"Survival of the Fastest: Predators and Prey on the African Savannah"

GRADE LEVELS: 5-8

TIME ALLOTMENT: One or two 45-minute class periods

OVERVIEW:

In this lesson, students will learn about the various attributes of different predators on the African grasslands which make them effective hunters, and about the attributes their prey have developed to help them survive the predators' attacks. The development of both sets of attributes will be presented as part of natural selection—a process which takes varied forms (and produces varied results) in the earth's different ecosystems.

In the Introductory Activity, students will use an online interactive to familiarize themselves with the physical attributes of the cheetah which make it such an effective predator. In the Learning Activities, students explore the cheetah's use of these attributes in pursuit of its equally well-adapted prey—the gazelle—through video from the "Hunters and Herds" episode of the PBS series NATURE,, which also discusses the similar contest between lions and wildebeests. The Culminating Activity challenges students to research, compare, and contrast predator/prey relationships in earth's different ecosystems, and present their findings to the class.

This lesson is intended for use during study on natural selection and adaptations, or a unit on the food chain/web.

SUBJECT MATTER: Science, Biology

LEARNING OBJECTIVES:

Students will be able to:

- Identify the attributes of different predators which contribute to their effectiveness as predators
- Identify the attributes of different prey animals which contribute to their ability to elude predators
- Discuss how the attributes of both predator and prey animals have developed in a process of natural selection
- Compare and contrast predator/prey relationships from different ecosystems around the world.

STANDARDS:

National Science Education Standards

http://www.nap.edu/openbook.php?record_id=4962

Life Science
Content Standard C
As a result of their activities in grades 5-8, all students should develop understanding of:

1. Structure and function in living systems
2. Reproduction and heredity
3. Regulation and behavior
4. Populations and ecosystems
5. Diversity and adaptations of organisms

MEDIA COMPONENTS:

Video:

Clip #1 "Cheetah vs. Gazelle"
An animation-enhanced comparison of the strengths and weaknesses of both predator and prey.

Clip #2 "Lion vs. Wildebeest"
An animation-enhanced comparison of the strengths and weaknesses of both predator and prey.

Websites:

"Toki's Survival Challenge"
www.pbs.org/wnet/nature/episodes/the-cheetah-orphans/game-tokis-survival-challenge/675/
An interactive in which a cheetah hunts its prey on the African savannah. From the PBS NATURE web site.

"Anatomy of a Cheetah"
www.pbs.org/wnet/nature/episodes/the-cheetah-orphans/interactive-anatomy-of-a-cheetah/662/
A simple interactive highlighting the primary physical attributes of the cheetah as a predator.

MATERIALS:

For the class:

- 1 computer w/ internet connection and projector

For each group of 3-5 students:

- 1 computer w/ internet connection

PREP FOR TEACHERS:

Prior to teaching this lesson, you will need to:

Preview all of the video segments and websites used in the lesson.

Download the video segments used in the lesson to your classroom computer, or prepare to watch them using your classroom's internet connection.

Bookmark the website used in the lesson on each computer in your classroom. Using a social bookmarking tool such as del.icio.us or diigo (or an online bookmarking utility such as portaportal) will allow you to organize all the links in a central location.

INTRODUCTORY ACTIVITY

1. Assign each student to a computer and ask them to log on to the "Toki's Survival Challenge" game **at** www.pbs.org/wnet/nature/episodes/the-cheetah-orphans/game-tokis-survival-challenge/675/.
(If insufficient computers are available for each student to have his or her own, break the class into as many groups as there are available computers and allow each student to play the game once.) Explain that in this game, each student will be playing "Toki"—a cheetah hunting for impalas while avoiding predators on the African savannah—and that they should keep track of their "score" of successfully hunted impalas. After giving students a minute to orient themselves to the game's controls (the keyboard arrow keys control Toki's movements) have the class commence playing. (Each player is allowed only ONE game—no restarting allowed!)

2. When everyone has played the game, ask the student with the highest score what his or her strategy was. (*Answers will vary, but should include stalking the impalas from behind*.) Ask the class if they think this game is very realistic? Why or why not? (*Answers will vary, but most students probably won't think so.*) Ask students if they think individual impalas wander the savannah on their own? (*No*.) How do they travel? (*In herds*.) How do they think this helps them survive attacks by predators like the cheetah? (*Answers will vary.)*

3. Ask students what they know about the cheetah that allows it to be an effective predator. (*Answers will vary but should include mention of the cheetah's extreme speed.)* Have students log on to the "Anatomy of a Cheetah" interactive website at

www.pbs.org/wnet/nature/episodes/the-cheetah-orphans/interactive-anatomy-of-a-cheetah/662/ . Provide a FOCUS FOR MEDIA INTERACTION by asking them to note what the cheetah's various strengths and weaknesses as a predator are. Allow students five minutes to click through the different highlighted features of the cheetah before asking them to volunteer one answer each from their notes. *(Answers should include the following:*

Strengths:

- *Large eyes positioned for maximum binocular vision*
- *Enlarged heart, wide nostrils, and large arteries allow for speeds up to 70mph*
- *A flexible spring-like spine allows for long strides*
- *Long, slim legs allow a longer gait.*
- *A small, flat ribcage allows easier breathing and freedom of movement for legs*
- *Non-retractable claws and rubber-like pads on paws give better traction*
- *A long tail acts like a rudder and stabilizer at high speeds.*

Weaknesses:

- *A small head means relatively small, weak jaws.*
- *Only capable of short bursts of speed (400-600 yards) before it is exhausted*
- *Requires a half hour to recuperate between hunting, during which time it is vulnerable to predators.*

4. Ask students if they thought of any other characteristic not specifically mentioned on the website that helps make the cheetah such an effective hunter? (*The camouflaged pattern of its fur.*) Explain that this lesson will be taking a closer look at the highly specialized anatomy of both predators and their prey using video segments from the "Hunters and Herds" episode of the PBS series NATURE.

LEARNING ACTIVITIES

1. Tell students that they will now be taking a closer look at the cheetah and another of its primary prey animals—a type of antelope called a gazelle. Provide a FOCUS FOR MEDIA INTERACTION by asking students to identify which characteristics make the gazelle a worthy adversary for its predator. PLAY Clip #1, "Cheetah vs. Gazelle."

2. PAUSE the clip at 45:28, after the narrator says "But survival depends on vigilance." Review the focus question by asking students which characteristics of the gazelle make it a worthy adversary for its predator. *(Quicker turns, greater stamina over longer distances, a gut which pumps like a piston to maximize oxygen intake.)* Ask what the distinctive leaps made by gazelles are called. (*Cronking*.) Ask students if that kind of jumping reminds them of any other animal? (*Answers may vary, but a likely comparison is with the leaping behavior of dolphins.)* Ask students if they can think of any other similarities between these two mammals (i.e. dolphins and gazelles)? (*Both travel in groups--"herds" in the case of gazelles, and "pods" for dolphins.)* Provide a focus

question for the remainder of the clip by asking how the cheetah actually makes its final kill with the gazelle. PLAY the clip through to the end.

3. Review the focus question by asking how the cheetah actually makes its final kill with the gazelle. (*Once knocked down by the cheetah's extended, clawed paws, the prey is killed by suffocation as the cheetah grasps its windpipe with its blunt canine teeth.)*

4. Tell students that they will now be shifting their focus to a different part of the great African grassland, where an even more formidable predator stalks an even more powerful prey. Provide a FOCUS FOR MEDIA INTERACTION by asking students what the pros and cons of moving in herds are for wildebeests? Play Clip #2, "Lion vs. Wildebeest."

5. PAUSE at 3:27, after the narrator says "It's inevitable that some will fall prey." Review the focus question: what are the pros and cons for wildebeests of moving in herds? *(A herd is a large, obvious target, but the risk for any individual wildebeest is reduced. Overall, it boosts the chances of survival.)* Provide a focus for the next part of the clip by asking what the significance of 50 yards is in the contest between lion and wildebeest. RESUME playing clip.

6. PAUSE at 4:09, after the narrator says, "The critical distance where a wildebeest's speed often gets the better of the big cat's enormous powers of acceleration." Review the focus question: what is the significance of 50 yards in the contest between lion and wildebeest? (*It is the approximate distance at which a wildebeest's long-distance speed beats out a lion's faster short-term acceleration*.) Ask students if this contrast of abilities sounds familiar to them. (*Yes—it is the dynamic as that between cheetah and a gazelle*.) Provide a focus for the next part of the clip by asking what a wildebeest's anatomical strengths are. RESUME playing clip.

7. PAUSE at 5:08 "This is a body built to be on the move, because every day is a race for life." Review the focus question: what are the wildebeest's anatomical strengths? (*Body mass is concentrated high and forward, ideal for long-distance running and short busts of speed up to 40mph; scent glands allow wildebeests to track the other animals in their herd.*) Provide a focus for the next part of the clip by asking which of the gazelle's anatomical characteristics the lion exploits to bring it down. RESUME playing clip through to the end.

8. Review the focus question: which of the wildebeest's anatomical characteristics does the lion exploit to bring it down, and how? (*Wildebeests, with their long slender legs, are topheavy and unstable from side to side. In contrast, lions have short, heavily muscled legs which give it a lower center of gravity and the advantage in the brief wrestling match which ensues after the lion's claws have pulled the wildebeest off balance.*) What physical attributes does the lion use to make the final kill and strip the meat from the bones? (*Its canine teeth clamp onto the windpipe, killing by suffocation; its carnassial*

teeth then act like scissors to cut the meat, as sharp bumps on its tongue rasp the meat.) Is this hunting method similar to the cheetah's? (*Yes.*)

9. Ask students if they think that the development of predators' physical attributes had anything to do with the development of the physical characteristics of their prey? (*Accept all answers.*) Do they think that lions have made wildebeests faster over time? (Accept all answers.) Ask what it means for a herd of wildebeests if lions tend to prey on the slowest of their number? (*The surviving wildebeests will tend to be the fastest; all other factors being equal, as it is the survivors who will have future opportunities to pass on their genes, future generations of wildebeests will be faster and faster.*) What is this process called? (*Natural selection.*) Does this same principle of natural selection work in the other direction? In other words, do wildebeests' speed affect lions' speed over time? (*Yes. Lions unable to catch wildebeests will be unlikely to pass on their genes.*) Explain to students that natural selection is not a one-way process for a species, or even a two-way relationship between species, but rather an almost infinitely complex web of challenges and adaptations among all living creatures.

10. Ask students if they recall whether or not cheetahs, like lions, tend to prey on the weakest or slowest animals in a herd. (*They do not, preferring the fastest animals.*) What might be the "natural selection" explanation for this? (*Accept all answers, but suggest that the cheetah's ambitious appetite might be a means of regularly testing its ability to catch the fastest prey in a herd, thus ensuring that the slower animals in the herd will provide a plentiful food source.*)

CULMINATING ACTIVITY

1. Tell the class that while the two pairs of predator and prey animals they've looked at in this lesson both inhabit the same African grassland, predator and prey relationships exist in every ecosystem on the planet. Ask the class what some of these other ecosystems are. (Answers will vary, but may include desert, jungle, mountain, underground, ocean, and sky.) Break the class into groups of 3-5 students and assign each group one of the ecosystems mentioned. The following activities can either be conducted in a separate class or assigned as homework, depending on time availability.

2. Explain that each group will select one predator from their ecosystem to research, along with one type of prey on which that predator feeds. Be sure students understand that their chosen creatures may be of any shape, size, and species. As the class did together with the cheetah/gazelle and lion/wildebeest pairings, each group should research which attributes their predator has developed to make it a more effective and efficient hunter, and which attributes their prey has developed to help it survive the predator. This research should be compiled into a 5 minute presentation to be given before the class. Encourage the use of images and video clips where possible.

3. Have each group give their presentations before the class. After all groups have finished, ask if there were any attributes common to predators from different ecosystems. Where any attributes unique or specific to one type of ecosystem? Were predators' attributes adapted to their different environments? Were they adapted to the nature or behavior of their prey? What were common themes and/or unique outliers in prey animals' defenses against predators?