Evolution: The Darwinian Revolutions

BIOEE 2070 / HIST 2870 / STS 2871

DAY & DATE: Monday 25 June 2012
READINGS: None (yet)
Lecture 6:00-7:20: Darwin's Dangerous Idea
Section 7:30-9:00: The Natural Selection Game

Announcements:

- **Several of the course textbooks and readings are available for free online:**

  ***On the Origin of Species…(*first edition) available at:**
  http://darwin-online.org.uk/content/frameset?itemID=F373&viewtype=side&pageseq=1

  ***The Autobiography of Charles Darwin*, available at:**
  http://darwin-online.org.uk/content/frameset?itemID=F1497&viewtype=side&pageseq=1

  MacNeill/Evolution: The Darwinian Revolutions, available at the course website:
  http://evolution.freehostia.com/

  Cosmides & Tooby/"Evolutionary psychology: A primer," available at:
  http://www.psych.ucsb.edu/research/cep/primer.html

- **There is a course website, located at:**

  http://evolution.freehostia.com/

All of the course materials, including handouts, lecture notes, etc. will be available at this website.

Introductions: The Course

Syllabus

Texts

Course Packet

Course Staff:

- **Allen MacNeill**
- **Nirav Patel**

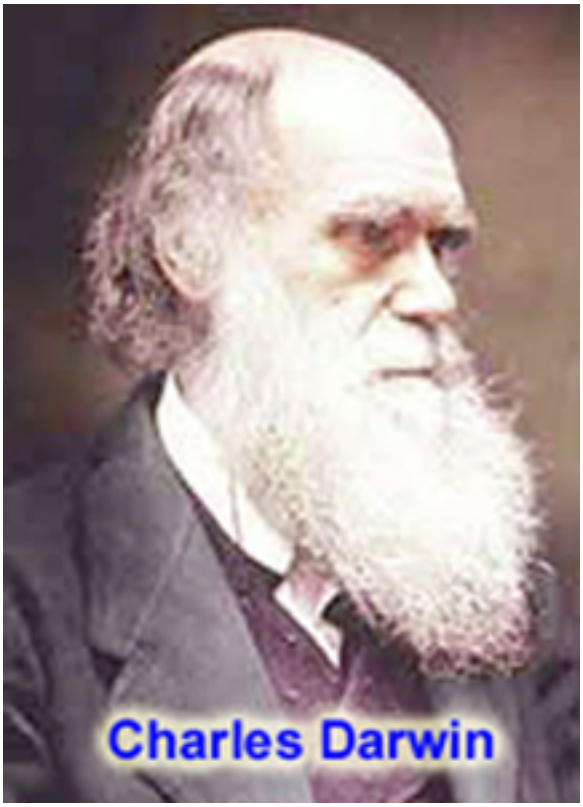
Students:

- **Who are you, where are you from, and why are you here?**

All of us together:

- **A questionable exercise…**
- **What do we want to get out of this course?**

Introduction: Darwin's Dangerous Idea



Daniel Dennett, a philosopher of science, said this about Darwin's theory of evolution by natural selection:

> **"If I were to give an award for the single best idea anyone ever had, I'd give it to Darwin, ahead of Newton and Einstein and everyone else. In a single stroke, the idea of evolution by natural selection unifies the realm of life, meaning, and purpose with the realm of space and time, cause and effect, mechanism and physical law. But it is not just a wonderful scientific idea. It is a dangerous idea."**

Why is it "dangerous"? Because it forces us to answer, as carefully and dispassionately as we can, the most fundamental questions every thinking person has ever struggled with:

- **Who are we?**
- **Where have we come from?**
- **Why are we here?**

and

- **How do we know?**

The answers that the theory of evolution gives to these questions may not be what all of us want to hear. But, they have a quality that most of the answers to these questions lack: they can be found by simply looking at the world around us. To see why, let's begin with the last question first.

How Do We Know?

There is a question we need to get out of the way right in the beginning - that is, are the answers that the theory of evolution provides to those questions "true"? To answer that question, consider the following scenario:

It's the first day of your evolution class, and you're hurrying to get ready. You rush around doing all of those last-minute things - brushing your teeth, finding your campus map, checking to see if you have your textbooks in your backpack, etc. Then, you dash outside and hurry up the street, only to come upon this:

[Cue sound effects: sirens, people talking in hushed voices, a radio popping and growling in the distance, maybe a dog barking, and (of course, this is Ithaca) rain pattering on the sidewalk and road…or maybe it's just the hose that guy is spraying around]

If you're like almost any human being, you stop your headlong rush to class and rubberneck a little. You walk up to the police tape, checking out the wreckage, smelling smoke, and noticing all of the damage.

And then, if you're curious, you begin trying to figure out what happened.

What happened?

If you think about it, there are at least three logically consistent answers to this question:

- **There has been a house fire, which started accidentally.**
- **There has been a house fire, which was set on purpose.**
- **Someone (for example an experienced and well-funded movie director and crew) has just staged what looks like a house fire.**

How can you tell the difference?

Consider:

- **You did *not* witness the event (remember, you came on the scene shown above, presumably *after* the incident happened)**
- **All you have available to you is what you can see (and hear and touch, etc.)**

Let's imagine that relatively few of the people standing around saw the actual event either. And, even if they did, you would have to take their word for what they saw. Furthermore, as you can see, the occupants of the house (assuming there were some) are no longer there, so they can't tell you what happened either.

Given the foregoing, what can you conclude vis-à-vis the three proposed explanations of what happened?

Consider the following questions:

- **Can you be *absolutely certain* that this situation happened "by accident?"**
- **Can you be *absolutely certain* that this situation *didn't* happen "on purpose?"**
- **Can you be *absolutely certain* that this situation has *not* been staged?**

If you answer these questions with the viewpoint of a scientist, the answer to all three of these questions must be NO. All you have to go on is what you can observe, and what you observe is compatible with either of the two explanations proposed.

So, how do you decide which to believe?

The answer, if you are a scientist, is that you provisionally accept the simplest explanation that best fits all that you have observed and experienced in this event and events like it that you have experienced in the past. If you are lucky, you may never have observed a house fire yourself. However, you almost certainly have seen the aftermath of one, either directly or in the form of photographs, movies, videos, etc. And so you make your best guess, based on the information available and what you know from past experience.

Inference

What you are doing when you make a guess like this is inferring that an event that you have not actually observed has, in fact, taken place. This is precisely what the theory of evolution does, and when you apply the theory to the natural world, you are using essentially the same reasoning that you would use to decide whether a house fire had occurred before you left your dorm on the way to class.

Inference is the basis for all reasoning, including scientific reasoning. It's what we will use throughout this course to try to answer the "big questions" we posed at the beginning of this lecture.

Inference and Darwin's Dangerous Idea: A Demonstration

I could go on telling you about the importance of inference in scientific reasoning, and telling you how important Darwin's theory of evolution by natural selection is, and why it should matter to you. But we think it's better to actually get down in the dirt and wrestle with the idea. So, what we're going to do is play a simple little game.

It's called The Natural Selection Game, and was devised about fifty years ago by a famous evolutionary biologist named G. Ledyard Stebbins. There are lots of fancy simulations like it that you can try online, but this one is played on the floor, with pieces of cloth and paper dots. That's what we're going to do, right after we take a short break.

A Natural Selection Game

Consider the following questions:

1) What were your results and what conclusions can you draw from them? Which color morph succeeded and why? Which failed? Why?

2) All scientific investigations include starting assumptions and built-in biases. What were the starting assumptions for this experiment, and can you detect any bias that might have influenced the results?

3) Consider the following thought experiments in natural selection - what outcomes might you expect under the conditions described?

- **If the color differences were less distinct, would you expect the same results? Why or why not?**
- **What if the red dots made the predator very ill? What assumptions must you make about the predator to answer this question?**
- **What if the red dots made the predator very ill, but a new color morph, say reddish-orange, did not? What would happen to red dots? To reddish-orange dots? Why?**

4) Which has the greater effect on adaptation - the organism or its environment?

5) Do you think the same processes occur in nature? Why or why not?

6) What do the results of this experiment tell you about the concept of evolution by natural selection?

- **In particular, do these results support the conclusion that purpose plays a role in evolution by natural selection?**
- **For example, are the white dots that survive in the all white environment white "in order to survive being eaten" and therefore "to ensure the survival of white dots?"**