

Instructor Resource Guide : **How To Eat & Avoid Being Eaten! (Mammals)**

First thing's first: How do we classify what a "mammal" is? Scientists agree that an organism is a mammal when they have the following characteristics:

1. **Hair:** All mammals have hair or fur at some point in their lifetime: even dolphins and whales are born with fine-haired mustaches!
2. **Warm-Blooded:** Mammals, like birds, generate body heat to keep their body temperature fairly constant in spite of how hot or cold their surroundings are.
3. **Bear Live Young:** Mammals are unique because, with few exceptions, instead of laying eggs all of their young are kept inside of their mother's body, where they can grow in a safe environment with lots of nutrients until they are born live.
4. **Milk Production:** Once the young are born, mammal mothers produce milk to nourish them using modified sweat glands known as **mammary glands** in a process known as **lactation**. This is where the name "mammals" comes from!

In addition to these general adaptations, they also have sophisticated *feeding* adaptations according to their eating habits. There are three different major categories of "feeders" in the animal kingdom:

- **Herbivores** eat the structures of plants, such as stems and leaves, or their byproducts such nuts, seeds, fruit, and nectar.
- **Carnivores** eat other animals to meet their nutrient needs. They can make use of the entire body, like fish eaters and insect eaters do, or they can only eat specific parts like the muscle or the blood.
- **Omnivores** are the non-picky eaters of the animal kingdom. They will happily consume any combination of the above, depending on what is available.

These can be broken down into many different sub-groups depending on what types of diets they *specialize* in, but within these broader groups you can find some general modification themes to better equip the mammal to consume their food and spot their prey or predators. Looking at the skull of a mammal, you can easily identify both of these lifestyle characteristics: this is useful in figuring out what kind of animal the skull came from!

Eyesight

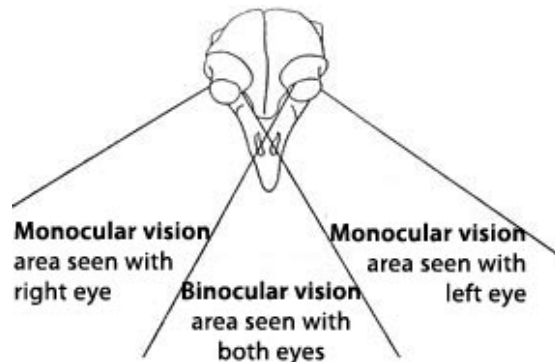
The placement and orientation of a skull's eye sockets can reveal to you whether the owner was a predator, stalking their quarry through the brush and gauging how far they need to pounce, or a prey animal, constantly surveying their surroundings to detect approaching trouble.

As the saying goes,

“ Eyes on the **front** like to **hunt**, eyes on the **side** like to **hide**. ”

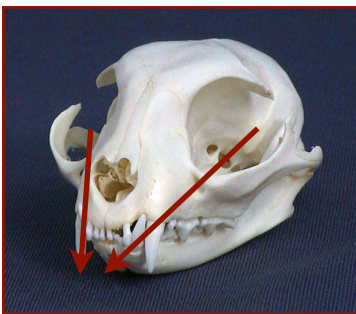
This has to do with the differences in **binocular** and **monocular** vision that each eye position lends to the bearer.

Predators tend to have more **binocular** vision, meaning there is more overlap in the field of vision received by each eye.



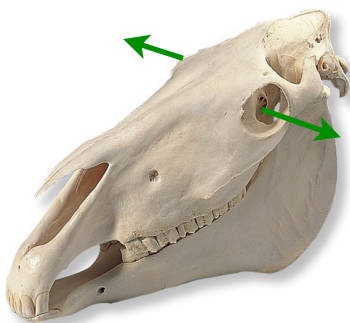
Prey tend to have more **monocular** vision, meaning that less of the visual feedback a mammal receives is shared between both eyes.

The reason for these tendencies lies in how each mammal uses their eyes. Is their primary goal to **hunt** or to **hide**?



Here we have a typical **predator** skull with eye sockets that are facing *forwards*. Thus, the picture taken from each eye is only *slightly* different. This means that when you are a predator:

- Your *field of vision* is *narrow*.
- Your **depth perception** (how easily you can tell how far away something is) is *strong*.
- You can see through some objects that are in front of you, allowing you to keep sight of your prey.



By comparison, the skull of this **prey** animal has eye sockets that are each facing a different side. When a prey animal sees the world, there is very little overlap between what pictures each eye takes. This means that when you are a prey animal:

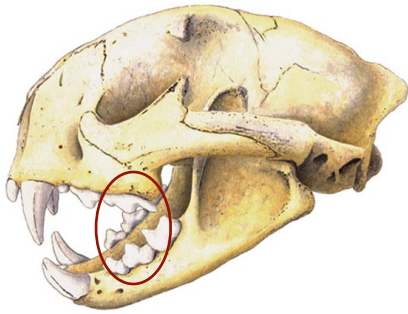
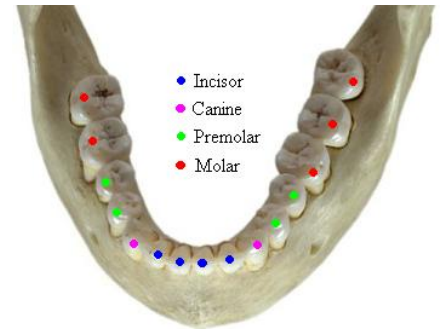
- Your *field of vision* is *wide*.
- Your *depth perception* is *weak*.
- You get a **panoramic view** (almost 360) of your surroundings. This lets you detect incoming predators from almost any direction!

Tooth Structure

The second, and most obvious, way to discover clues about the animal's feeding choices from just a skull is to look at their *teeth*. Mammal teeth are highly specialized to the animal's diet, according to whether the goal is to grind the food into smaller pieces, or slice it up.

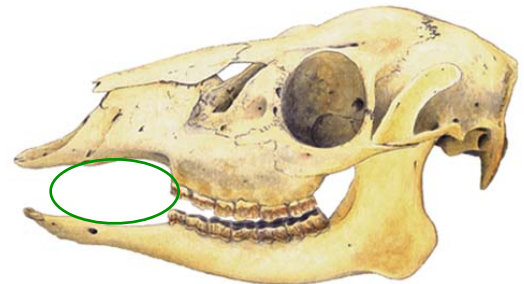
There are four different kinds of teeth that are unique to mammals.

- **Incisors** come with sharp edges that function to perform the initial cuts in food as it is being eaten.
- **Canines** end in sharp points that are used to tear, and can hook in to food to anchor a piece while the rest is being pulled away.
- **Premolars** mark the transition between the slicing teeth and the chewing teeth. They are flatter on the top, but still have some keen edges to them.
- **Molars** are the classic chewing teeth, with mostly flat or ridged interfaces to grind food.



Carnivores have very sharp canines to grasp and hold prey. The molars and premolars have a shearing edge known as the **carnassial**, which acts like garden shears to slice meat into little pieces before swallowing.

Herbivores rely on their incisors to clip plant material into bite-sized pieces. Most herbivores either have very small canines or are missing them *entirely*, creating a gap between the incisors and the premolars known as the **diastema**. Herbivores often have long tongues, that loop through this gap to help grasp food and guide it into the mouth.



Omnivores like humans strike the middle ground between the two above extremes in tooth structure. Our incisors and canines are somewhat sharp, but without the puncturing ability of the carnivores. Our premolars and molars are mostly flat, creating grinding plates like what can be seen in herbivores, but they still have sharp cusps and edges that can help chop food into smaller pieces before it is swallowed.

These structural dietary adaptations help us to understand how *form follows function* in determining body shape and characteristics. But this is not the complete story! There is an entire *world* of animal behavior. However, each of these behaviors involves a delicate balance between helpful and harmful qualities. For instance, Both predator and prey mammals find benefit in living in groups.



Prey mammals who live in family groups or herds gain the benefits of:

- Keeping more eyes on the lookout.
- The **Dilution** Effect: Living in a larger group minimizes the chances of *you* being singled out to be eaten.
- The **Confusion** Effect: Predators have a harder time focusing on just one prey mammal when there is an entire group fleeing from them.

VERSUS



Prey mammals who live in family groups or packs gain the benefits of:

- More paws, claws, and jaws for bringing down prey.
- The ability to strategize! When hunting in a group, you have options such as tag-teaming a chase until the prey is tired enough to drop, or can surround a group of prey mammals and have a few individuals flush the prey into getting ambushed by the others.

However, whether you are a predator or a prey mammal, working in a group means that you are less likely to be able to effectively *hide*. Prey mammals must deal with being an obvious target for predators, and predators have a higher chance of losing the element of surprise when multiple members of the hunting group are trying to sneak up on a prey animal.

Besides group living, there are many examples of decisions mammals need to make about their behavior, that embody their own advantages and disadvantages:

- Is it better to forage more efficiently, or keep a sharper eye out for predators?
- Is it better to perform dangerous activities (like drinking at a watering hole) at high traffic or low traffic times?
- Is it better to capture many low-quality prey, or work for a few high-quality prey?

With an understanding of how these adaptations are involved in how mammals eat and avoid being eaten, we have the opportunity to appreciate how specialized animals become according to their environments, and how we get the diversity in this world that we see!

Some Excellent Books and Websites to find out more!

- <http://animals.pppst.com/what-animals-eat.html>
 - This is an *excellent* online resource, with different pages for varying introductory topics in animal feeding, food chains, and balancing ecosystems. Also, for teachers provides media like pictures, power point presentations, videos, and online games for free!
 - Caution: You need to set aside some time to navigate the site before using it. (It isn't the most organized.)
- *The Biology of Small Mammals* by Joseph F. Merritt. © 2010 The Johns Hopkins University Press, Baltimore Maryland.
 - This is a text resource for teachers, or students in high school or above. It provides excellent background information and goes in to many helpful details and explanations about the science behind what we see, but is too in-depth for younger ages.
- *Mammology: Adaptation, Diversity, and Ecology*, 2nd edition by George A. Feldhamer, Lee C. Drickamer, Stephen H. Vessey, and Joseph F. Merritt. © 2003 McGraw Hill Higher Education, Singapore.
 - Same advice as *The Biology of Small Mammals*.
- *The Mammals* by Life Nature Library. Text by Richard Carrington. © 1963 Time-Life Books, New York.
 - This book is a handy introduction to the mammals. They use large, colorful pictures and lots of concrete examples. An easy read for older age groups! (age 12+)
- These are some really good books for kids to check out at their school and/or local library if they want to find out more!
 - *Do Cows Eat Cake?: A Book About What Animals Eat* by Michael Dahl, Illustrated by Sandra D'Antonio. © January 2006 Picture Window Books. (Ages 4 - 8)
 - *Lunch At the Zoo: What Animals Eat and Why* by Joyce Altman, Illustrated by Rick Chrustowski. © Henry Holt & Co. (Ages 4 - 8)
 - *What Grassland Animals Eat (Nature's Food Chains)* by Joanne Mattern. © July 2006 Weekly Reader Early Learning. (Ages 4 - 8, bilingual w. Spanish)
 - *What Forest Animals Eat (Nature's Food Chains)* by Joanne Mattern. © July 2006 Weekly Reader Early Learning. (Ages 4 - 8, bilingual w. Spanish)
 - *What River Animals Eat (Nature's Food Chains)* by Joanne Mattern. © July 2006 Weekly Reader Early Learning. (Ages 4 - 8, bilingual w. Spanish)

- *What Desert Animals Eat (Nature's Food Chains)* by Joanne Mattern. © July 2006 Weekly Reader Early Learning. (Ages 4 - 8, bilingual w. Spanish)
- *Animals Eating: How Animals Chomp, Chew, and Swallow* by Pamela Hickman, Illustrated by Pat Stephens. © February 2001 Kids Can Press. (Ages 9 - 12)
- *A Savanna Food Chain: A Who-Eats-What Adventure in Africa (Follow That Food Chain)* by Rebecca H. Wojahn and Donald Wojahn. © 2009 Werner Publications. (Ages 9 - 12)
- *An Australian Outback Food Chain: A Who-Eats-What Adventure (Follow That Food Chain)* by Rebecca H. Wojahn and Donald Wojahn. © 2009 Werner Publications. (Ages 9 - 12)
- *A Desert Food Chain: A Who-Eats-What Adventure in North America (Follow That Food Chain)* by Rebecca H. Wojahn and Donald Wojahn. © 2009 Werner Publications. (Ages 9 - 12)
- *A Temperate Forest Food Chain: A Who-Eats-What Adventure in North America (Follow That Food Chain)* by Rebecca H. Wojahn and Donald Wojahn. © 2009 Werner Publications. (Ages 9 - 12)
- *A Rain Forest Food Chain: A Who-Eats-What Adventure in South America (Follow That Food Chain)* by Rebecca H. Wojahn and Donald Wojahn. © March 2009 Werner Publications (Ages 9 - 12)