**EVOLUTION EXAMPLE LESSON PLAN**

**Target Audience**: AP high school, freshman biology majors. Students who have solid biology background and are at least somewhat familiar with evolutionary trees. Depending on how much background an instructor wants to give, this could provide a good practical exercise for introducing or reinforcing evolutionary tree-thinking concepts.

**Learning objectives – by the end of this lesson, students will be able to:**

* Generate a hypothesis about the genetic basis of a cool phenotype
* Identify what NCBI resources are relevant to the evolutionary biology research question
* Build a simple phylogenetic tree using sequence data
* Identify sequence orthologs related to the phenotype
* Evaluate changes in sequence orthologs that could
* Use visualization tools to support hypothesis and share findings with others

**Materials Needed:** Computers for each student/group of students, access to internet to look at NCBI webpages. Optional: Printer to print out and annotate images of evolutionary trees.

**Assessment/Artifacts:**

* Students will fill in worksheets with hypotheses, accession numbers etc.
* Students can send link to MyNCBI collection to instructor to check progress
* Students will send their favorite figures to instructor and show to other groups
* Lab practical: We can supply another evolutionary example and have students complete a similar workflow

Activity Structure:

The ability to taste different flavors is crucial for toxin avoidance and assuring proper nutrition intake. In humans, the ability to distinguish sweet (sugars) and savory (amino acids) is conferred by different pairs of three subunits encoded by the T1R genes. In this exercise students will use NCBI data to understand the genetic causes of two seemingly confusing facts:

* All other birds have lost the ability to taste sugars, due to the loss of one of the T1R genes. How can hummingbirds detect the sugar in the flower nectar that they eat?
* Almost all mammals, including dogs, have the ability to detect sugars (think about ice cream – yum!). Why can’t cats (big AND small!) do this too?

To accomplish this, students will:

* Gather mitochondrial sequences from a set of vertebrates.
* Use BLAST to infer a phylogenetic tree using these sequences
* Use TreeViewer to export an image of the tree
* Find NCBI Orthologs of the three T1R subunits for the animals in this study
* Map the presence/absence of sweet-tasting ability on the tree alongside the presence/absence different T1R orthologs, and use these patterns to generate evolutionary hypotheses
* Pick useful of taxa and align their T1R orthologs and look for amino acid changes that could affect tasting ability (COBALT and MSA) - relate these changes back to the original hypothesis
* Choose an informative image of the alignment to export and share with the class