

# Reproductive Advantage in Sticklebacks

## *Plausible Arguments*

### Background

Reproductive advantage means that individuals with certain characteristics are more likely to produce offspring than individuals with other characteristics. If individuals with a certain variation in an inherited trait are more successful at reproducing, then they will have a chance at passing their genes—and the particular variation—to the next generation.

Most sticklebacks breed just once in their lifetime. Females place several hundred eggs into a male stickleback's nest. The males fertilize the eggs, and then care for the young fish for a few weeks after they hatch, keeping the young in the nest and chasing predators away.



Some young sticklebacks in freshwater lakes are eaten by dragonfly larvae.

After that, the young fish are on their own. Most will be eaten by predators, die from disease or starvation, or meet another unfortunate end. Just a few young from each nest will survive the two years it takes to reach adulthood, successfully reproduce, and pass their alleles to the next generation.

### Question

In a population of sticklebacks in Loberg Lake in Alaska, researchers observed that the frequency of low-plated fish increased over time. ***Do low-plated sticklebacks have a reproductive advantage over completely plated fish in Loberg Lake?***

### Instructions

1. Read the Reasoning pages and the Evidence cards.
2. Decide what Claim each line of Reasoning supports.
3. Match the Evidence cards to the Reasoning pages.  
*Note: There may be fewer than 3 pieces of supporting Evidence for some of the Reasoning pages. You may not need to use all of the Evidence cards.*
4. Once you are happy with your matches, do one of the following:
  - Attach the Evidence cards to the Reasoning pages.
  - Fill in the table on the Plausible Arguments Organizer.
5. Which arguments are plausible? Decide whether the reasoning is sound, supported by evidence, and related to the question (above). If it is not, it is a bad argument; set the sheet aside.

## Reasoning #1

Since lateral plates are made of bone, low-plated sticklebacks need to make less bone tissue than their completely plated peers. This allows the low-plated fish to grow more quickly in fresh water, which has a low concentration of minerals. Because the low-plated sticklebacks grow larger, they are then better able to survive their first winter and are therefore more likely to reproduce the following year.

## Claim

According to this reasoning, which fish have the greatest reproductive advantage in Loberg Lake?

Low plated

Partially plated

Completely plated

None

## Evidence

Place the cards that support the reasoning below:

--	--	--

## Notes

## Reasoning #2

Because low-plated sticklebacks hatch at a higher rate in fresh water than completely plated fish do, low-plated sticklebacks will have fiercer competition with other low-plated sticklebacks for the same resources. Since completely plated fish are fewer in number, they will have unique advantages compared to so many low-plated sticklebacks. Because they are more rare, the completely plated fish will have a reproductive advantage.

## Claim

According to this reasoning, which fish have the greatest reproductive advantage in Loberg Lake?

Low plated

Partially plated

Completely plated

None

## Evidence

Place the cards that support the reasoning below:

--	--	--

## Notes

### Reasoning #3

Because they have more protection, completely plated fish are more likely to escape from the jaws of predatory fish and survive any resulting damage. In the ocean, this makes completely plated fish more likely to reproduce. Since Loberg Lake has no predatory fish, there is no reproductive advantage to having more lateral plates.

### Claim

According to this reasoning, which fish have the greatest reproductive advantage in Loberg Lake?

Low plated

Partially plated

Completely plated

None

### Evidence

Place the cards that support the reasoning below:

--	--	--

### Notes

## Reasoning #4

Young sticklebacks with fewer lateral plates are faster and more nimble; therefore, they are more successful than completely plated fish at escaping predatory dragonfly larvae. Since low-plated fish also grow more quickly than completely plated fish, they are vulnerable for a shorter period of time to dragonfly larva predation. Since the low-plated fish are more likely to survive predation by dragonfly larvae than completely plated fish are, they are also more likely to reproduce.

## Claim

According to this reasoning, which fish have the greatest reproductive advantage in Loberg Lake?

Low plated

Partially plated

Completely plated

None

## Evidence

Place the cards that support the reasoning below:

--	--	--

## Notes

## Reasoning #5

Both the low-plated fish and the completely plated fish will use the same basic cellular machinery to transcribe and translate the two different *Eda* alleles. Because low-plated sticklebacks tend to grow faster in fresh water than completely plated sticklebacks do, and because they move faster, their cellular machinery will need to use more energy. This greater need for energy puts the low-plated fish at a reproductive disadvantage.

## Claim

According to this reasoning, which fish have the greatest reproductive advantage in Loberg Lake?

Low plated

Partially plated

Completely plated

None

## Evidence

Place the cards that support the reasoning below:

--	--	--

## Notes

### **Evidence Card 1**

In freshwater lakes, low-plated sticklebacks grow larger more quickly than completely plated sticklebacks. But in salt water, there is no difference in growth rate.

### **Evidence Card 1**

In freshwater lakes, low-plated sticklebacks grow larger more quickly than completely plated sticklebacks. But in salt water, there is no difference in growth rate.

### **Evidence Card 1**

In freshwater lakes, low-plated sticklebacks grow larger more quickly than completely plated sticklebacks. But in salt water, there is no difference in growth rate.

### **Evidence Card 2**

In freshwater lakes, larger fish are more likely to survive their first winter than smaller fish are.

### **Evidence Card 2**

In freshwater lakes, larger fish are more likely to survive their first winter than smaller fish are.

### **Evidence Card 2**

In freshwater lakes, larger fish are more likely to survive their first winter than smaller fish are.

### **Evidence Card 3**

Young sticklebacks with fewer lateral plates are faster and more nimble than their completely plated peers.

### **Evidence Card 3**

Young sticklebacks with fewer lateral plates are faster and more nimble than their completely plated peers.

### **Evidence Card 3**

Young sticklebacks with fewer lateral plates are faster and more nimble than their completely plated peers.

### Evidence Card 4

An individual fish's allele combination for the *Eda* gene is correlated with the rate of egg hatching in fresh vs. salt water:

	2 'low' alleles	2 'complete' alleles
fresh water	Higher hatching	Lower hatching
salt water	Lower hatching	Higher hatching

### Evidence Card 4

An individual fish's allele combination for the *Eda* gene is correlated with the rate of egg hatching in fresh vs. salt water:

	2 'low' alleles	2 'complete' alleles
fresh water	Higher hatching	Lower hatching
salt water	Lower hatching	Higher hatching

### Evidence Card 4

An individual fish's allele combination for the *Eda* gene is correlated with the rate of egg hatching in fresh vs. salt water:

	2 'low' alleles	2 'complete' alleles
fresh water	Higher hatching	Lower hatching
salt water	Lower hatching	Higher hatching

### Evidence Card 5

The concentration of minerals, such as calcium, is higher in ocean water than in freshwater lakes. Young sticklebacks need calcium for building strong bones, including lateral plates.

### Evidence Card 5

The concentration of minerals, such as calcium, is higher in ocean water than in freshwater lakes. Young sticklebacks need calcium for building strong bones, including lateral plates.

### Evidence Card 5

The concentration of minerals, such as calcium, is higher in ocean water than in freshwater lakes. Young sticklebacks need calcium for building strong bones, including lateral plates.

### Evidence Card 6

In the ocean, sticklebacks are often eaten by larger fish. Because young fish are small, they are more vulnerable to fish predation, but predatory fish eat sticklebacks of all sizes.

### Evidence Card 6

In the ocean, sticklebacks are often eaten by larger fish. Because young fish are small, they are more vulnerable to fish predation, but predatory fish eat sticklebacks of all sizes.

### Evidence Card 6

In the ocean, sticklebacks are often eaten by larger fish. Because young fish are small, they are more vulnerable to fish predation, but predatory fish eat sticklebacks of all sizes.



### **Evidence Card 7**

Lateral plates help to protect sticklebacks from being punctured by the teeth of predatory fish. Fish with more lateral plates have better protection.

### **Evidence Card 7**

Lateral plates help to protect sticklebacks from being punctured by the teeth of predatory fish. Fish with more lateral plates have better protection.

### **Evidence Card 7**

Lateral plates help to protect sticklebacks from being punctured by the teeth of predatory fish. Fish with more lateral plates have better protection.

### **Evidence Card 8**

Loberg Lake does not have a population of larger predatory fish, but sometimes adult sticklebacks eat young sticklebacks that are still very small.

### **Evidence Card 8**

Loberg Lake does not have a population of larger predatory fish, but sometimes adult sticklebacks eat young sticklebacks that are still very small.

### **Evidence Card 8**

Loberg Lake does not have a population of larger predatory fish, but sometimes adult sticklebacks eat young sticklebacks that are still very small.

### **Evidence Card 9**

Like many other freshwater lakes, Loberg Lake has a population of dragonfly larvae. Dragonfly larvae are predators that sometimes eat young sticklebacks. Once sticklebacks reach a certain size, they are too big for the dragonfly larvae to catch and eat.

### **Evidence Card 9**

Like many other freshwater lakes, Loberg Lake has a population of dragonfly larvae. Dragonfly larvae are predators that sometimes eat young sticklebacks. Once sticklebacks reach a certain size, they are too big for the dragonfly larvae to catch and eat.

### **Evidence Card 9**

Like many other freshwater lakes, Loberg Lake has a population of dragonfly larvae. Dragonfly larvae are predators that sometimes eat young sticklebacks. Once sticklebacks reach a certain size, they are too big for the dragonfly larvae to catch and eat.