Blood and Guts; Animals from the Inside Out
Zoo U Summer 2010

Introduction to the Curriculum:

This curriculum attempts to introduce students to some of the basic body systems of birds, reptiles, and mammals. By the end of the week, students will have a better understanding of the way organ systems work together to keep animals alive. Activities investigate the diversity and commonalities among basic organ systems and the purpose and function of those systems. The background information for this curriculum is formatted a little differently. The key concepts and talking points are briefly outlined at the beginning of each day, but in-depth information articles and websites will be attached to the end. "Blood and Guts; Animals from the Inside Out" is written for students between the ages of 10 and 14. Most of the activities listed can be easily modified to meet the needs of 10-12 or 12-14 year-old groups. Notes are made in the instances where significant modification may be necessary.

Critical Attributes/Understandings:

- Each body system serves an important function and is connected to every other system.
- The cells in animal bodies have a very specific set of chemical and temperature needs collectively referred to as homeostasis.
- Every body system contributes to the animal's ability to maintain homeostasis (stay alive).
- Most vertebrates' body systems work in very similar ways.

Essential Questions Driving the Learning:

- If you were to make an animal from scratch, what organs and systems would be necessary for it to stay alive? (Driving question throughout the week)
- How do organ systems help animals maintain homeostasis (stay alive)?
- How are vertebrate organ systems alike and different?
- How do organ systems interact with one another?

Predictable Misunderstandings and Errors:

These are broad misunderstandings to be aware of throughout the week. Predictable misunderstandings about specific organ systems will precede each daily plan

- Assuming that most animals are the same inside.
- Assuming most animals are vertebrates.
- Believing that exothermic animals actually have cold blood.
- Considering one body system more or less important than other body systems in keeping an animal alive.
- Thinking about organ systems as separate or isolated from other systems in the body.

Pre-camp Preparation for Animal Bodies Curriculum

- Request a snake and gecko animal encounter for the Connective Tissue days.
- Request a Day and Night house BTS tour for the Respiratory System days.
- Request a tour/talk with the Commissary or Dr Doo on the Digestive System days.
- Put out an all-zoo email request for the following reused items:
    - Plastic drink bottles (20-ounce preferably, but 2-liter will work)
    - Film canisters (there are plenty in storage as of 10/09)

Best Practice Hints and Suggestions:

Build understanding through:

- Providing opportunities for students to connect new concepts to what they already understand about the way the world works
- Activities, crafts, and games that relate directly to the content
- Zoo tours in which the students are able to observe evidence from discussions
- Exploring biofacts and manipulatives
- Discussions in which the students are encouraged to give answers and ask questions of one another

Hints for better information retention:

- Repeat information in new contexts
- Give 10 minutes of information, then break or change topics.
- Guide students in connecting new information to previous topics

Management strategies helpful for groups of 10-14 year-olds:

- Provide as many opportunities as possible for peer discussion and interaction.
- Give students ownership of the group conduct expectations.
- Be clear about the reason for limitations on their behavior, pre-empt the "Why not?" questions by providing the explanation before stating the rule.
- Find ways to say "yes" as often as possible.
- Be clear in expecting that students will challenge themselves to the edge of their comfort zones and treat them accordingly.
- Some of the activities may seem too immature for a particular group of students, omit any activities the group is unlikely to enjoy. Depending on the preparation required, instructors may even want to offer the craft as a choice allowing the group to decline.

Day 1: What does a body do? Introduction to systems and vocabulary

Essential Questions:

- What organs and systems are necessary when creating an animal from scratch?
- How do animal bodies stay alive?
- What types of systems are needed to maintain homeostasis?
- How do scientists communicate about where things are in an animal's body?

Objectives: Students will be able to:

- Act out their understanding of homeostasis.
- Describe at least three basic functions an animal's body must perform to stay alive
- Connect at least two body systems to the basic functions they serve in maintaining homeostasis
- Locate specific parts of an animal by following anatomical directional terms
- Select or create a short description of a habitat and it's challenges for the animal mash-up project

Discussion/key concepts

- What do bodies do?
  - Animal bodies do an incredible number of things in order to stay alive: eating, sleeping, breathing, moving around, sensing the outside world, communicating, the list goes on.
  - When we stop to examine what is required for each of these activities, we discover a whole new world of interdependent cells, tissues, and organs.
  - In many ways, the systems in an animal's body are as intricate and intertwined and those of the richest ecosystems in the world. Being alive is amazing!

- How do bodies stay alive? (Homeostasis)
  - The chemical process involved in being alive can only happen in a relatively narrow range of conditions.
  - Maintaining these conditions is called homeostasis: "homeo" is derived from the Greek root word meaning similar or constant and "stasis" is from the Greek root meaning standing still.
  - Some conditions involved in staying alive include: body temperature, glucose levels, hydration, oxygenation, blood pH, and waste concentrations
  - The following link takes you to an interactive program where you attempt to maintain homeostasis in a human body by adjusting multiple factors. It is a little too complicated for the majority of the students, but is a good illustration for instructors to build a better understanding. http://www.teachersdomain.org/asset/tdc02_int_bodycontrol/.

- What types of systems are needed to maintain homeostasis?
  - Essentially every body system plays a part in maintaining homeostasis. Below is a list of the typical systems studied in anatomy.
    - Integumentary System (Skin etc.)
    - Skeletal System
    - Muscular System
    - Circulatory System
    - Respiratory System
    - Digestive System
    - Nervous System
    - Endocrine System (hormones)
    - Immune System
    - Reproductive System

- A note about system definitions: because these systems are linked so closely, the boundaries of each system can be adjusted based on the question scientists are trying to answer. For example, the liver might be considered part of the digestive system or circulatory system or endocrine system depending on what aspect of the liver someone is investigating.

- How do scientists communicate about where things are in an animal's body?
  - Anatomical directions are a fun bit of knowledge and create a shared vocabulary for the week.
  - However, they are not necessary to understanding body systems. If students are not having fun using these words, there's no reason to push the issue.
  - Refer to the Anatomy Construction Vocabulary Card in the appendix for the terms and their definitions.
  - The following link takes you to a Wikipedia article with more information about anatomical directions. http://en.wikipedia.org/wiki/Anatomical_directions

- Limited scope: The animal kingdom is comprised of animals as small as a single cell and as large as great blue whales. Because this is only a week-long curriculum, it cannot do justice to this amazing variety in the world. During the week the students will only be examining a small section of animals whose anatomies are more similar to our own.

Biofacts/props
- Animal Kingdom Poster
- Pictures of a variety of bioclimatic zones

Explore the Zoo
- Northern Trail: focus on animals' adaptations to maintaining homeostasis in more extreme weather conditions.
- Bug World: focus on the amazing variety of invertebrates that this curriculum isn't addressing.

Activities

Group Building/Expectation Setting (15 min)

Taking time at the beginning of the first day to establish the tone of the group will pay off when activities depend increasingly on students self-managing and working well together as the week progresses. The activity below is just one suggestion. Group dynamics may require a less introspective activity.

Ages: 10-14

Materials: Scrap paper, pencils, whiteboard, markers

- Give each student a piece of scrap paper and a pencil. Ask students to write down the following: (It may be helpful to have these topics written on the whiteboard.)
  - Three things that you are most looking forward to doing this week,
  - Three things that people do that make you feel respected or comfortable,
  - Three things that others can do to help you have fun at camp.
- Use a piece of poster paper to record student responses as you facilitate the conversation.

- After students have shared, work to summarize the group's thoughts into three to five guidelines for the week.
- Write these guidelines clearly and boldly on a piece of poster paper and ask students to add their names to the bottom of the paper (alternatively have students trace their hands on the paper and write their names inside their hands).

What do bodies do? (15 min)
This activity is intended to help instructors find out what their students understand about the way bodies work. Instructors should resist the temptation to correct misunderstandings or over-share information.
Ages: 10-14
Materials: Whiteboard and markers, note paper, pens or pencils,

- Have students think of all the things their bodies did from the time they woke up until they arrived here. Record a list of common activities on the whiteboard.
- Give students 3 minutes to break down larger activities into as many discrete parts as possible and record those activities on their note paper. (e.g. Eat Breakfast might break down to tasting, chewing, swallowing, and digesting.) The actual time provided for this might be more or less than the stated time depending on when the group starts to run out of ideas.
- Ask students to identify body parts that correspond to these discrete activities or place question marks to ones they might not know.
- Lead a short discussion allowing students to share their answers if they want. This discussion may begin the process of thinking about the way these body parts interact.

Stayin' Alive (Homeostasis Introduction) (15 min)
Introduction to the concept of homeostasis based on the "Yurt Circle" type activities.
Ages: 10-14
Materials: Space to spread out on relatively level ground

- After the "What do bodies do" discussion, encourage students to consider some of the different things a body needs to stay alive (air, food, water, and warmth at the very least). Discuss that it is not just whole animal bodies that need these things, but each and every cell inside the animal's body needs its own special environment in which to live. This optimal condition is called homeostasis. Different body parts and/or cells are responsible for maintaining different aspects of homeostasis.
- Have students partner up with one other person, hold hands, and lean back to the point that if either one let go they would fall. You can think of this dynamic as one aspect of maintaining homeostasis like temperature.
- Now have the partners group up with one other pair, hold hands and lean back. Now you have two aspects of homeostasis working like temperature and water concentration.
- Add yet another pair to this circle. The new pair could represent maintaining a constant oxygen level. This time, every other person will need to lean forward instead of back. Maintaining balance in this circle is much more difficult and often there will be a continuous sense of motion as students work to stay up. Sometimes maintaining one aspect of homeostasis can send another one off balance temporarily. Staying alive is pretty tricky.

- Continue this trend until the whole group is in a single circle. (Some examples of additional homeostasis factors: glucose/energy, waste, and pH)
- Once balance is established with the whole group, get them to sing the chorus of "Stayin' Alive" for fun and as a way to remember the meaning of the word homeostasis.

Habitat Adaptation Tableaus (20 min)
Brainstorm and act out some of the things an animal's body might be specifically adapted to address.
Ages: 10-14
Materials: Pictures of a variety of bioclimatic zones, pictures of multi-species interactions, strips of paper.

- Introduce this activity with a short discussion about how animals are adapted to specific habitats using pictures as conversation aids as needed.
- Work with students to create a list of 4-6 categories of factors influencing an animal's habitat. Something like:
  - Climate and seasons
  - Terrain
  - Water
  - Vegetation
  - Competition
  - Predation
- Assign students to category teams in order to create a set of 4-6 different types of each category factor. (e.g. Terrain team might come up with rocky mountains, sand dunes, open plains, and rolling hills.)
- Have them write each type on a separate slip of paper.
- Using the same teams or reconstructing 4 new teams, give one slip of paper from each category to each team (every team will have a climate, terrain, water, vegetation etc.)
- Give teams about 3 minutes to create a Tableau or visual story about their new habitat. Or allow teams to describe a kind of animal that could live in this habitat and how it is adapted to do so.

Body Systems Puzzle (20 min)
Group puzzle to connect body systems with the functions they perform. A note about this puzzle, each piece is identical in shape. This means that every piece connects with every other piece in some way or another. The text of the clues has been printed in several different directions to encourage students to see each piece differently.
Ages: 10-14
Materials: Tessellated puzzle with body system names/descriptions and homeostasis factors (see attached)

- Lead a short discussion to introduce the body systems referencing the major organs students already know.
- Shuffle the puzzle pieces and distribute at least one piece to each student
- Note that some factors may require more than one system to stay in balance
- Note that some systems may serve more than one function
- Have students find at least one piece to connect with the one in their hand
- Have those pairs find other connections until the puzzle is completely assembled. Remember, this puzzle may look different every time it is assembled.
- Wrap up
  - How did they decide on connections?
  - Were there any connections they didn't understand?
  - Are there connections that are not illustrated in the puzzle?

Limited Scope (10 min)
Discussion acknowledging that there are many more kinds of animals and ways to maintain homeostasis than can be examined in a single week.
Ages: 10-14
Materials: Animal Kingdom Poster

- Lead a short discussion exploring the poster and pulling from what students already know about the differences between the animals this curriculum will cover and the animals it will not.
- Why might we choose to limit the scope the way we have? (Most like the bodies we're already familiar with)
- Head to Bug World to visit and contemplate some of these animals at least briefly.

Anatomy construction (25 min)
This activity illustrates the usefulness of common vocabulary for locating and describing animal parts.
Ages: 10-14
Materials: Play dough (or model magic), pre-built model magic animals, construction taboo word cards, anatomy construction vocabulary cards

- Have students work in pairs and sit back-to-back.
- Give one partner a ball of dough and the other a picture of model animal
- Each picture is accompanied by a list of taboo words
- Have the students with pictures tell their partners how to build the model without using any of the taboo words
- Distribute and read over the anatomy construction vocabulary cards
- Redistribute the cards and more dough allowing partners to switch roles using the anatomy construction vocabulary cards a reference
- Wrap-up:
  - Was the shared vocabulary helpful?
  - Were there other difficulties that the vocabulary didn't address?
  - How might scientists use these words?

"Anatomeese" (Anatomy Direction Game) (20 min to introduce)
Once the rules of this game have been established, it can be played during short transitional periods or as a way to blow off steam throughout the week. "Anatomeese" is loosely based on the Ship-to-Shore style camp games. The intent is to expose students to some of the directional vocabulary used in the study of anatomy. Kinesthetic learners will find this activity helpful in retaining these words. While some students may retain this vocabulary, the key objective of this activity should be to have fun and be playful.
Ages: 10-14
Materials: A little space to spread out,

- Explain and practice each of the terms and their actions
- Call out the terms and give a specific response time (shortening as the week progresses). Students who fail to respond or respond incorrectly are out and will get another chance next time.
- Play until there is one clear winner or shortly before the group loses interest.
- Directional term actions

        - Anterior: Shoulder shimmy facing front
        - Posterior: Back up with "reverse beeper"
        - Lateral: Open jumping jack (arms and legs spread)
        - Medial: Closed jumping jack (hands together over head and feet together)
        - Cranial: Pat head
        - Caudal: Wag tail
        - Proximal: Touch shoulders
        - Distal: Jazz hands
        - Dorsal: Arched cat pose on all-fours
        - Ventral: Lay on back with arms and legs in the air.
    - Other vocabulary term actions (add as they are covered throughout the week)
        - Homeostasis: Disco arms while singing "Stayin' alive, stayin' alive, Ah Ah Ah, stayin' alive"
        - Endothermic: Jogging and miming eating (optional vocal: "Feel the burn!")
        - Exothermic: Sit in a sunny spot (optional vocal: "Chill out!")
        - Individual groups may be inspired to come up with more. Have fun with it.

Animal Mash-up Project Description (25 min)
A "mash-up" in music lingo refers to combining elements of two or more popular songs often from very different genre to create something new (follow this link to a mash-up called "Every Car You Chase" http://www.youtube.com/watch?v=7O3Z00jn47M). This activity is intended as a way for students to record and apply the things they learn throughout the week. In the sample schedules, Mash-ups are listed as the conclusion activity at the end of each day, but could be moved to a review activity at the beginning of the next day in most cases.
Ages: 10-14
Materials: Crafting supplies, reference and collage pictures of animals, notebook paper, pens/pencils,

- Explain the concept of a music "mash-up" to students (or have students tell you what they know about them)
- Challenge students to create an animal mash-up of their own using what they learn over the course of the week. Their animal might have a reptile's circulatory system, mammal fur, and a bird's respiratory system.
- Students will want to consider the habitat their animal will be living in as the driving factor behind their choices about which systems to use.
- Explain that each day they will have the opportunity to add more detail to their mash-ups.
- Encourage students to describe their mash-ups using whatever medium works best for them including but not limited to drawing, collaging, modeling, written descriptions and any combination therein.
- A rough guide for topics is listed below, but this project should be adapted to the needs and interests of each group and its students.
    - Day 1: Climate, habitat, body shape and size, endothermic or exothermic.
    - Day 2: Skin covering, bone and muscle structure.
    - Day 3: Heart and lungs
    - Day 4: Digestive tract
    - Day 5: Nervous system and glands

Day 1 Sample Schedule

Start	Activity Description	Length	Transition
9:15	Group building, expectation setting	0:15	0:05
9:35	What do bodies do? Eliciting ideas activity	0:15	0:05
9:55	Staying Alive (Homeostasis introduction lesson)	0:15	0:05
10:15	*Tour of Northern Trail* (snack on tour)	1:10	0:10
11:35	Habitat Adaptation Tableaus	0:20	0:05
12:00	Lunch w/Zooper	0:30	0
12:30	"Free-time"	0:30	0
1:00	Body Systems Puzzle	0:20	0:05
1:25	Limited Scope Discussion	0:10	0:05
1:40	*Bug World Tour*	0:30	0:05
2:15	Start Animal Mash-up Project	0:25	0:05
2:45	Snack and Break	0:10	0
2:55	Anatomy Construction	0:25	0:05
3:25	Introduce "Anatomeese" (Anatomy Direction Game)	0:20	0:05
3:50	Pack-up and Check-out		