Scientific Categories

Whole Chicken
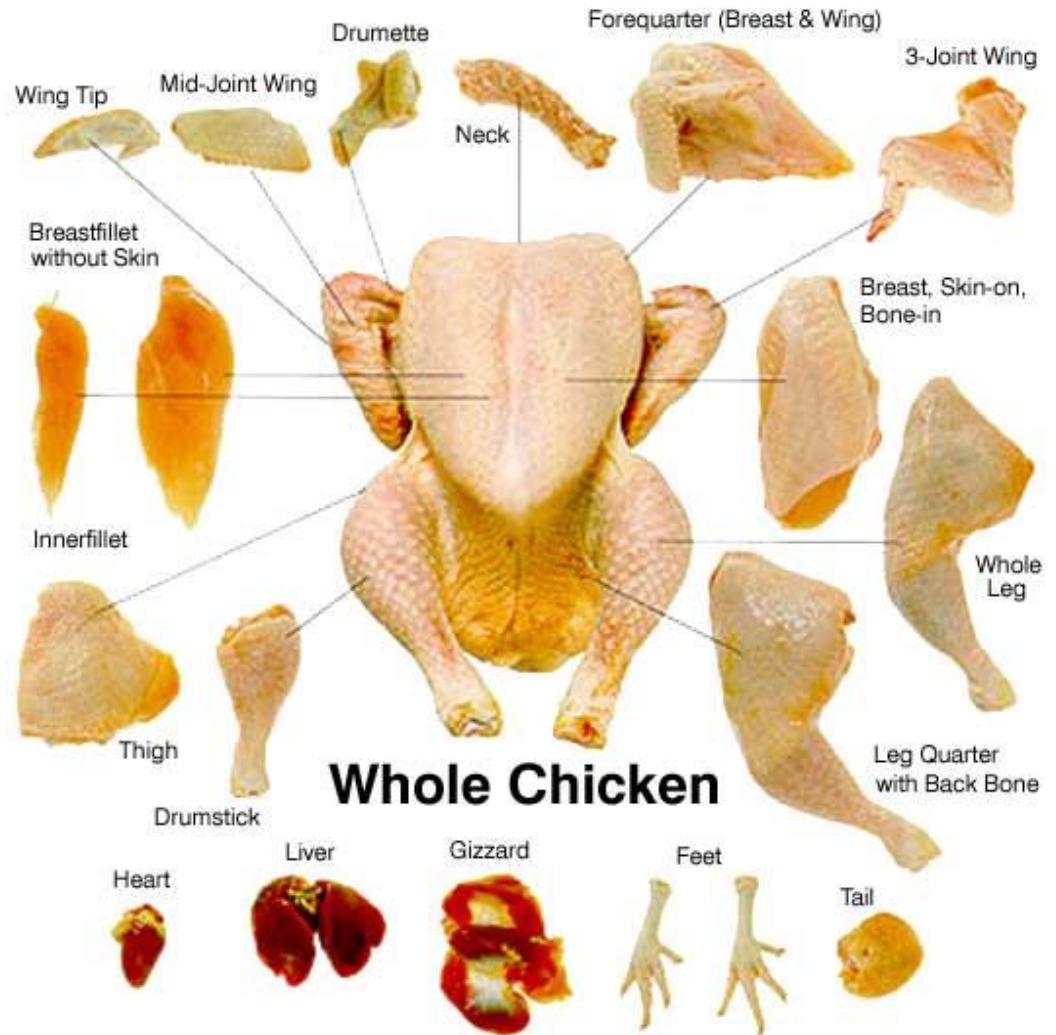
Carving up the world

The first taxonomist:

"Now the LORD God had formed out of the ground all the beasts of the field and all the birds of the air. He brought them to the man to see what he would name them; and whatever the man called each living creature, that was its name." (Genesis 2:19)

(Humans understand the world by naming, classifying, arranging into kinds, etc.)

Physics and Stamp Collecting

"All science is either physics or stamp collecting" (ERNEST RUTHERFORD, 1871-1937)

- Rutherford dismisses sciences (especially biology, but also geology, etc.) whose work is largely to arrange objects into groups. This is what stamp collectors do. Physicists also classify, but not to anything like the same extent.

What are we to make of so-called "stamp collecting" in science, i.e. the organisation of objects into groups? *Does it have any scientific value?*

How does classification connect with the *main* task of science, i.e. understanding the causes of phenomena?

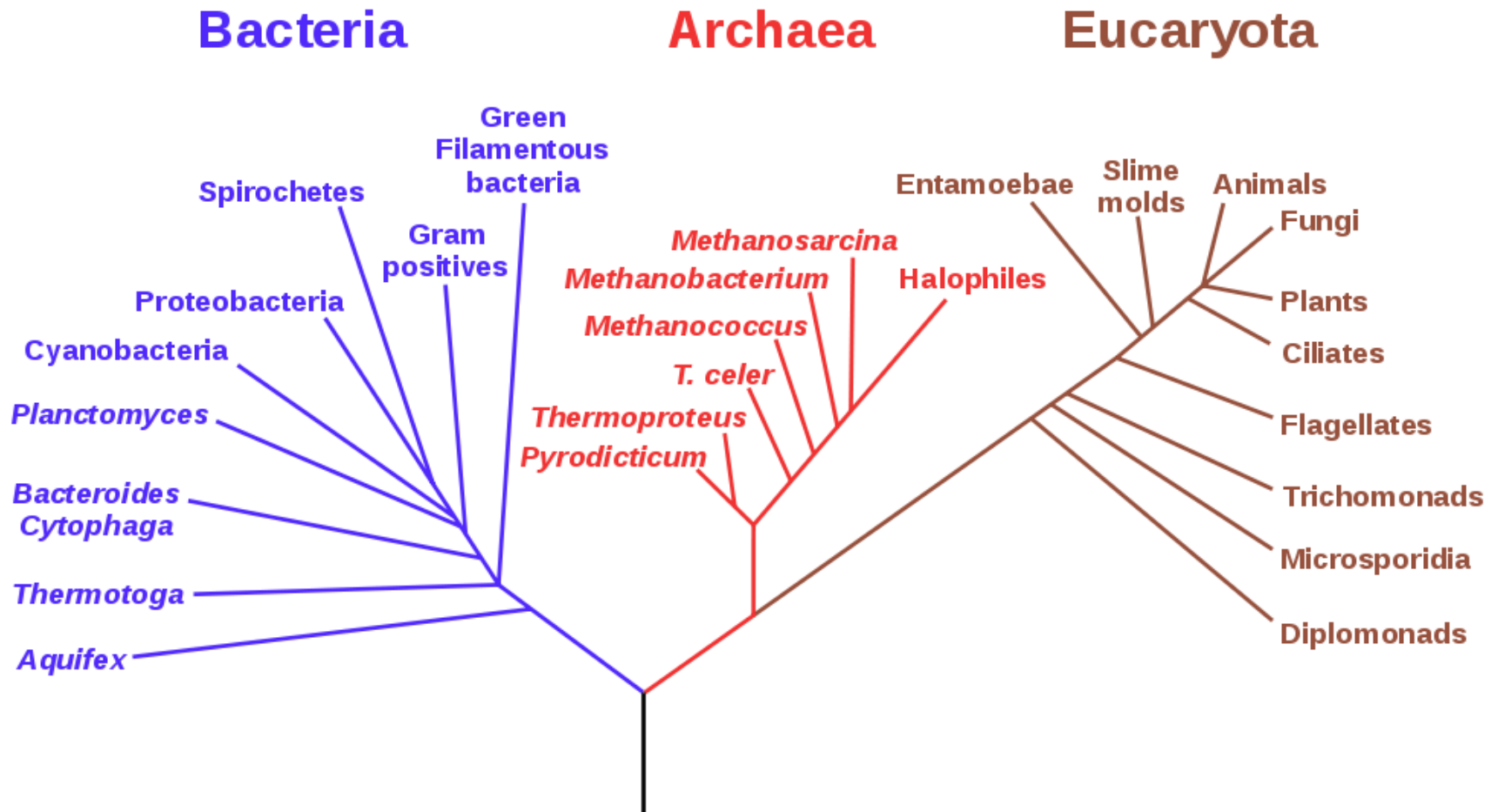Are systems of classification true (or false)?

1. *Realist*. One classification system (the *true* one) gives us important knowledge about the nature of the objects we're studying. (This true grouping is thought to be determined by the nature of the objects, and so is sometimes said to be a **natural kind**, and to **carve nature at the joints**.)

2. *Pragmatist*. A classification system may be *useful*, relative to a particular research goal. In another context, another grouping might be more useful. There is no one, single, "true" grouping.

3. *Relativist*. All systems of classification are completely arbitrary. The groupings we use derive from our language, or conceptual scheme, and have nothing to do with the objects themselves.
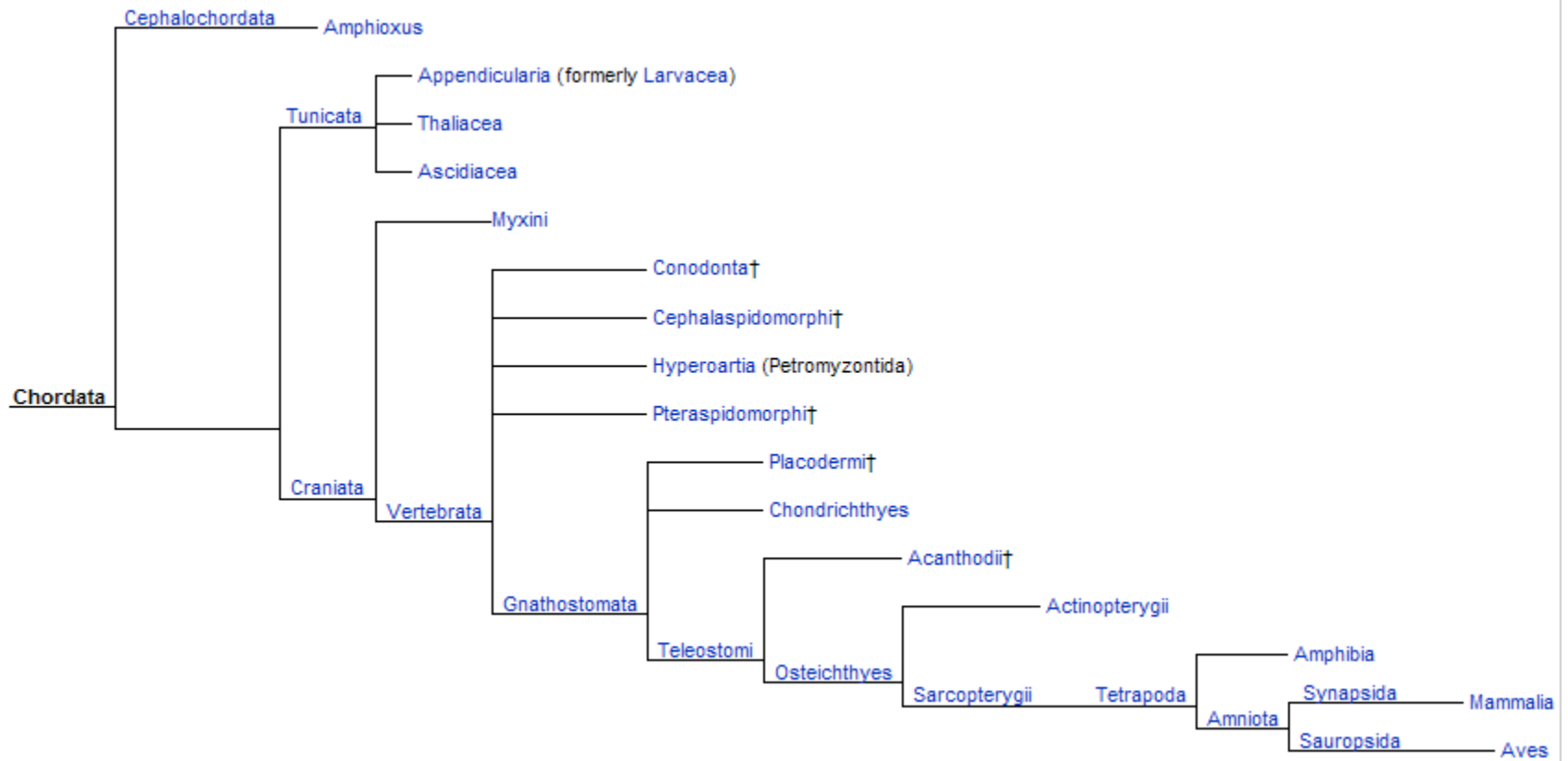
Biological Kinds

- The science with the most detailed and complex classification system is biology. Its system was developed by Swedish biologist Carl Linnaeus in the 18th century.

  - (It's been modified since then, but not beyond recognition.)

  - E.g. it was Linnaeus that created the group *primates*, and included humans in the group.
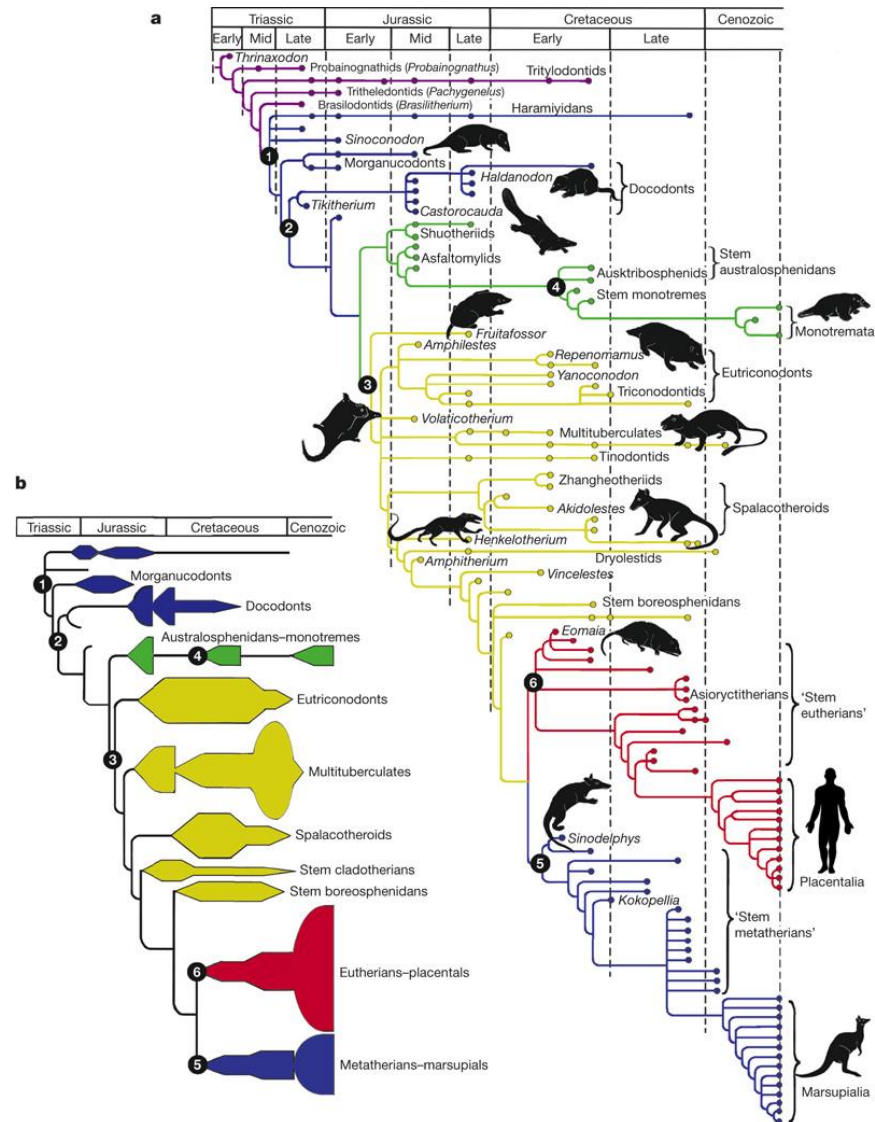
Phylogenetic Tree of Life

Bacteria

Archaea

Eucaryota

Green
Filamentous
bacteria

Spirochetes

Gram
positives

Methanosarcina

Methanobacterium

Halophiles

Proteobacteria

Methanococcus

Entamoebae

Slime
molds

Animals

Fungi

Cyanobacteria

T. celer

Plants

Planctomyces

Thermoproteus

Ciliates

Pyrodicticum

Bacteroides
Cytophaga

Flagellates

Trichomonads

Thermotoga

Microsporidia

Aquifex

Diplomonads

Our phylum: "chordata"

Our class: Mammalia

Conflicting classification schemes:
Are dolphins fish?

Dolphins	Sharks	Mice
Live in ocean	✓	✗
Elongated, tapered shape	✓	✗
Fins and tail	✓	✗
About 8 feet long	✓	✗
Warm-blooded	✗	✓
Foetus grows in uterus	✓ ✗ (varies)	✓
Feeds young with milk	✗	✓
Breathes using lungs	✗	✓
Certain skeletal features	✗	✓

Shark skeleton
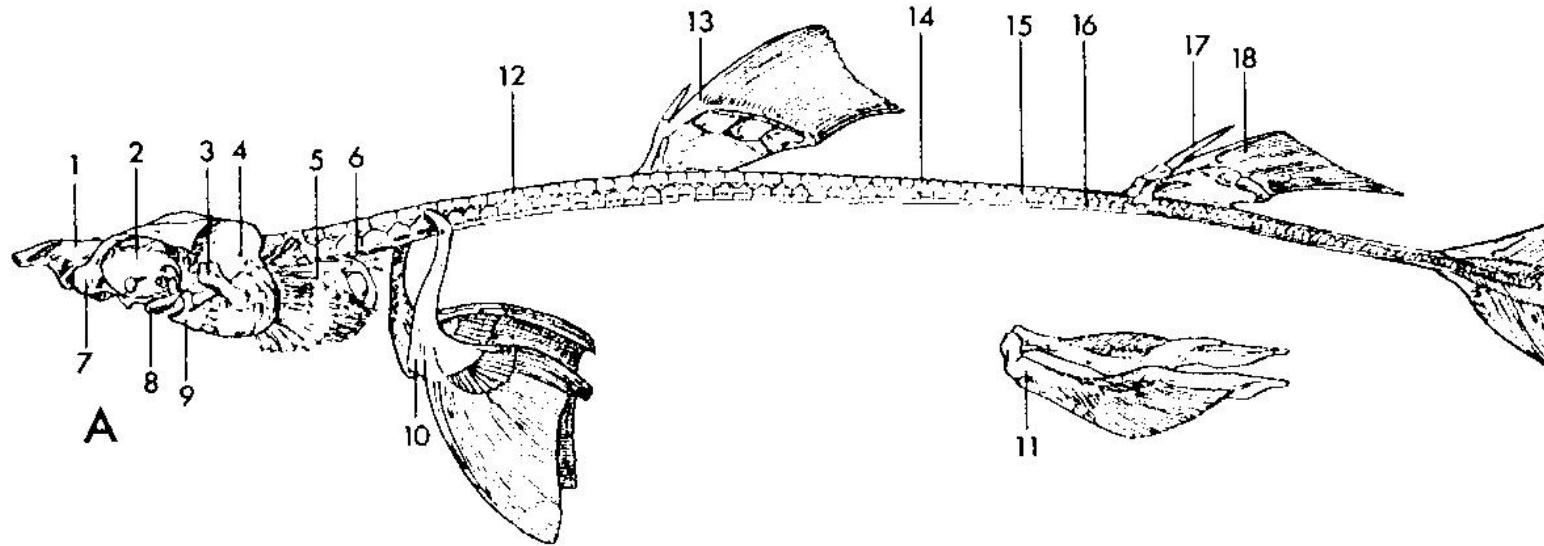
Dolphin skeleton
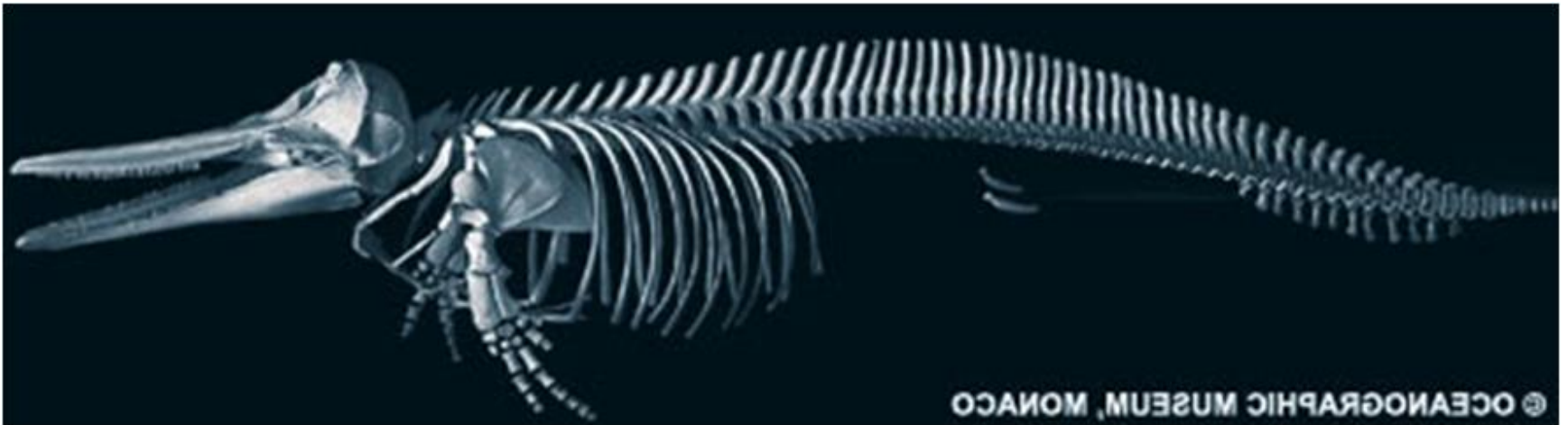
Mouse Skeleton

Are Biological Categories 'Real"?

- For Linnaeus, a creationist, biological categories represented ideas in God's mind.

- For contemporary biologists, biological categories group organisms with a (relatively) recent common ancestor.

- Either way, the groupings are not arbitrary, but are grounded in the deepest, "essential", objective reality.

Alternative Classifications

- On a restaurant menu, there might be a "seafood" section:

Tuna Nicoise   Seventeen

Shark au jus   Twenty one

Dolphin à l'orange   Twenty two

Seal bisque   Twelve

Is that *wrong?*
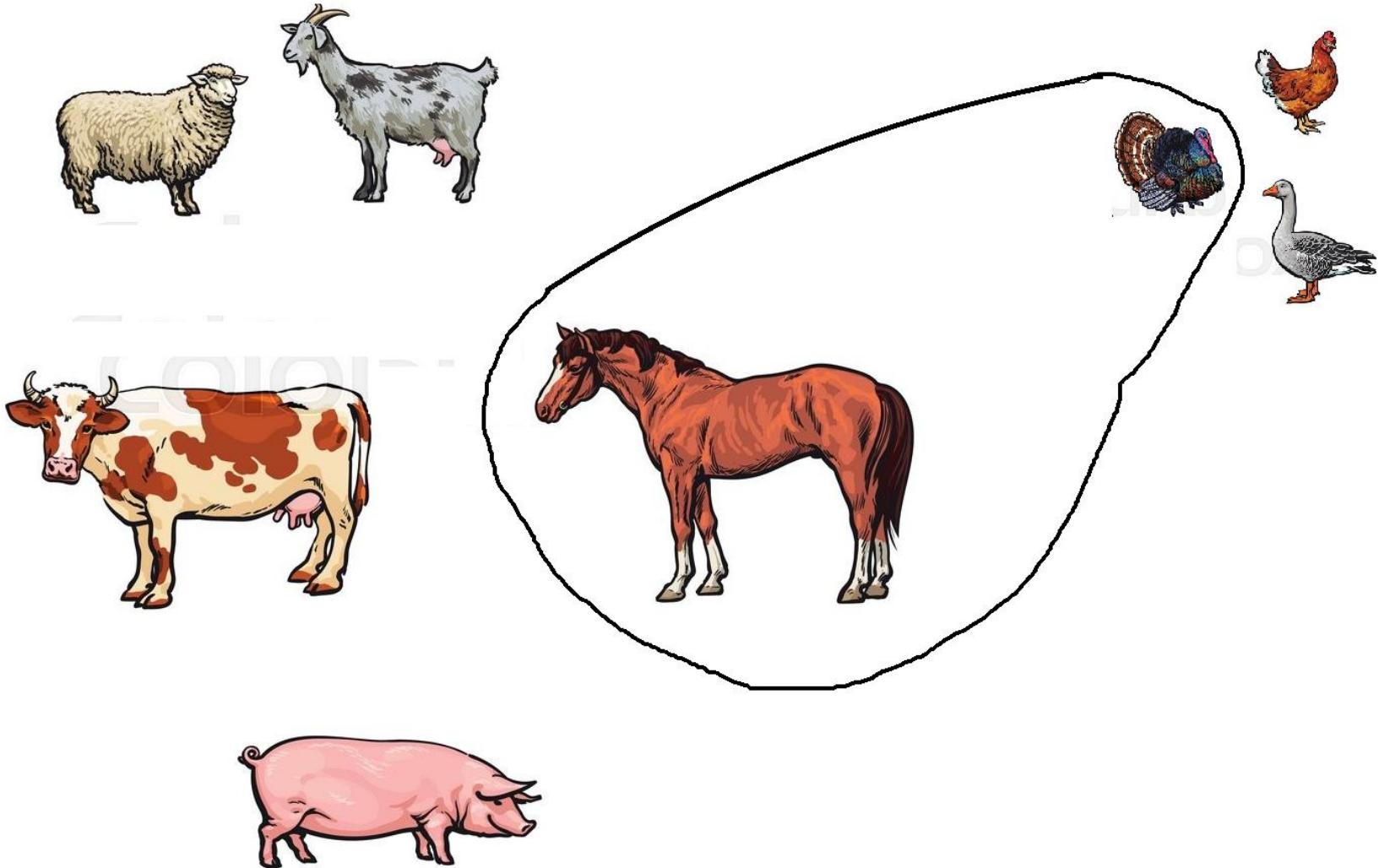
Crazy Categories

- FIVER: Anyone whose house number has digits that average 5 or more. E.g. Fred, who lives at 4659 Clark Drive.

- TOWERLING: Everything within a 100m radius of the Eiffel Tower (e.g. that chair, this mouse)

- BOOKANINE: Everything that's either a book or a dog.

- GRUE: Something that's green before Jan 1 2050, and blue after that.

Natural kinds
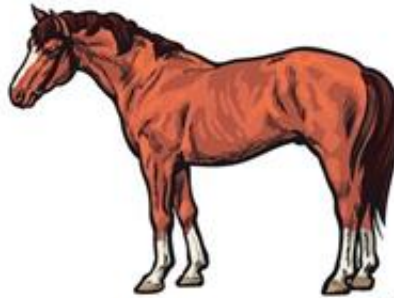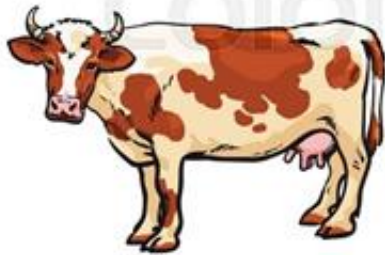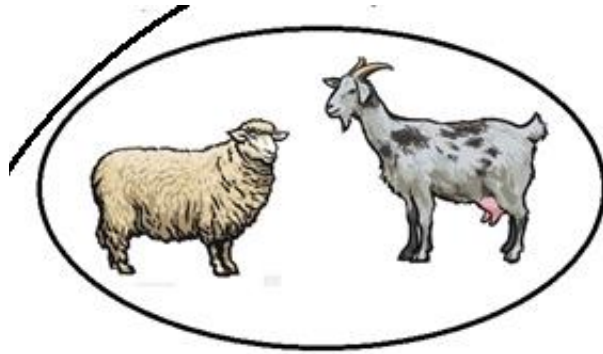
Unnatural kind

Are the *continents* social constructs?

"The ideal criterion that each continent be a discrete landmass is commonly disregarded in favor of more arbitrary, historical conventions."

"Some view separation of Eurasia into Europe and Asia as a residue of Eurocentrism"

In the USA, north and south America are separate continents. In Latin America they are the same continent.

Do the continents include the surrounding shallow seas ('continental shelf')?

Natural + *Social*

- Continents are somewhat separate, but not entirely (they're joined).
- The contingents are based on geographical reality, but there is some social construction on top.

No sharp borders

- Is Mt. Everest real, or a social construct?
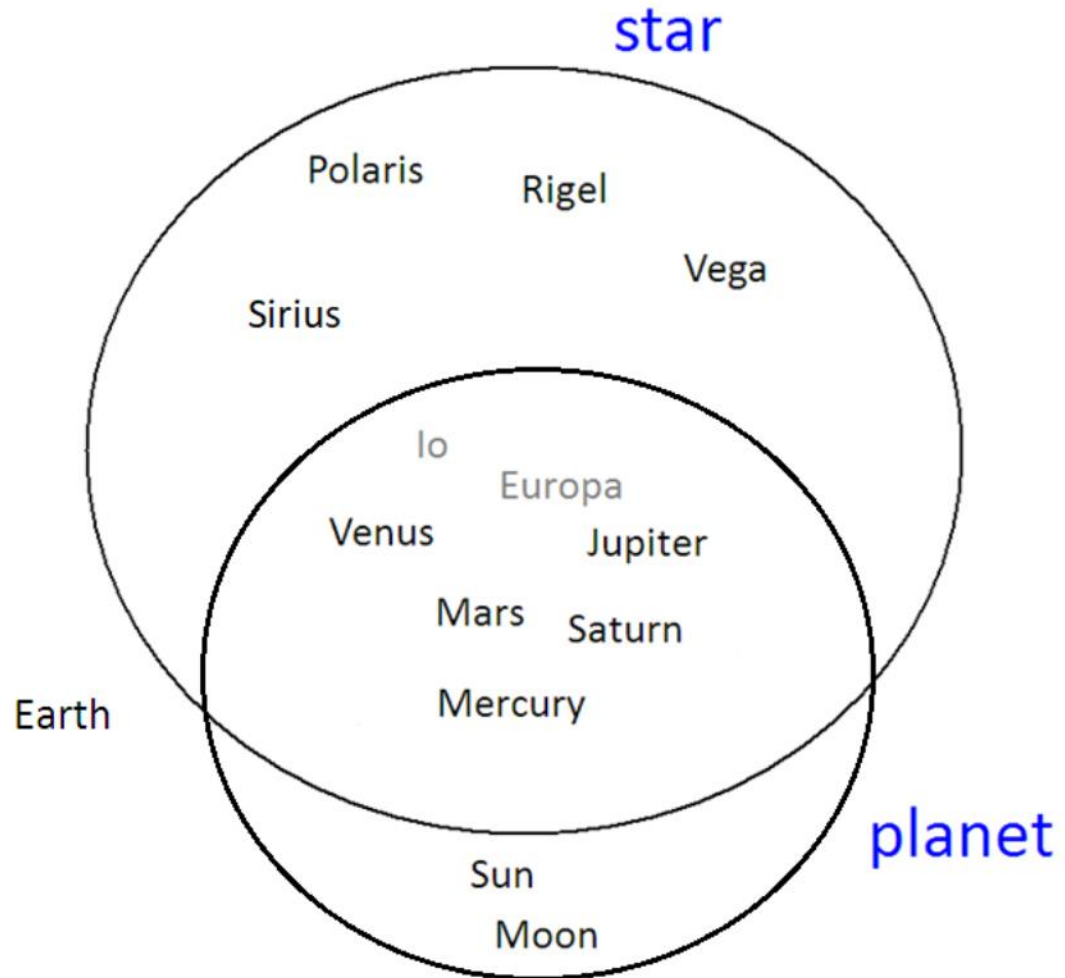
Naturally occurring?

- Is every *naturally occurring* thing a natural kind?

- Is *Frant* a natural kind?
  - (A frant is anything that is either a frog or an ant)
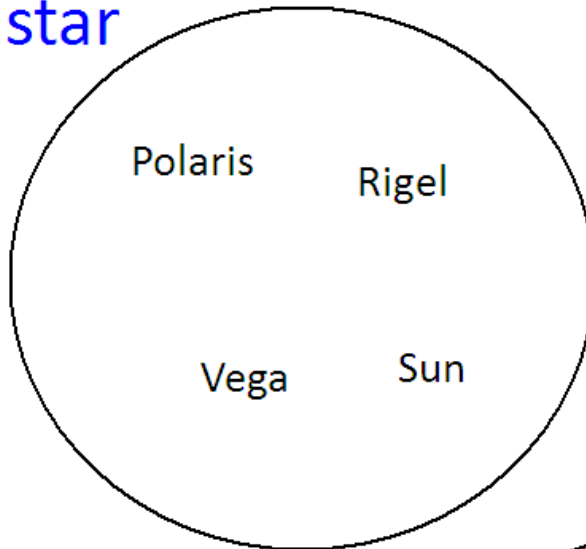
Classification changes with paradigm

Celestial bodies
for Ptolemy

Copernican taxonomy

star
- Polaris
- Rigel
- Vega
- Sun

planet
- Mercury
- Jupiter
- Venus
- Mars
- Saturn
- Earth
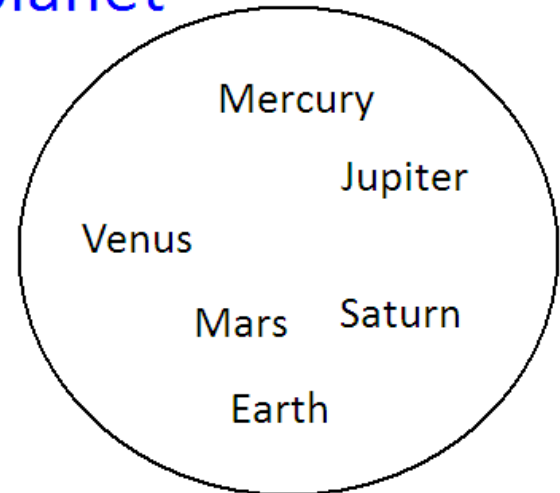
satellite
- Moon
- Io
- Europa
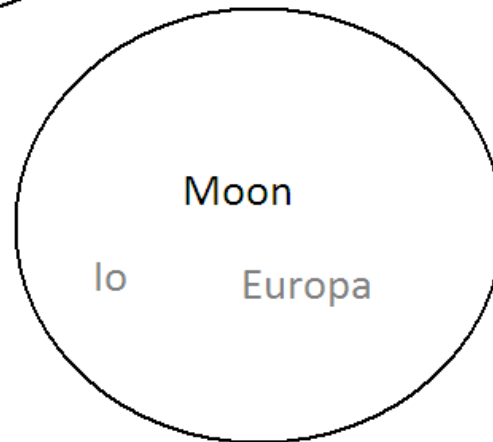
'Macrovolution' and 'microevolution'

- In biology, 'microevolution' generally refers to relatively small changes in gene frequencies in a population. It can happen on a time scale of decades. It may include new species appearing.

- 'Macroevolution' refers to larger, irreversible changes, involving new families, orders, classes or phyla. These changes seem to take millions of years.

- The exact meanings of these terms have shifted now and then, since being introduced in 1927.

'Macrovolution' and 'microevolution'

- According to the 'neo-Darwinist' paradigm in evolution, there is no fundamental difference between micro- and macro- evolution. They occur by exactly the same processes. Macroevolution is just an *accumulation* of microevolution.

- According to most other views (e.g. mutationism, orthogenesis, symbiogenesis, creationism) macroevolution involves some special and rare process, and is totally different from microevolution.

- Hence the term 'macroevolution' is rarely used by Darwinians. It sounds a bit suspect to them.

Part 2

Classification affects induction

Some classification systems *lead to useful generalizations* (e.g. laws) about categories in that system. These generalizations can, in turn, be used to predict future events. Some have used the existence of such successful classification schemes as evidence for category realism.

If the members of a class are *objectively* similar, forming a *natural kind*, then we can expect similar behaviour from them. But not if they're linked only by arbitrary social convention.

Classification affects induction

- Has the Copernican taxonomy of celestial bodies led to new, useful generalisations or predictions?

  - The expectation that other planets could have moons.
  - The expectation that other stars could have planetary systems.

Is *life* objectively real, or a social construct?

"Why is it so difficult for scientists to cleanly separate the living and nonliving and make a final decision about ambiguously animate viruses? Because they have been trying to define something that never existed in the first place. Here is my conclusion: Life is a concept, not a reality. …

… It's not there. We must accept that the concept of life sometimes has its pragmatic value for our particular human purposes, but it does not reflect the reality of the universe outside the mind."

"Why Nothing Is Truly Alive", FERRIS JABR, *New York Times*, MARCH 12, 2014

Is *Health* a scientific category?

- The healing business is being run by scientists these days (or a least people with scientific training).

- Healing aims at the health of the patient, so that *health* has become a concept that science has to deal with.

- But can science provide a satisfactory understanding of health?

- What's the *objective basis* of health?

A need for *telos*?

- Health is opposed to various states of non-health, such as disease, disorder and disability.

- Can those be defined in scientific terms?

- The problem here is that health (e.g. for Aristotle) was originally a *teleological* term, i.e. one that appealed to the function, or purpose, of an organism. A healthy organism has achieved its telos, or goal, and is "functioning properly".

- And contemporary science (post Darwin) has repudiated all teleology, deeming it "unscientific".

WHO definition, 1946

'Health is a state of complete physical, mental and social **well-being** and not merely the absence of disease or infirmity'

- What does 'well-being' *mean* though?

well-be·ing

/ˈwelˌbēiNG, ˌwelˈbēiNG/

noun

the state of being comfortable, healthy, or happy.
"an improvement in the patient's well-being"

Political implications

- The health/disease distinction is important in society as well as in science, as we generally think that health should be promoted and disease should be fought against.
  - A public policy that causes health should be adopted, but one that causes disease should not be adopted, other things being equal.
  - *Therapeutic* surgeries are publicly funded in Canada, but *cosmetic* surgeries are not, as the latter do not cause health.

- Can disease and health be defined *without* teleology?
  - Satisfaction of an individual's *desires*?
  - Happiness or pleasure?

1. Disease occurs infrequently

- If a condition is *rare*, then does this mean it's a disease?
  - Math prodigy (very rare).
  - Obese (24% in Canada)
  - Left-handed (7 – 10%)
  - Red-headed (1 - 2%)

2. Disease causes distress ('dysphoria')

- Is a dislocated shoulder abnormal?
- Pregnancy?
- Psychopathy?
- Narcissism?
- Deafness?
- Low testosterone?

(N.B. Distress depends on culture)

- The amount of distress one experiences due to a condition can depend on culture.
  - For example, some cultures are prejudiced against red-haired people, left-handed people, etc.
- Are these disorders?

3. Disease is disabling, or impairs normal functioning

- E.g. heroin addicts suffer mental problems, are in danger of toxic overdoses, sometimes lose their jobs, and so on.

- Pregnancy?

- Is the criterion circular?

- Can one argue that X is a disease because X causes Y, and Y is already accepted as a disease?

-

- N.B. Pregnancy can cause diabetes, blood clots (and even death).

- Left-handed people are more likely to have schizophrenia and ADHD, and redheads have increased risk of certain diseases.

4. Disease deviates from social norms

- If society regards a condition as abnormal, then this makes it a disease.
  - One obvious feature of this criterion is that a certain condition will be a disorder in some countries but not in others. (E.g. homosexuality, cycling)

5. Disease deviates from animal behaviour

- Since *animals do not have culture*, their behaviour can be regarded as purely natural, in some sense.
- In the context of *mental* disorders, therefore, animal behaviour might show what is normal for humans.
  - Is male aggression "toxic masculinity"? Maybe not, since male chimps do similar things.
  - Is female sexual promiscuity a disorder? Maybe not, since female fairy wrens often have more than 1000 sexual partners.

- Also, what's normal for (say) fairy wrens or chimps might not be normal for humans. In general, what's normal for one species can be grossly abnormal for another (imagine a mouse laying eggs!).

Lesbian Lizards?

Figure 6.1. Sexual behaviour in *C. uniparens* (redrawn by Steven W. Allison from Myers, 1990, p. 273).
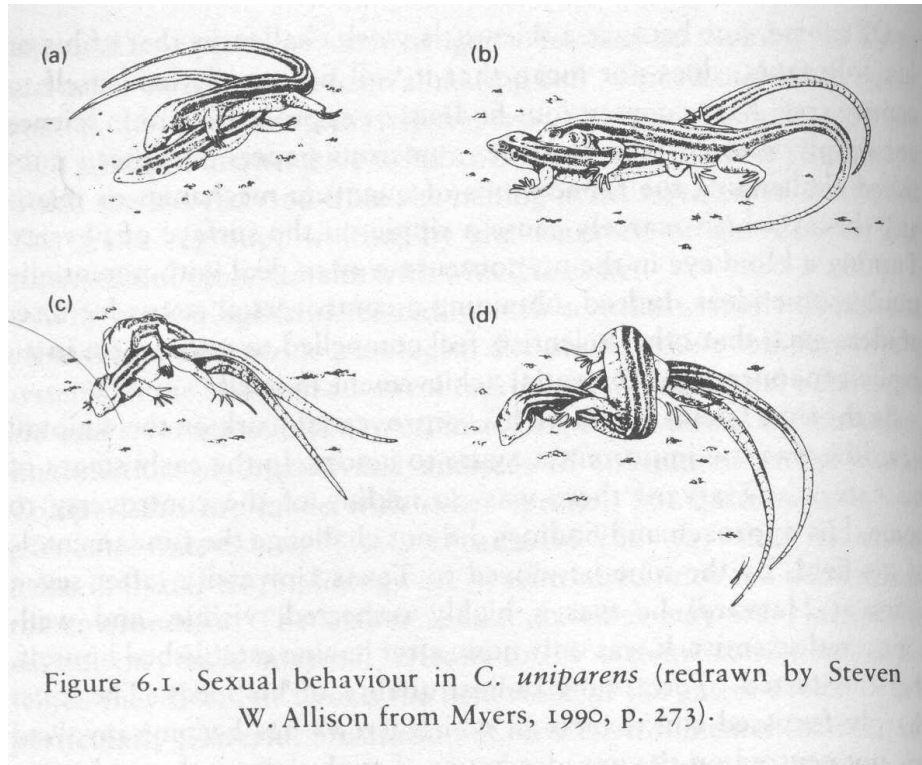
Apart from humans and domesticated sheep, no animal species is known to have members with a lifelong same-sex orientation.

Evolutionary theory of health?

- A healthy/normal trait is one that was *selected for* during the evolutionary history of the organism.

- E.g. hearts pump blood through the lungs, and then around the body. This activity enhanced the fitness of organisms, and so was selected for. It is therefore (at least part of) the *function* of the heart.

- Hearts also make a thumping sound. But this feature did not increase the number of offspring of organisms, and so was not selected for. It isn't part of the heart's function.

Case Study: the evolution of rape

- Anthropologists Thornhill and Palmer argued, in 2000, that rape has evolved as a (moderately successful) male reproductive strategy.
  - (Rape can be a cause of pregnancy and hence may lead to spreading the rapist's genes, including any rape-inducing gene. So it was selected for in our ancestors.)
  - On the evolutionary definition of health, rape is a healthy and normal trait.

Case Study: the evolution of rape

- As you might expect, Thornhill and Palmer were anxious to point out that *no moral consequences can be derived from this empirical study*. One certainly should not infer, they say, that rape is morally permissible.
  - But can acting on a normal and healthy trait be morally wrong?

Case Study: Is sickle cell trait/anemia a *disease*?

- A genetic mutation in the hemoglobin protein results in red blood cells that are unstable, and solidify into pointy shapes when invaded by the malaria parasite.

  - (The gelling of the hemoglobin prevents the parasite from feeding, and the defective blood cells are then destroyed in the spleen, preventing the spread of the infection.)

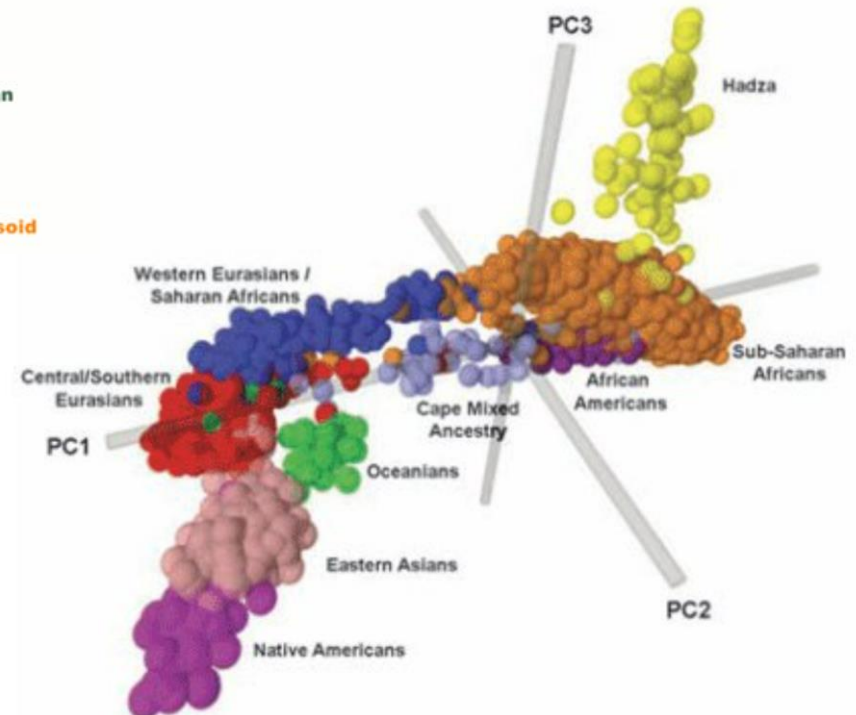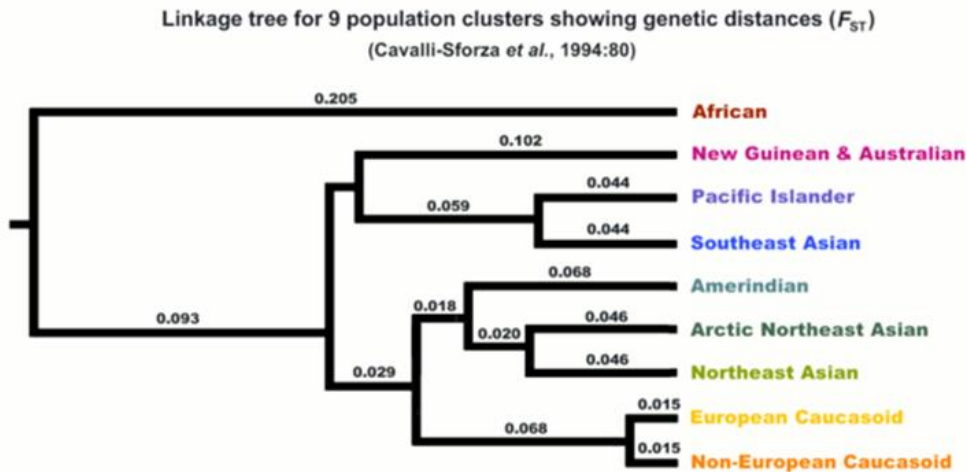Normal erythrocyte (Red Blood Cells)
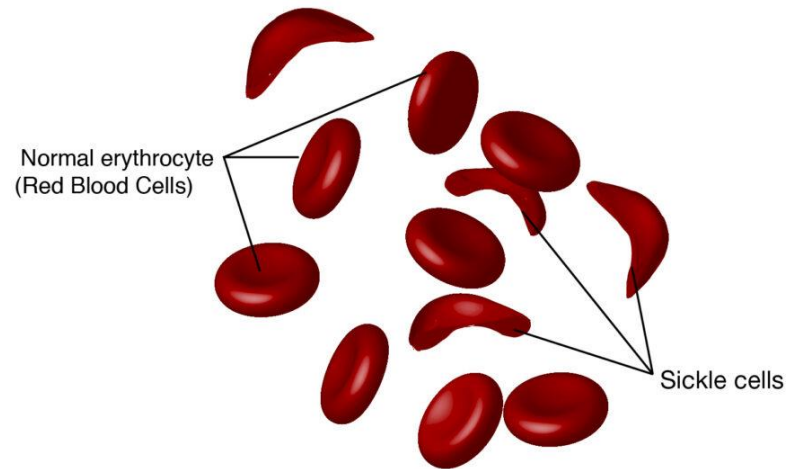
Sickle cells

Is it *healthy*?

- Sickle cell trait is strongly selected for in regions with malaria. But is it a healthy trait? It involves *damaging* blood cells. (Like burning a bridge to prevent an invading army from gaining access to a city.)

- If you get two copies of the sickle trait gene, then you have sickle cell *anemia*, and will be very sick (and die young, in the absence of advanced medical treatment).

Conclusion

- Health and disease, disorder, etc. are (I think) normative categories that science has no ultimate ability to define.

  – Science can find relevant information, however, e.g. in finding the causes of a condition, and causal connections between conditions.

Is race a social construct?

- Genetic differences between races exist, but are very minor overall.

Linkage tree for 9 population clusters showing genetic distances (F_{ST})
(Cavalli-Sforza et al., 1994:80)

- Before about 60,000 years ago, the ancestors of all humans today lived in Africa, but from that time modern humans began to spread across the globe.

- Geographical, social, and cultural barriers then gave rise to reproductively isolated human populations, that gradually diverged from each other in certain traits, leading to the so-called 'races' of humans.

- Genetic studies have shown that individuals sampled worldwide fall into clusters that roughly correspond to continental lines: Africans, European/West Asians, East Asians, Pacific Islanders, and Native Americans.

- Certain diseases are much more prevalent in some racial groups than others.

SCIENTIFIC AMERICAN®

BIOLOGY

Race Is a Social Construct, Scientists Argue

Racial categories are weak proxies for genetic diversity and need to be phased out

By Megan Gannon, LiveScience on February 5, 2016

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"Today, the mainstream belief among scientists is that race is a social construct without biological meaning."

- "In one example that demonstrated genetic differences were not fixed along racial lines, the full genomes of James Watson and Craig Venter, two famous American scientists of European ancestry, were compared to that of a Korean scientist, Seong-Jin Kim. It turned out that Watson and Venter shared fewer variations in their genetic sequences than they each shared with Kim."

- N.B. Conventional geographic racial groupings differ from one another only in about 6% of their genes, so that most physical variation, about 94%, lies *within* so-called racial groups.

1. The ancestral populations that are revealed by genetic comparisons don't map onto traditional notions of race.
   – For example, the 'Caucasoid' group in the family tree above includes not just native Europeans but also some Ethiopians, Somalis and Indians, who are not usually considered to be close relatives of the Swedes.

2. The ancestral populations had some interbreeding, so that **variations in any given trait tend to occur gradually** rather than abruptly over geographic areas.

   – There are no *sharp boundaries* separating each group from others.

3. The idea of race has always carried social meaning, that arranged races into 'higher' and 'lower', as a strategy for dividing, ranking, and enslaving colonized people.
   – Even today, a belief in the reality of human races often fuels racism.
   – The 'one drop rule' is clearly not scientifically valid.