

Welcome to Lecture #2, Weds, May 8

Our goals today

- 1. We want to expand our understanding of evolutionary process**
 - Special attention to biology
 - More scientific detail
 - Will complement the understanding we gained from
 - » Evolution in Action examples (Monday)
 - » Prisoner's Dilemma game and NIPD game (Mon, Tues)
- 2. We want to start to investigate a specific evolutionary process in more detail**
 - We have some examples: Evolutionary “Gems”
 - We will use an active learning method
 - » Think, Pair, Share

NOTE

- **Unintended Python exercise**
 - The code `EVO_NIPD.py` has a inverted payoff matrix
 - Please correct the values in order to get the intended performance

Wednesday Agenda

- **Evolutionary biology**
 - Evolution Definition
 - Brief history
 - Variation
 - Inheritance
- **Evolutionary Gems Discussion**
 - Dr. Una-May will outline briefly some specific evolutionary processes
 - You will choose one “Gem” to study in more detail
 - “Think”: You will read information on your “Gem”
 - “Pair”: You will pair up and discuss your “Gems” today
 - » May have to happen outside class
 - You can ask more questions during Office Hours
 - Wednesday 1400 – 1700, 1930 - 2130
 - Thursday 1800 – 1900
 - “Share”: Friday, you will orally present your “Gem” to class

Poll

- How many have studied biology?
- How many know who Charles Darwin is?
- How many have studied evolutionary biology?

Evolution in the Oxford English Dictionary

- The process by which different kinds of living organisms are thought to have developed and diversified from earlier forms during the history of the earth.
- The gradual development of something, especially from a simple to a more complex form: *the forms of written languages undergo constant evolution*
- *Chemistry* the giving off of a gaseous product, or of heat.
- Pattern of movements or maneuvers: *silk ribbons waving in fanciful evolutions*
- *Mathematics, dated* the extraction of a root from a given quantity.

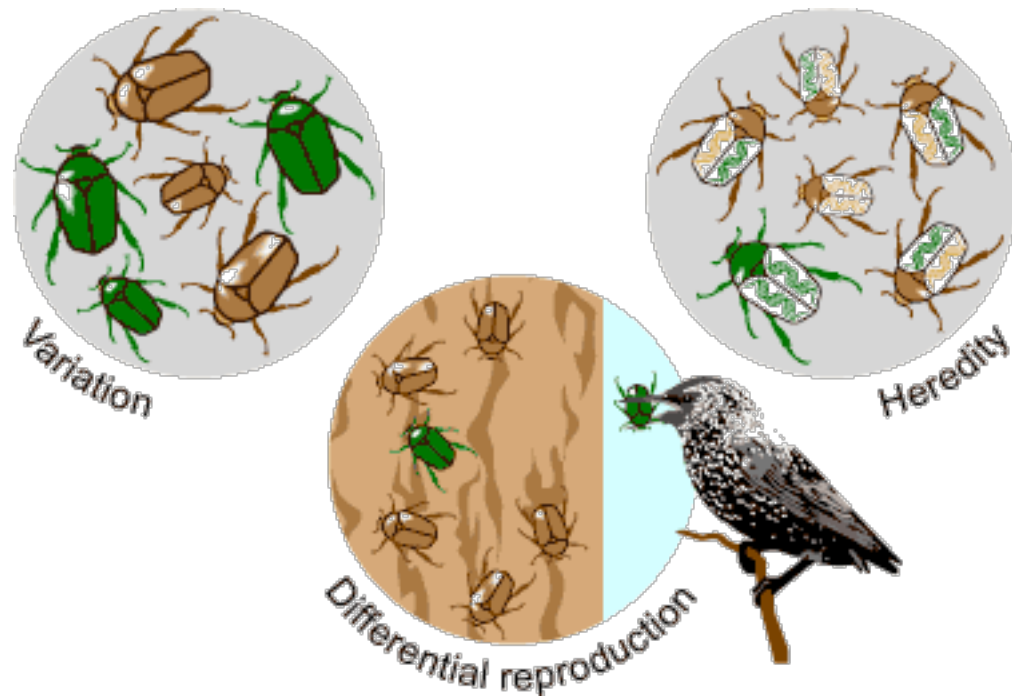
- Origin: early 17th century: from Latin *evolutio(n-)* 'unrolling', from the verb *evolvere*. Early senses related to physical movement, first recorded in describing a tactical “wheeling” maneuver in the realignment of troops or ships. Current senses stem from a notion of “opening out” and “unfolding,” giving rise to a general sense of 'development'

Darwin's Theory Of Evolution

- **A series of causal element working together produce transformations:**
 - Species vary ever so slightly in respect to their many traits
 - Species tend to exponentially increase in size over generations
 - The exponential increase in combination with limited resources, disease, predation creates a constant struggle for survival among the members of the species
 - Some individuals have variations that will give them a slight advantage in the struggle
 - These individuals tend to survive better and leave more offspring
 - Offspring tend to inherit the variations of their parents
 - Therefore favorable variations will be passed on more frequently, “Natural Selection”
 - Overtime the character of the species will change
 - After long enough time the the descendants are so different they will be classified as a new species

Example of Evolution

- Variation of individuals
- Variation leads to different reproduction rates
- The traits are passed from parent to offspring



Evolution Breakdown

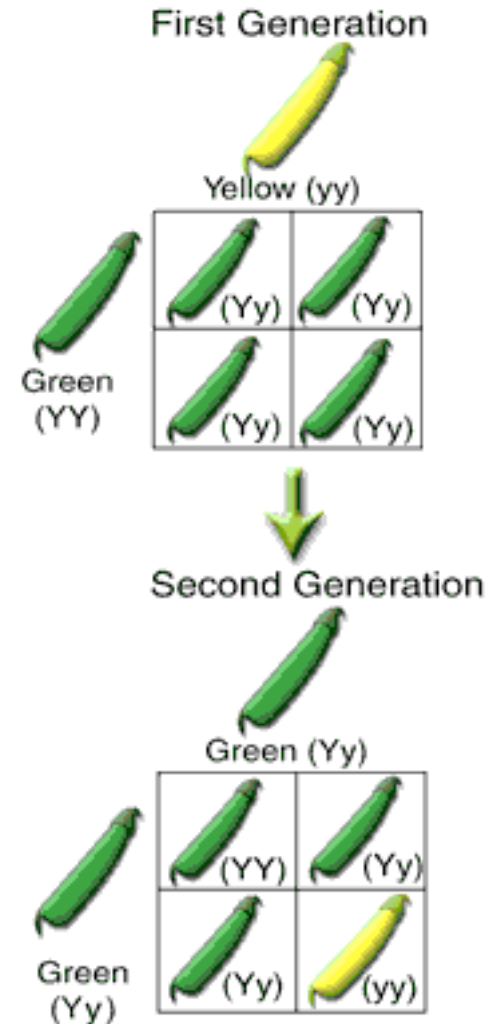
- The theory of evolution makes statements about three different, though related, issues:
 - (1) the fact of evolution—that is, that organisms are related by common descent;
 - (2) evolutionary history—the details of when lineages split from one another and of the changes that occurred in each lineage; and
 - (3) the mechanisms or processes by which evolutionary change occurs.
- [Theodosius Dobzhansky](#), “Nothing in biology makes sense except in the light of evolution.”

Elements Required for Evolution

- **The Units of Selection Author(s): R. C. Lewontin**
Source: Annual Review of Ecology and Systematics, Vol. 1 (1970), pp. 1-18
- **The individual struggle for existence has three principles:**
 - Variation between “individuals”
 - Differential fitness, i.e. different rates of survival and reproduction for different “individuals”
 - Heritability of fitness. No particular mechanism of inheritance needs to be specified, only a correlation in fitness between parent and offspring

Inheritance of Traits

- Some organisms have two chromosomes
- Genes are dominant or recessive
 - Genetic variation is measured through proportion of heterozygotes in a population
 - » In a heterozygous individual the two genes for a trait, one received from the mother and the other from the father, are different.
 - » The proportion of heterozygotes in the population is, therefore, the same as the probability that two genes taken at random from the gene pool are different.



Mary S. Gibbs (GNN)

Gems Agenda

1. Dr. Una-May will outline briefly some specific evolutionary processes
2. You will choose one “Gem” to study in more detail
3. Start Active Learning
 - Think, Pair, Share

1. GEMS Introduction

Using Fossil Record (3)

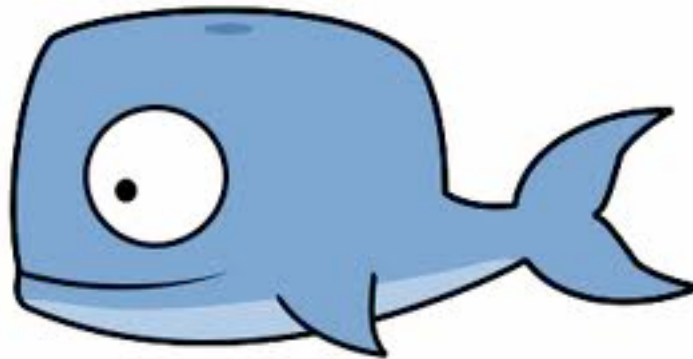
1. Land-living ancestors of whales
2. From Water to Land
3. The Origin of Feathers

Habitat Study (6)

6. Natural selection in speciation
7. Natural selection in lizards
8. A case of co-evolution
10. Selective survival in wild guppies
11. Evolutionary history matters
12. Darwin's Galapagos finches

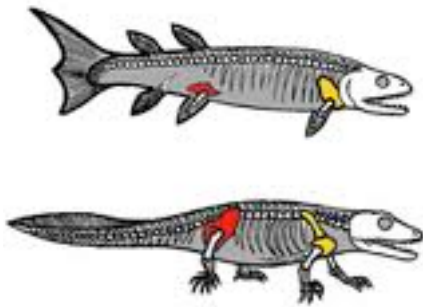
1. Land-living ancestors of whales

- Whales are mammals not fish
- How did they evolve to leave land and go into water?
 - Why?



2. From Water to Land

- **Tetrapods**
 - Vertebrates living on land
 - Evolved from fish
 - Adapted for life out of water
- Did tetrapods have legs then move to land?
or
- Did tetrapods move to land then evolve legs?



<http://askabiologist.asu.edu/plosable/fish-out-water>

3. The Origin of Feathers



- How does a major group of animals evolve to another?
- For example: Birds
 - Did they come from dinosaurs?
- What conclusion does fossil record support?

- <http://scienceblogs.com/tetrapodzoology/2008/10/23/epidexipteryx-at-last/>

6. Natural selection in speciation

- **A (new) species:**
 - variations of same species can not reproduce with each other any more
- **What forces in nature drive evolution of new species?**
 - Is it environment?
 - Answer for the stickleback fish



http://fish.dnr.cornell.edu/nyfish/Gasterosteidae/threespine_stickleback.jpg

7. Natural selection in lizards

- Can a prey shift behavior to avoid predator?
- Will this help it avoid natural selection?
- Prey: small lizard: *Anolis sagrei*
- Predator: big lizard: *Leiocephalus carinatus*



http://upload.wikimedia.org/wikipedia/commons/f/f0/Anolis_sagrei_reproduction.jpg



http://upload.wikimedia.org/wikipedia/commons/fff/Leiocephalus_carinatus_armouri_FL.jpg

8. A Case of co-evolution

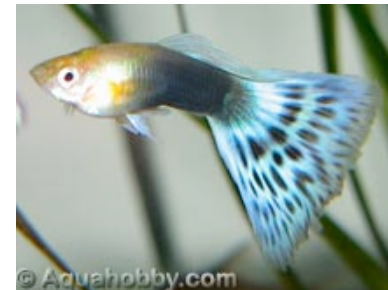
- Water fleas and microscopic parasites
- Evolutionary arms race
- As water fleas get better at evading parasitism, the parasites get better at infecting the fleas



http://www.mblaquaculture.com/assets/images/content/photo_Daphnia_magna.jpg

10. Selective survival in wild guppies

- Evolution can narrow diversity
 - We saw fewer strategies in NIPD game
- But...there is still lots of variation in population!
- How?
 - Frequency dependent survival
 - Example of guppies and their color patterns



http://www.aquahobby.com/gallery/e_Fancy_Guppy_Poecilia_reticulata.php

11. Evolutionary history matters

- How did an eel evolve its fish mouth while it also evolved a long, narrow body?

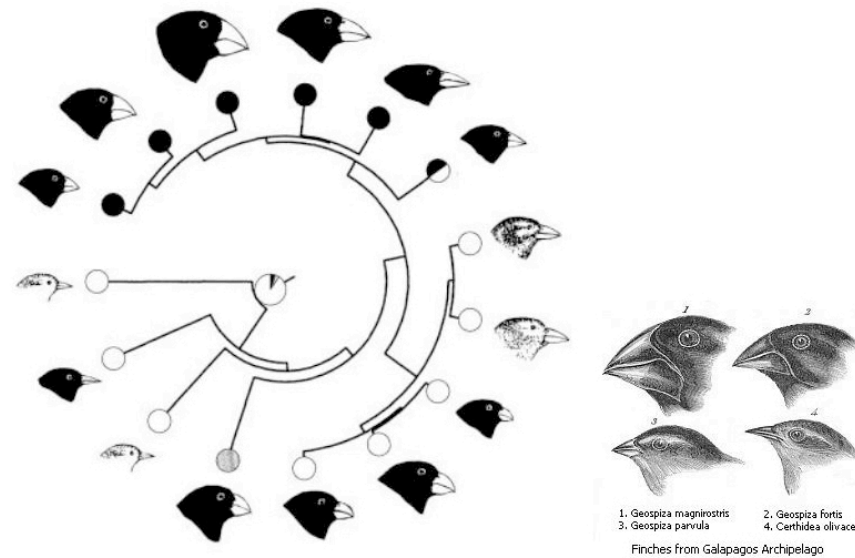


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http://1.bp.blogspot.com/-AIVpUu6hFj8/TdDPpUgiFrI/AAAAAAAAUY/aFcDskUmqBg/s1600/moray_eel_img_2426.jpg

12. Darwin's Galapagos finches

- Just look at first paragraph of gem
- How can evolution of small differences in a finch's beak lead to new species?



<http://www.science.ca/scientists/scientistprofile.php?plD=444&pg=1>

2. Choose a GEMS

- **Get the full document**
 - Email or on lab's computers
 - Also at
<http://www.nature.com/nature/newspdf/evolutiongems.pdf>
- **Email Meijuan your choice by noon, Weds**
 - Send her # and title, your name

3. Gems Active Learning

- **“Think”**: You will read information on your **“Gem”**
 - This will be challenging
 - » Vocabulary: circle and look up words
 - » What is point of article? What is it trying to say?
 - » What should you say to others about this example?
 - Make it relevant to our class
 - Why is it interesting?
- **“Pair”**: You will pair up and discuss your **“Gems”** today or tomorrow
 - Must happen outside class
- **“Share”**: Friday, you will orally present your **“Gem”** to class
- You can ask more questions during Office Hours
 - » Wednesday 1400 – 1700, 1930 - 2130
 - » Thursday 1800 – 1900

Expectations on “Gem” Active Learning

- **“Pair”**: minimum 5 minutes of good discussion each (10 total)
 - Help each other!
 - Don’t pick partner with same gem!
- **“Share”**
 - **ORAL Presentation**
 - » Speak loudly and clearly to ***EVERYONE***
 - » introduce yourself first
 - **Make one PPTX slide**
 - » maximum 20 words on 1 slide
 - » Convert to PDF and send to Meijuan before 7am on Friday!
 - **USE Diagram, figures or Pictures!**
 - » Images from internet
 - » Draw and take photo with cell phone, put on PPTX
 - **REHEARSE**
 - » have a friend listen
 - » More than once!
 - 1-1.5 minutes maximum
 - Optional: be relaxed, funny, yourself!

Wednesday's Learning Outcomes

From today's lecture:

- More knowledge of biological evolution
- Brief introduction to different specific evolutionary processes
- Ready to work on a evolutionary “gem”

Wednesday Journal Entry

Use these questions to guide today's journal entry

- Be brief
- Sketch or bullets
- A journal is a diary
- Make an entry for each day (Monday, Tuesday, Weds, Thursday)
- How does more information on biological evolution extend your understanding of evolution?
- Do you have more examples of evolutionary process now?