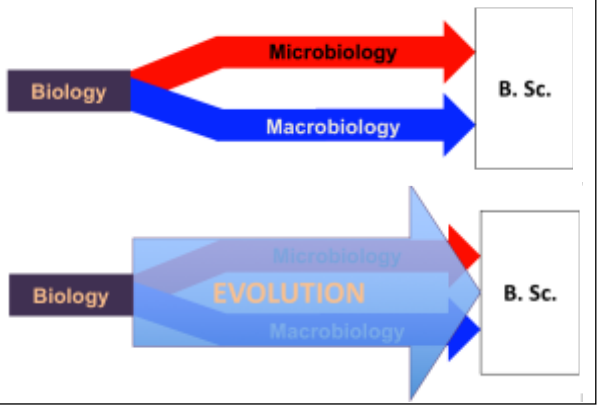
# Evo-Ed Cases: Connecting Biology Across the Curriculum

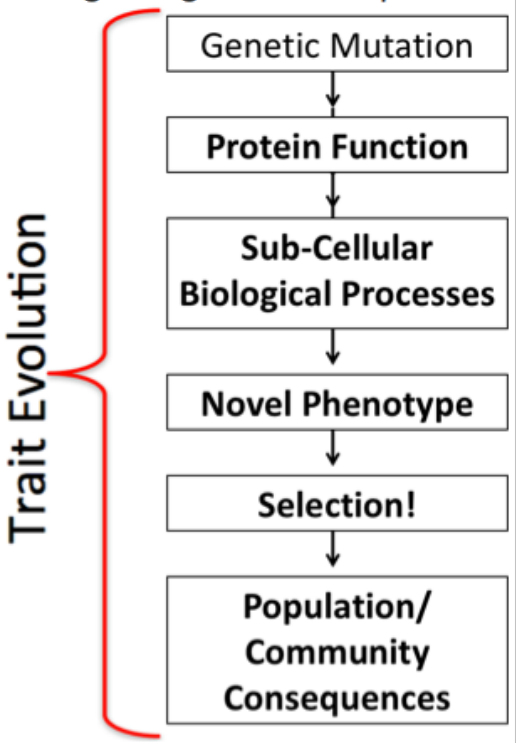
## A Bioquest 2017 Workshop

**Evolution spans the two tracks of biology education.**





Teaching cases of trait evolution across scales helps students to make connections across scales & among biological sub-disciplines.




## Potential Projects

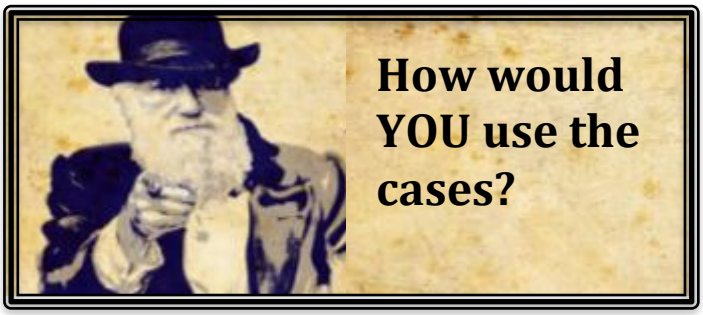
- Create a classroom activity using the cases.
- Storyboard an idea for a new game or sim.
- Create a homework activity that guides students through one of the cases.
- Write a new NCCSTS Case Study.
- Assemble a new a Data Nugget activity.
- Design a lesson plan.
- Use the process figure to map out a pathway through one of the cases.
- Synthesize existing research to describe a new case of trait evolution.
- Publish your resources!

**www.evo-ed.org: Cases for Evolution Education:** Partial support for this work was provided by the National Science Foundation's Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics program, Award No. 1043876 and the National Sciences Foundation's Discovery Research PreK-12 program, award No. 1620746. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. 

# *Mapping Evo-Ed Cases to Biology Curriculum*

**SIX CASES:**

- Citrate Metabolism Evolution in ***E. coli*** Bacteria
- Seed Taste Evolution in **Pea** Plants
- Toxin Resistance Evolution in Soft Shell **Clams**
- Fur Color Evolution in Beach **Mice**
- Color Vision Evolution in New World **Monkeys**
- Lactase Persistence Evolution in **Humans**




## Protein structure and function

*Transmembrane proteins*
- Mice: Melanocortin-1- receptor (MC1R)
- *E. coli*: Citrate transporter
- Clams: Voltage gated sodium channel
- Monkeys: Opsin

*Enzymes*
- Peas: Starch Branching Enzyme 1
- Humans: Lactase

**Biochemical pathways**
*Citric Acid Cycle – E. coli*
*Synthesis of melanins* – Mice
*Sugar/Starch synthesis* – Peas
*Lactose breakdown* – Humans

## Cell biology

*Prokaryotic cells – E. coli*
*General plant cells* – Peas
*Specialized cells*
- Mice*: melanocytes*
- Monkeys: *cone cells*
- Clams: *neurons and action potentials*
- Humans*: enterocytes*

*Aerobic and anaerobic metabolism – E. coli*
*Cellular Respiration – E. coli*
*Synthesis of sugars/starch in plants* – Peas
*Signal Transduction* – Monkeys, Clams

## Ecology

*Ecosystems – E. coli*, Clams, Mice, Monkeys
*Niches – E. coli*, Clams
*Population biology* – Mice
*Predator/Prey* – Mice, Clams
*Competition – E. coli*
*Food gathering strategies* – Monkeys
*Bioaccumulation* – Clams

## Genetics

**Transmission Genetics**
*Meiosis* – Monkeys, Peas
*Mendel's Laws* – Clams, Peas
*Co-dominance* – Mice

**Molecular Genetics**
*Genes to proteins* – All six cases
*Gene Regulation – E. coli*, Humans

**Kinds of mutations**
*DNA Duplication – E. coli*, Monkeys
*Single nucleotide substitution* – Clams, Mice, Humans
*Insertion of many nucleotides* – Peas
*Gene duplication and mutation* – Monkeys

**Population Genetics/Population dynamics**
*Differential population growth – E. coli*
*Artificial and Natural Selection* – Peas
*Distribution of two genotypes* – Clams
*Allele Frequencies* – Mice, Clams
*Trait distribution in populations* – Humans

## Natural Selection and Adaptation

*Experimental design for nat. sel. – E. coli*
*Cladistics – E. coli*
*Artificial selection* – Peas
*Fitness* – Clams
*Positive and negative selection* – Humans
*Convergent evolution* – Humans

## Prokaryotic Biology – *E. coli*

## Unicellular Organisms Biology

Clams: Dinoflagellates – life cycle and red tides

## Plant Biology – form and function

Photosynthesis – Peas

## Animal Biology – form and function

*Basic biology of mollusks* – Clams
*Hair, hair color* – Mice
*Coat coloration and patterns* – Mice
*Mechanics of vertebrate vision* – Monkeys
*Digestive tract* – Humans