanations to Baba’s lyrics at RapGenius.com: <http://rapgenius.com/Baba-brinkman-artificial-selection-lyrics>

Assign students to report on the annotations they added. Do they agree with the annotations other users have already contributed? Do they disagree? Why? (Hint: there are serious errors in the current set of comments).

I’m A African

Show the class this video: <http://rapguidetoevolution.co.uk/i'm-a-african>

Ask the class to discuss / consider the key scientific point Baba is making in the following rhymes. Depending on the class, you could review the key scientific concepts & terms (in **bold**) and ask them to give similar analogies.

1. Check the massive evidence of Homo Erectus
And Australopithecus afarensis in the fossil record
And then try to tell me that we’re not all connected
The fossil record has **gaps, but no contradictions**

Question: What does it mean for a collection of evidence to have “gaps but no contradictions”

2. I wasn’t born in Ghana but Africa is my mama
‘Cause **that’s where my mama got her mitochondria**

Question: What is mitochondria and how is it inherited?

Bonus exercise: assign students to add their own original “annotations” and explanations to Baba’s lyrics at RapGenius.com: <http://rapgenius.com/Baba-brinkman-im-a-african-lyrics>

Assign students to report on the annotations they added. Can they find new or independent sources for the information and annotations found on [Baba’s website](#)? Can they improve on those annotations? (Hint: the annotations on rapguidetoevolution.co.uk were written by Baba and his science consultant Djuke Velduis, a Cambridge PhD in bio-anthropology, but they are not complete).

Notes:

1) More advanced students might consider, what causes a rap artists to thrive. Is it down to the rappers’ *genes*? Their *environment*? The whim of the public? Have students suggest examples of rappers who got very famous and other rappers who failed to leave their mark, and discuss why.

2) Are there ‘universals’ that artists have to adhere to in order to ‘make it’ (i.e. *survive to reproduce* make records and stay in business) regardless of time and place, or are they culturally-dependent. (Examples of universals might be an emphasis on risqué or daring behaviour to appeal to a younger audience, use of sex and violence as attention-grabbing subject matter, use of devices like comedy, lyricism, and storytelling to capture an audience, etc)

3) Charles Darwin’s theory of evolution by means of natural selection is currently the only well-supported theory for explaining the complexity of life, but it is still being tested and refined as new evidence is discovered. This provides an opportunity to discuss the evidence that we have for natural selection occurring e.g.

- The ongoing struggle between disease and our immune systems:
<http://news.sciencemag.org/sciencenow/2012/04/natural-selection-is-still-with-.html>
- Our ability to digest milk by virtue of the enzyme lactase:
http://www.slate.com/articles/health_and_science/human_evolution/2012/10/evolution_of_lactose_tolerance_why_do_humans_keep_drinking_milk.html
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3) Have students discuss the difference between a “theory” in the scientific sense (ie an explanatory framework used to account for a diverse set of facts and observations while generating new hypotheses that can be tested) and a “theory” in the common vernacular sense (ie a hunch or conjecture).

What’s the evidence?

Questions to ask students:

1. How does the process of natural selection work?
See e.g. http://evolution.berkeley.edu/evolibrary/article/evo_25
2. How was Darwin’s theory received? By the public? By Christians? By scientists?
See e.g. http://www.christs.cam.ac.uk/darwin200/pages/index.php?page_id=d7
3. How might different species affect each other’s evolution?

Teachers aiming for KS3/4 may find the following hands-on exercises illustrated in this video helpful:
<http://www.tes.co.uk/teaching-resource/KS3-4-Science-Teaching-Evolution-6047753/>

Quiz (true or false?)

1) Darwin was the sole originator of the theory of natural selection?

FALSE: Alfred Russell Wallace was also instrumental. as one of the 19th century's most remarkable intellectuals. Not only did he co-discover the process of evolution by natural selection with Charles Darwin in 1858, but he also made very many other significant contributions, not just to biology, but also to subjects as diverse as glaciology, land reform, anthropology, ethnography, epidemiology, and astrobiology. For more information see:

2) Darwin developed his theory without any knowledge of Mendel’s work on heredity

TRUE: Darwin was unaware of Mendel’s work on inheritance of traits using pea plants.

3) Evolution stops once a species becomes a species.

FALSE: Evolution does not stop once a species becomes a species. Every population of living organisms is undergoing some sort of evolution, though the degree and speed of the process varies greatly from one group to another.

4) Darwin fought against religion

FALSE: Many have seen the evolutionary theory as an attack on religion, where the fight was between God and Darwin. It is a widespread mistake that Darwin intended to harm religion or religious belief. His work was about raising awareness of life on earth on a scientific basis. See:
<http://www.darwinarkivet.dk/en/myths/the-atheist/>

Notes:

More common misconceptions and explanations relating to *The Origin of Species*, the theory of natural selection and the life and times of Charles Darwin can be found here

http://evolution.berkeley.edu/evolibrary/article/evo_32 and <http://www.newscientist.com/article/dn13620-evolution-24-myths-and-misconceptions.html>

Interactive

Activity 1:

Debate – ask the students to split into even numbered groups and ask them to consider whether scientific knowledge can spread as **meme**. What about *fashion* or *music*?

For more advanced classes, you might like them to debate for/against the notion that “The success of religion in terms of its ability to be adopted by millions of people, is in itself a cultural variant of *natural selection* in action.”

Activity 2:

Weak and strong – the concept of the ‘weak’ and the ‘strong’ comes up frequently in Baba’s *Natural Selection* rap.

Ask students to discuss what the problems are with describing species or individual organisms in this way?

Activity 3:

Have students add annotations to Baba’s other Rap Guide to Evolution lyrics in accordance with their preference, and report on their findings. All of the rapgenius lyrics can be found here:

<http://rapgenius.com/albums/Baba-brinkman/Rap-guide-to-evolution>

Online resources / library

- The Wellcome Trust website has expansive materials and articles to help teachers bring evolution into the class room: <http://www.wellcome.ac.uk/Education-resources/Teaching-and-education/Big-Picture/All-issues/Evolution/index.htm> These include teaching notes and topic guides: <http://www.wellcome.ac.uk/Education-resources/Teaching-and-education/Big-Picture/All-issues/Evolution/Teachers-resources/index.htm>

In relation to “Natural selection” the following might be of interest:

- Balancing selection: <http://www.wellcome.ac.uk/Education-resources/Teaching-and-education/Big-Picture/All-issues/Evolution/Articles/WTD026064.htm>
- Do religious beliefs provide a selective advantage? <http://www.wellcome.ac.uk/Education-resources/Teaching-and-education/Big-Picture/All-issues/Evolution/Articles/WTD026070.htm>
- Directed evolution / artificial selection: <http://www.wellcome.ac.uk/Education-resources/Teaching-and-education/Big-Picture/All-issues/Evolution/Articles/WTD026063.htm>

- The 'Understanding Evolution' site is great for all sorts of easily accessible facts and information which can be adapted to suit a variety of teaching needs:
<http://evolution.berkeley.edu/>
- The Smithsonian also provides sets of teaching plans for a variety of grades:
<http://humanorigins.si.edu/education/lesson-plans>