

# Your Hands, My Feet, My Fins, My Wings Our Bones!

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(Adapted from the comparative anatomy exhibit at the University of Oregon's Natural History Museum)

## Synopsis:

Visitors will observe common bone structures between the frontal forelimbs of five different mammals. Then they will compare two different phylogenetic trees of mammals one derived from morphology and one from genetics to see the different trees that different types of evidence produce. The last activity will be to predict and draw what a digging mammal's forelimb would look like and compare that prediction to a mole's limb. The big ideas for this lesson are life's connection through comparative anatomy and how biology is always changing based on new evidence.

## Audience:

The target audience will be the general public from about 8 or 9 years old to adults. Primarily this activity is suited to a table top outreach setting. This activity could also be adapted to a Middle School or High School classroom setting.

## Activity Learning Goals:

- 1) Visitors will develop an understanding that anatomy is comparable between different species.
- 2) Visitors will be able to explain how/why comparative anatomy is substantial evidence for evolution and realize the diversity adaptations create in homologous structures.
- 3) Visitors will be able to walk away with the basic ability to interpret a phylogenetic tree and explain that life evolves from common ancestors.

## Concepts to Address:

- 1) Evolution/Adaptation (evolutionary modification of structures to specific adaptations of a species, i.e. a bat wing to fly)
- 2) Comparative Anatomy

- 3) The biological connection of life on Earth
- 4) Phylogeny
- 5) Descent with Modification (Darwin)

## Materials (Estimated Cost- Under \$20)

- Poster board (see example photos)
- Permanent marker, markers and colored pencils along with a pencil box
- Printouts of the forelimb bone structure of a human, bat, horse, dolphin, dog, horse and mole, along with separate labels if needed (included after example photos)
- 5 Clear paper protectors for each animal listed above with permanent marker outlines for each bone structure.
- Printouts of Phylogenetic trees (morphological and genetic)
- Sizable stack of blank paper, enough for your audience
- Tape and stapler/staples
- Table Décor, i.e. table cloth, streamers, etc. (optional)
- If possible: 3D replica or actual bone structure of a mammal forelimb
- Notes if needed

## Preparation (Approx. 1-3 hrs)

Write activity title and place phylogenetic trees on poster board, and make it eye catching with bold colors or however you'd like to decorate it. Possibly add photos of mammal x ray bones. Print out bone structures and place in clear paper protectors, then draw an anatomically correct outline around the bone structure. The humerus is red, radius purple, ulna blue, carpals yellow, metacarpals green and phalanges orange. Review included vocabulary if needed. Gather necessary supplies.

## Set-Up:

Decorate table or designated area (optional). Set up poster board, preferably to one corner of the table, but leave off the animal cut outs. Lay out the paper protectors and place bone structure print outs face down beside them. On the other corner of the table make a pile of blank paper and set marker/colored pencil filled pencil box on top. (see example photos).

## Guiding Questions:

What do you know about where different species come from?

What types of things do you think animals/mammals have in common?  
What do you know about the bones in your hands?  
Have you ever made a family tree/have you heard of a phylogenetic tree?  
Have you heard of Darwin's Finches?  
What do you think this limb is used for?  
What similarities can you think of between us and other mammals? Other animals?  
What type of environmental pressures do you think caused this particular animal to develop this bone structure?  
What do you think about the similarities between our bones and other animals' bones?  
Why do you think these phylogenetic trees are different?

### Activity Description:

Begin by asking visitors what they know about evolution and comparative anatomy (see Guiding Questions). Then have them look at bone structure print outs of the human, bat, horse, dolphin and dog, and let them guess which animal each may be. Then have them place the bone printouts in the appropriate paper protector. Discuss the similarities and differences between each animal and expand upon concepts like adaptation and common ancestry. After that have visitors look at each phylogenetic tree and discuss that placement along with emphasizing common ancestry links. Also explain that different evidence gives different results and new evidence can change biology. Lastly have the visitors predict how a mammal's forelimb structure would look on a mammal adapted for digging, then have them draw that prediction. Compare that prediction to a print out of a mole's forelimb bone structure. If desired hang predictions around the table/designated area, unless the visitor wants to keep it. Encourage visitors to communicate and help each other with the activities.

### Teaching Strategies:

Teaching strategy will be to follow the 5 E's of the learning cycle:

**Engagement:** Engage the visitors by drawing them in with the title and colorful layout of the table. Ask questions to access prior know and encourage visitors to interact with the comparative bone structure activity.

**Explore:** Allow visitors to explore comparative anatomy through the comparing the bone structure and through learning about the phylogenetic tree. They will need to know that they are looking at mammal forelimbs and that the bones which are colored the same are the same bones.

**Express:** Visitors will express how they are understanding the connection between the comparative anatomy and evolution by how connecting with the idea of common ancestry on the phylogenetic tree. Continue asking open ended questions (see guiding questions) so they can express their understanding through their answers.

**Elaborate:** Elaboration will occur with predicting the forelimb structure of a digging mammal. This will encourage visitors to take what they are learning further by putting them in the place of a biologist. Guide learners to make predictions much as biologists do when discovering and looking for new species.

**Evaluate:** Evaluate the visitors learning throughout the activity. Ask open ended questions to evaluate their understanding and observe their own explanations to other visitors if possible. When comparing the bone structures make sure they understand the connection that all of these mammals have and how that relates to the connection of all life on earth. Understanding the phylogenetic tree and the results of the digging mammal prediction activity will also allow evaluation that visitors are making a connection with what real biologists do and the predictions they make.

## Vocabulary:

Comparative Anatomy/Evolution/Phylogeny or Phylogenetic Tree/Homologous/Analogous/Clade/Bones: Phalanges, Metacarpals, Carpals, Radius, Ulna and Humorous/Common Ancestor/Morphology/Genetics

## Science Content Background and Additional

### Resources:

Be sure that you have an understanding of evolution, phylogeny and comparative anatomy. Become familiar with the forelimb bone structure of mammals. Review vocabulary and concepts to address.

Suggested resources: A section on comparative anatomy in any biology textbook.

Google images works well to find images of bone structures and phylogenetic trees, just include the URL on the printout for citations of the phylogenetic tree. The dollar store would be a great resource for supplies.

Included are example photos and bone structures as follows: human, horse, bat, dog and dolphin.

















