

The natural history of the human body reflects billions of years of evolutionary history. Come explore some of the characteristics that we share with other organisms as a result of our common ancestry.

### Fourth Floor (Panorama)

#### 1. Look at the plants throughout the Panorama. Think about the diversity of colors you see.

*Trichromatic vision.* Humans and our close primate relatives (e.g. baboons, chimps) have **trichromatic** (“three-color”) **vision** based on three different visual pigments, which means they can discriminate between reds, blues and greens (unless you are color blind).

*Produce Picking.* The ability to see a wide range of colors in primates is thought to be an adaptation for finding and selecting ripe food in dense forests. Compare the three photographs below and consider how color vision might be helpful to determine ripeness? Ask Visitor Services if you need a color copy of these images.



*Monochromatic* – see grays

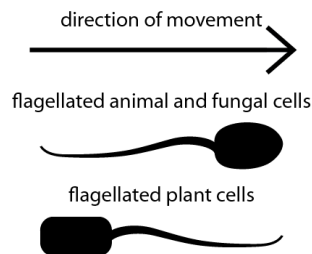
*Dichromatic* – see blues & greens

*Trichromatic* – see reds, blues & greens

#### 2. Go to the Boreal Forest and look for the paper birch tree to the right in front of the caribou. Find the mushroom on the ground in front.

*All in the family.* Think about yourself, the mushroom and the tree. Of the three of you, which two organisms do you think are most closely related to each other?

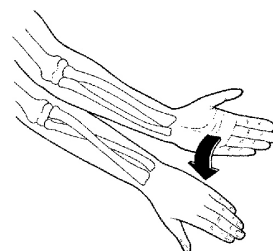
*Fungus Among us.* The two most closely related are the mushroom and you! Surprised? Although for a long time, fungi were considered plants, we now know that animals and fungi are closely related making up the group “opisthokonta”. The character fungi and animals share is the **tail location in their flagellated cells**—cells with tails. It is located on the posterior side.



### Third Floor (Fossil Galleries)

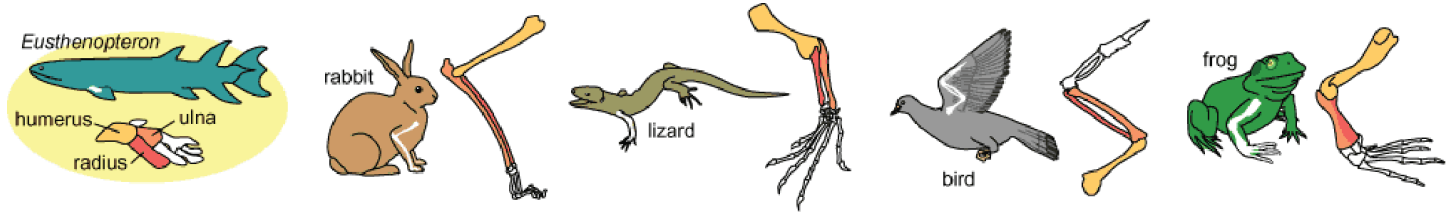
#### 3. Find *Eusthenopteron* in the Devonian fish exhibit.

*Tricky Turning.* Hold your arms out in front of you, palm side up. Now try turning your hand over **WITHOUT** rotating your wrist to cross the bone on the outside of your arm over the inside one.



*Frustrated?* The ability to rotate our wrist independently from the rest of our arm results from having **two separate bones** in the lower part of our arms allowing one bone to rotate around the other. Otherwise, you would have to rotate your entire arm at the shoulder.

*Long History.* This basic forelimb pattern of one bone in the upper part that articulates with the body and two bones in the lower part, seen in the fish *Eusthenopteron*, traces its origins back to our distant relatives, the earliest tetrapods (four-legged vertebrates) and their fishy ancestors more than 360 million years ago.



#### 4. Find the exhibit with the fossil fish *Xiphactinus*. Look at where the head meets the body.

*Flop like a Fish.* Imagine that you have no neck and your head is attached directly to your shoulders, and then try to look around. In bony fishes, the skull is directly attached to the pectoral girdle—bones in the shoulder area, so they cannot move their head independently from their body.

*Turn around.* The skull no longer being attached to the shoulder area and having a **distinct neck region** is a feature we share with other tetrapods (four-legged vertebrates).

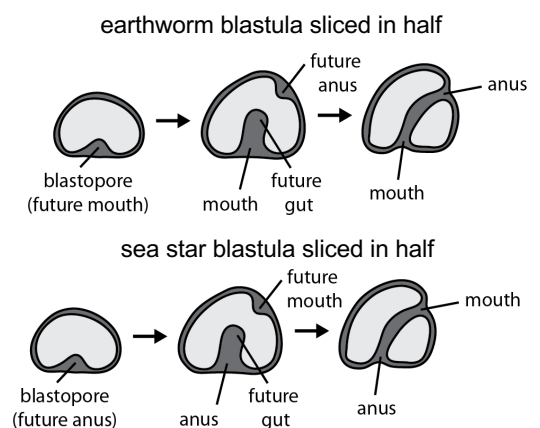
*vertebrae Diversity.* Look at the complete **mosasaur skeleton** on display nearby or find another non-fish vertebrate skeleton, and observe the different regions of the backbone in the body, and the distinct features of the vertebrae in each section.

#### 5. Go to the evolutionary tree diagram showing animal relationships in the invertebrate case. Find the shared character labeled 'gill slits at some point during development'. Another shared character relates to the formation of the early gut.

*Beginning of the End.* The digestive system in most animals is a long tube running the length of the body with an opening at either end. Early in development, all animals are a hollow ball of cells or blastula, and then an opening forms called the blastopore along with the future gut.

*Earthworms, Squid, Cockroaches and More!* In most major groups of animals, the first hole becomes the mouth and a second opening forms the anus later.

*Talking out of another hole?* This initial opening in echinoderms (e.g. sea star, sea cucumber) becomes the anus. In humans and other vertebrates, this first hole closes; new ones develop later. The developmental character we share with echinoderms relates to the blastopore – the cells that eventually form fluid-filled body cavities (e.g. pericardial sac that surrounds our heart) pinch off from the early gut as the digestive system and blastopore form.



#### 6. Find the trilobite display. Look for the eyes on display or watch the video about trilobite eyes.

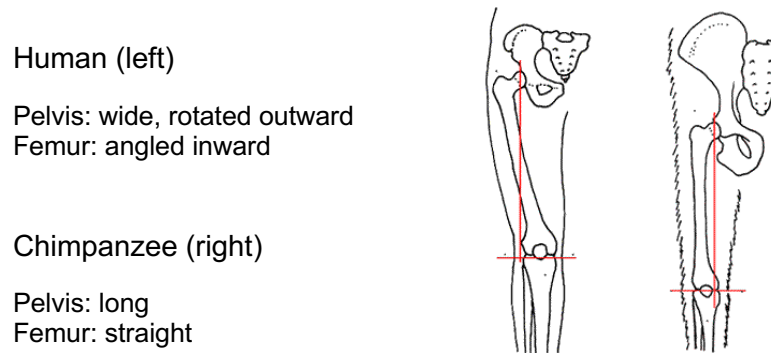
*Bug Eyed.* Arthropods, such as trilobites, crabs and flies, have compound eyes—what you would think of as a typical 'bug eye' with multiple lenses. You can see this most clearly in the trilobite *Phacops rana*. Light sensitive organs have evolved independently in different lineages. Eyes have diverse forms including the single lens eye in vertebrates, the photoreceptive cells in sea star arms, and the pit, slit and lens eyes in box jellies. However, light-sensitivity in all animals is due to the shared gene that codes for the protein **opsin** that absorbs light.

## Fifth Floor (Explore Evolution)

### 7. Find the mirrored wall in the human/chimp exhibit. Compare your backside to that of chimpanzees.

*Ever Wondered?* Perhaps you have noticed that compared to humans, chimpanzees and other non-human primates have flat backsides.

*walk this way.* Humans, and our most recent extinct relatives, are the only primates that are habitually **bipedal**—walk on two legs. Our fleshy backsides reflect the thick and strong *gluteus maximus* (butt muscles) that attach high up on the back of the pelvis, providing leverage and stability.



*Flat Butts.* In non-human primates, the *gluteus maximus* are small muscles that attach low on the pelvis, and are used to extend the hip backwards (i.e. think climbing).

### 8. Find the mitochondrial DNA sequence in the “Evidence for Whale Evolution” section.

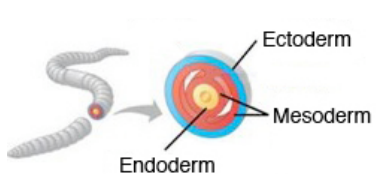
*What are those letters?* Those four letters—A, C, G and T—represent nucleotides, or the chemical building blocks of DNA sequences. All structures in all living things start with nucleotides.

*Why are they similar?* More closely related organisms have more similar DNA sequences. Compare the Amazon river dolphin, hippopotamus, human and chimpanzee sequences—note how similar they are. All these animals are mammals and so share much of their sequence due to shared ancestry.

*Why are they different?* The hippo and dolphin sequences are more similar to each other, than they are to human and chimps. This means that they share a common ancestor with each other more recently, than they share a common ancestor with humans and chimps. Look for when these groups are thought to have shared common ancestors on the “Whales: Evolution from Land to Sea” and “Our Closest Living Relatives” diagrams. Humans and chimps shared a common ancestor with hippos and whales at least 55 million years ago.

## Sixth Floor

### 9. Find the earthworm in the Darwin exhibit. If you cut it in half, it would look like this.



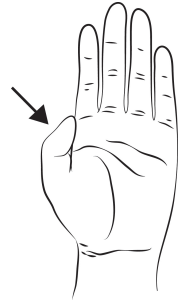
*Triple Layers.* Most animals have three tissue layers and are called “**triploblasts**” (check out the evolutionary tree in the third floor invertebrate exhibit). The inner or endoderm layer forms the inside of the digestive system. Mesoderm or the middle layer forms muscles, bones and most organs. The outer or ectoderm layer forms the outer skin and nervous system.

*Series of Tubes!* Most animals—triploblasts—are based on a tube-within-a-tube body plan with specialization in parts of the tubes: a central internal tube (guts); several other tubes for different jobs (circulatory, nervous systems); and an outside tube to hold them all together and for moving around. Three tissue layers and a tube-based body plan are features humans share with other animals.

## 10. Find the Kansas squirrels exhibit, and look at its hands.

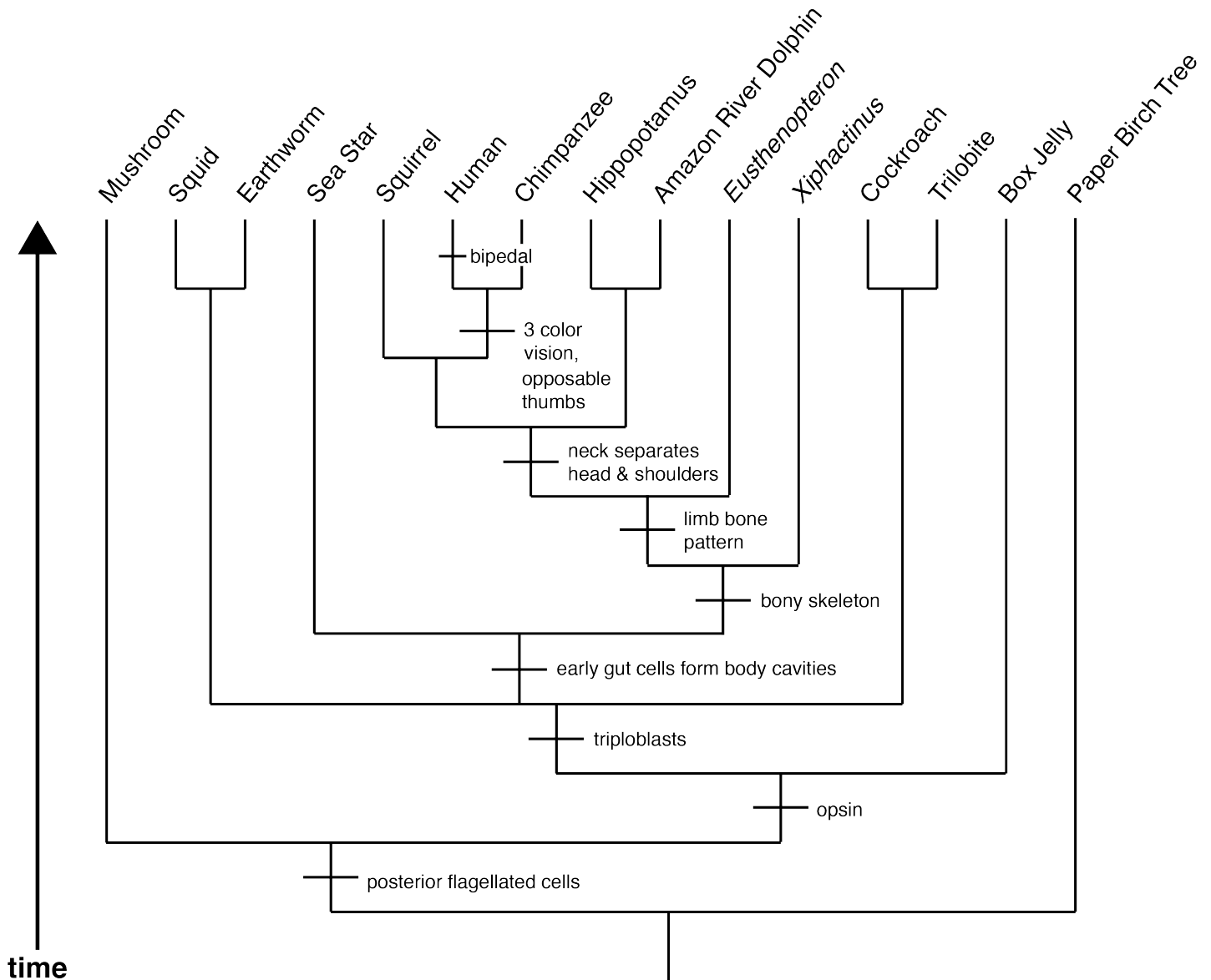
*All Fingers!* Hold your thumb against the side of your hand—to simulate the non-opposable thumb of most mammals. Keeping your thumb tight against your hand, try to flip and fold over this page.

*Dextrous Digits.* An **opposable thumb** or pollux means that it can be moved around to touch the ends of the other fingers giving us the ability to grasp and manipulate objects. Grasping hands is a feature we share with most other primates.



## Putting it all Together – Evolutionary Trees

Tree diagrams show the evolutionary relationships between organisms; this tree includes organisms discussed in this guide, and the shared characters that support these relationships and reflect common ancestry.



What to know more? Check out these resources.

*Your Inner Fish: A Journey into the 3.5-Billion-Year History of the Human Body.* (2008) Neil Shubin. Pantheon Books.

*The Ancestor's Tale.* (2004) Richard Dawkins. Houghton Mifflin.