Natural Selection & People

- Human impact on evolutionary process
- Evolutionary process impact on people
- Ethical questions

Descendents of colonizers

Natural selection
ONE mechanism for evolutionary change
Natural selection acts as an editor

Neutral?
Good?
Bad?
Individual traits
ENVIRONMENT
The case of Australian rabbits
Marsupials are native

1780
1 Englishman
1 gamekeeper
3 rabbits

1825
Rabbits “doing well”
1859

**Thomas Austin**
– South Victoria
  – 24 wild British rabbits

1866
– 14,000+ on his property
  – Shoot 400/hour

1950

> 750 million rabbits

How to exterminate?

**Myxoma virus!**

1953
90% rabbit mortality
still...

75 million rabbits left
... what next?

Population rebound in 1960’s

Why didn’t myxoma virus kill off the rabbits?

Co-evolution
– Rabbits with resistance survived
– Less lethal strains of virus survived

What next?

Rabbit calcivirus disease

Immuno-contraception:
– genetically modified Myxoma virus will prevent fertilisation

... or will it?!
Natural Selection: a mechanism for change

Genetic Variation

Competition in environment
  – Selection pressures

Adaptation
  – Inherited trait that favors survival & reproductive success

1859 monograph

The Origins of Species by Means of Natural Selection
  – Species vary and have changed through time
  – Simple biological mechanism (natural selection)
  – No special arguments for humans

Alfred Russell Wallace

Natural selection for inherited traits in human populations

Milk: the case of lactose digestion
Aggressive advertising

“Everybody needs milk”

“Milk is good for everybody”

“got milk?”

Why?

Most human adults cannot digest milk sugar

– LACTOSE = milk sugar
– LACTASE = digestive enzyme

Biological norm?

Nursing infants produce enzyme lactase...

stop after weaning

– Most adults are lactose intolerant
Lactose tolerance is rare

Some adults can digest milk sugars
- produce enzyme lactase
- “lactase persistence”

Milk digesters

10,000 - 6000 years ago
fresh milk yogurt & cheese

Selection pressure

Descendents of early herders much more likely to be lactose digesters.

“cultural environment”
- Biological adaptations
- Cultural solutions
Evolution

Natural selection acts on the individual.

Individuals don’t evolve, populations do.

Principles of inheritance

Gregor Mendel, 1865

– Czech monk
– Breeding strains of peas

Mendelian genetics

Discovered 2 principles:

Segregation
– Some traits inherited as discreet units (genes), not blended together

Dominant vs Recessive alleles (genetic variants)
– Not all inherited traits are expressed in individual
Human Genome Project
Genetic identity
Genetic patterns of inheritance
Complete sequence: 2001

Genotype vs Phenotype
Genotype
- Inherited genetic potential
  - discreet traits (Mendelian traits)
  - poly-genic traits
Phenotype
- Expressed traits
  - Dominance (Huntington's disease)
  - Co-Dominance (Sickle Cell)
  - developmental effects (environment)

Huntington's disease
Inherited
- Progressive degeneration of brain
- First symptoms typically in 40's
Dominant allele (4th chromosome)
**Kids' risk of HD?**

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**Huntington's disease**

1 parent = carrier (heterozygote)?
- 50% chance of inheriting

Both parents carriers?
- 75% chance

**Ask your neighbor:**

If HD is such a bad trait, why hasn't it been eliminated by Natural Selection?
Questions about HD

10 cases / 100,000 people
- 30,000 diagnosed in US
- 150,000 at risk (heterozygotes)

No cures known
- Therapeutic interventions
  - drugs
  - fetal tissue transplants

Sickle Cell Trait

Video in sections
- Heritable trait?
- Environment?
- Effects on reproductive success?

Questions:

Why hasn't Sickle Cell been eliminated by Natural Selection?

What circumstances might change the future incidence of this disease?
Clinical Update

American Family Physician 2000;62:1309-14

- Treatment advances over the past 25 years have significantly decreased morbidity and mortality in children with sickle cell disease.
- Aggressive management of fever, early diagnosis of acute chest syndrome, judicious use of transfusions and proper treatment of pain can improve quality of life and prognosis for these children.
- Prophylactic hydroxyurea therapy has been shown to reduce the incidence and severity of pain crises in adults with sickle cell disease and has been effective in limited studies conducted in children.
- Research into stem cell transplantation provides hope that a cure for sickle cell disease may be possible.