

# Dinosaur Hearing

## 1-Line Summary

This demo explores how and what dinosaurs could hear through a comparison of basilar membrane lengths.

## Background:

Dinosaurs, like other birds or reptiles, did not have the outer ears that come to mind when we think of hearing. However, they did have ears and they used them to listen to sounds from their environment and other organisms. Scientists have been able to reconstruct the hearing abilities of dinosaurs by comparing fossilized ear bones with those of modern dinosaur relatives, such as crocodiles and birds, and applying basic principles of hearing.

One especially informative part of the ear that can be examined from fossilized remains is the basilar membrane length. The basilar membrane is a part of the ear that contains thousands of sensory hair cells, as well as analyzes frequencies by resonating at different points. Dinosaurs were large animals with long basilar membranes, indicating that they likely heard much lower frequencies than smaller species with shorter basilar membranes. Another important general rule is that larger animals typically hear and create sound and lower frequencies than smaller animals. It is estimated that dinosaurs likely had a range of hearing limited to lower frequency sounds, similar to that of large mammals such as elephants. The range of their hearing was likely about 600 Hz-3 kHz, comparable to modern birds and reptiles with a range of 1-5 kHz and considerably lower than the typical human upper limit of 20 kHz.

Hearing, while not the most important sense, would have served several purposes for dinosaurs. It would have allowed them to communicate within and amongst groups, which would have been particularly important amongst herd dinosaurs or those with complex signaling systems. It also would have allowed them to hunt for prey or avoid predators around them.

Readings:

*Introductory* –

<http://hearinghealthmatters.org/hearinginternational/2012/what-did-the-dinosaurs-hear-robert-traynor/>

*Advanced* –

Dooling, R., Gleich, O., & Manley, G. (May 01, 2007). Audiogram, body mass, and basilar papilla length: Correlations in birds and predictions for extinct archosaurs. *The Journal of the Acoustical Society of America*, 121, 5, 3052.

## Materials:

- Human ear model
- Dinosaur ear model
- Bird ear model
- Frequency sounds

## The Interaction:

*The pitch* – Do you want to learn about dinosaur hearing?

*Using the materials* –

1. Show visitors a model of the basilar membrane and explain what it is and how it works, as well as how it can be used to determine the frequencies an animal can hear.
2. Show visitors the different models of dinosaur, human, and bird ears and have them compare their basilar membranes. Ask them whether those animals would likely hear higher or lower frequencies. The dinosaur would hear lower frequencies and the bird higher, which the human should be somewhere in the middle.
3. Play for visitors the range of frequencies dinosaurs could hear to listen for how much of that range overlaps with their own hearing ability.
4. If visitors are interested you can talk about other animals like birds and whales and compare their different ear morphologies and hearing ranges.

**Messages:**

*Critical take home:* Dinosaurs could hear, and their hearing was limited to lower frequency sounds.

*But wait, there's more:* By observing and estimating different anatomical features of fossilized remains, scientists can reconstruct how extinct organisms hearing worked and the types of sounds they likely could have heard.

*And still more:* Other animals such as birds, whales, and humans, have their own unique hearing ranges based on their own ear morphologies. These ranges can be compared to dinosaurs to look at how hearing varies across the animal kingdom.

*And one more thing:* The hearing abilities of dinosaurs have implications for their speech abilities. They imply that dinosaurs did communicate through sound, and that those sounds were of lower frequencies.

**Homework:**

Tell visitors to listen to the dinosaurs in movies or TV shows and think about how they are portrayed either scientifically or dramatically. Suggest they think about whether the sounds the dinosaurs are using are actually at a realistic frequency for their hearing ability.

**Make the Link:**

This demo is a great linguistics connection with the AMNH Dinosaur exhibit as visitors can apply what they have learned about dinosaur hearing with the dinosaurs they will see in the exhibit.

It is also a good way to take a demo like the Ear Model a step further. The elements of the ear learned about in the model can be compared to another animal to show how the same basic principles result in different sensory abilities.

The Spectrogram is a great way to help visitors see the difference between high and low frequencies.

**Target Audience:**

This demo works well with many ages. Older kids, teens, and adults, will certainly understand frequency and the link between the physiology and hearing ability better, but younger children should be able to grasp the basic and fairly straightforward concept of larger animals hearing lower noises.

Bird, dinosaur and human cochlea for comparison:





