Agonistic Behavior in *Betta splendens*
Introduction to Ethology

Ethology is a branch of zoology focused on the **study of animal behavior in natural situations**. The goal of the **ethologist** is to understand natural behaviors in relation to the species' evolution, adaptive strategies, reproduction, and place in its ecosystem.

While the ethologist usually spends a great deal of time studying wild animals in nature, **field studies** are often complemented by laboratory and/or field experiments done by **behaviorists**.

One of the primary tools of the ethologist's trade is simple **observation** of animals in the wild without manipulating anything in their environment. Any artificial changes might affect the study animal's natural behavior, calling into question the study's validity.

An investigator studying the natural mating behavior of a particular bird should not alter anything about the bird or its environment. Rather, careful observations should be made, with the animal unaware of the investigator's presence, if possible. Once the bird's natural behavior is established via field studies, lab experiments in which various stimuli are manipulated could be performed. The laboratory data could then be compared to the natural field observations.

Over the course of this research project, you will begin to learn how to study animal behavior. Our model organism will be the **Siamese Fighting Fish, *Betta splendens*.***

Although you will not be observing these fish in a natural situation, you will be able to observe them and their behavioral responses to manipulated environmental stimuli. You will rely on the primary literature to discover the natural behaviors of *Betta splendens*.

With your literature search complete, and after a bit of practice observing *Betta* behavior, you and your team will confer to

- develop an interesting, relevant question regarding *Betta splendens* behavior
- devise an overall hypothesis
- devise null and alternative experimental hhypotheses
- design a rigorous experiment to test your hypotheses

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* The genus name is pronounced "beh'-tuh", ***not*** "bay'-tuh"
Hear the correct pronunciation at **http://www.thefreedictionary.com/betta** .
Compare with the pronunciation of β: **http://www.thefreedictionary.com/beta** .

I. Behavior and Evolution

Behavior is defined as the way an organism responds to stimuli in its environment. A **stimulus** can be any change in an organism's internal or external environment that influences its behavior.

Behaviors can range from very **simple**

- a bacterial cell moving toward an area with a higher sugar concentration
- a protist orienting itself towards a food item

…to the very **complex**

- mating vocalizations and dances of various species of birds
- your responses to the environment as you drove your car to school

Behaviors can also be classified based on the (1) conditions that elicit the behavior and (2) what other organisms are involved. These include behaviors associated with

- locating and consuming food
- avoiding predators
- parental care of offspring
- aggression towards competitors
- reproduction

…to name only a few.

Behaviors may be **learned** or **instinctual**. Many behaviors are some mix of the two.

Learned behaviors require experience that allow an organism to form associations between environmental stimuli and the behavior in question. Learned behavior changes with previous experience.

Instinctual behaviors are encoded by the organism's genes. Instinctual behaviors occur without any prior exposure to the particular stimulus that elicits the behavior.

Many instinctual behaviors are highly **stereotyped**. This means that they occur in the same way, every time, in different individuals of the same species. In instinctual behaviors, a **releaser** (some specific environmental stimulus) will trigger a **fixed action pattern**, an innate, stereotyped behavior.

Examples:

- The mere sight of an egg outside its nest will trigger innate egg retrieval behavior on the part of a nesting sea gull, whether or not that egg is its own.
- A baby mammal will root and suckle its mother immediately after birth, without ever having learned what a mammary gland delivers.
- When you are hungry, you seek food. You didn't have to learn that.

II. Proximate and Ultimate Questions

Because instinctual behaviors have a genetic basis, they are heritable traits. Even *the capacity to learn a particular behavior* may be encoded by an organism's genes. **Because many behaviors are heritable traits, they are subject to the processes of evolution.**

A **proximate question** is essentially a "**how**" question. For example, an investigator might ask *how* a firefly produces light in its abdomen to create a flashing pattern. What are the physiological processes that allow the insect to generate light?

An **ultimate question** is a "**why**" question. For example, an investigator might ask *why* fireflies produce light. What are the evolutionary reasons for light production?

Ethologists attempt to address both
how a behavior works **mechanistically**
why a behavior exists in an **evolutionary** sense

In this lab, we will be asking ultimate, "why" questions. Ultimate questions seek either the **adaptive value** of a behavior (how it contributes to an organism's survival or reproduction) or the **phylogeny** of a behavior (its evolutionary history).

Let's consider a behavior with which you are likely familiar—birdsong. As you walk across campus today, you may hear some small bird singing from a nearby tree.

- A **proximate question** about this behavior might be, "***How*** do birds sing?" The answer might include how the length of day (which changes during the year) affects hormone levels, which are responsible for stimulating birdsong. Or, you might consider the development of birdsong, and investigate how birds develop their song from the time that they are very young to when they are adults.

- An **ultimate question** might be, "***Why*** do birds sing? What is the adaptive value of birdsong?" Research into this line of thinking would include investigating how singing improves a bird's Darwinian fitness. In the temperate zone, males sing to defend their breeding territories against other males, and to attract females—both of which will improve their chances for producing offspring and passing on their genes.

When developing ultimate questions about your model organism, consider what environmental pressures its ancestors might have faced and how the species' traits may have changed as they were passed down to descendants.