

State Science Curriculum Standards for Unit 2: Of Skulls and Teeth			
Level	Exercise 1	Exercise 2	Exercise 3
K-3	K-3.1.1, K-3.1.2, K-3.2.2, K-3.2.3, K-3.11.1*, 1-3.3.1, K-3.5.1, K-3.5.2, 3.4.3*,	K-3.1.1, K-3.1.2, K-3.2.2, K-3.2.3, K-3.11.1*, 1-3.3.1, K-3.5.1, K-3.5.2, 3.4.3*,	
4-5	4-5.2.1, 4-5.2.2, 4-5.3.1, 4-5.3.2, 4-5.5.1, 4-5.5.2, 4-5.6.1*, 4-5.11.2*, 4-5.14.1*	4-5.2.1, 4-5.2.2, 4-5.3.1, 4-5.3.2, 4-5.5.1, 4-5.5.2, 4-5.6.1*, 4-5.11.2*, 4-5.14.1*	4-5.2.1, 4-5.2.2, 4-5.3.1, 4-5.3.2, 4-5.4.1*, 4-5.4.2*, 4-5.5.1, 4-5.5.2, 4-5.6.1*, 4-5.6.2*, 4-5.11.2, 4-5.14.1*
6-8	6.2.1, 6.2.2, 6.3.1, 6.5.1, 8.5.1	6.2.1*, 6.2.2*, 6.3.1, 6.5.1, 8.5.1	6.2.1*, 6.2.2*, 6.3.1, 6.5.1, 8.2.3*, 8.5.2, 8.11.4*
Gateway	2.5, 5.1, 5.2, 5.3		2.5, 5.1, 5.2, 5.3
Life Science	2.2*, 2.3*, 2.4* 2.6*, 5.1*, 5.2*, 5.3*, 6.4*, 6.5*	2.2*, 2.3*, 2.4* 2.6*, 5.1*, 5.2*, 5.3*, 6.4*, 6.5*	2.2*, 2.3*, 2.4* 2.6*, 5.1, 5.2*, 5.3, 6.4*, 6.5*
Biology I	2.3*, 2.4*, 2.5*, 6.1*, 6.2*, 6.3*, 6.4*	2.3*, 2.4*, 2.5*, 6.1*, 6.2*, 6.3*, 6.4*	2.3*, 2.4*, 2.5*, 6.1*, 6.2*, 6.3*, 6.4*
Biology II	1.1, 1.2, 1.3	1.1, 1.2, 1.3	1.1, 1.2, 1.3
Anatomy & Physiology	1.2 (in part), 1.4	1.2 (in part), 1.4	1.2 (in part), 1.4, 2.2, 2.3*, 3.4*
Earth Science	4.3*, 4.4*	4.3*, 4.4*	4.3*, 4.4*
Geology	4.3*, 4.4*, 4.5*	4.3*, 4.4*, 4.5*	4.3*, 4.4*, 4.5*
Environmental Science	1.2*	1.2*	1.2*
Ecology	1.2* (in part), 1.5*		
Sci. Research	1.3	1.3, 3.2, 3.4, 4.1, 4.3, 5.1	1.2, 1.3, 1.6*, 2.1, 2.2, 2.3, 3.2, 3.3, 3.4, 3.5, 4.3, 5.1*

* Denotes learning expectations that may not be addressed directly by a particular exercise, but could easily be related to the material covered through the use of additional assignments or activities, or brought into lecture using suggested information below. Teachers may want to also examine suggestions for grade levels outside their own for further inspiration.

For Teachers K-3

- ◆ Have the students take note of the fact that the skull is not a single bone, but comprised of many fused bones.
- ◆ You may also wish to stress that the skull houses the major sense organs, and also is a major structure an organism uses to interact with its environment (addresses State Learning Expectations K-3.2.2 and K-3.2.3).
- ◆ Though this exercise is not a physics exercise, you could easily introduce the concept of forces, and their ability to move objects, by talking about muscles, which are attached to the skull, and which can move articulated portions of the skull (and other structures) when they contract! (This addresses State Learning Expectations K-3.11.1!)
- ◆ For State Learning Expectation 3.4.3 - You may wish to stress the changing of appearances of organisms as they mature. Have them think about how their (children's) faces differ from those of their parents (adults), or differences in appearance between kittens/adult cats and puppies/adult dogs (which includes accompanying changes in skeletal structures, in addition to readily observable external changes)!

For Teachers 4-5

- ♦ For State Learning Expectations 4-5.2.1 & 4-5.2.2 - You may wish to heavily stress the necessarily intertwined ecologies of carnivores and herbivores: not only that one group eats the other, but that both have adaptations that allow them to interact with the living and non-living components of their environment in ways that help them survive.
- ♦ For State Learning Expectations 4-5.3.1 & 4-5.3.2 - Also, it's good to mention that successfully obtaining food is important, as it provides the energy needed not only for growth, but reproduction, as well! It might be a good time to quiz them on the source of this energy (carnivores get their energy from the herbivores, and the herbivores from plants, and plants from the sun!) (This also addresses differences between light and chemical energy, part of State Learning Expectation 4-5.14.1), as well as what would happen to a species if they didn't reproduce! You may also want to take the time to discuss the heritability of certain traits that they will observe on the skulls.
- ♦ For State Learning Expectations 4-5.6.1 & 4-5.6.2 - To address the notion of biological change over time, you may want to bring up some images of the skulls of several extinct carnivores (saber-toothed tiger, etc.) and herbivores (*Mesohippus*, etc.) and have students compare the images to the modern skulls.
- ♦ For State Learning Expectations 4-5.11.2 - Though this exercise is not a physics exercise, you could easily introduce the concept of forces, and their ability to move objects, by talking about muscles, which are attached to the skull, and which can move articulated portions of the skull (and other structures) when they contract!

For Teachers 6-8

- ♦ For State Learning Expectations 6.2.1, 6.2.2, 6.3.1 - This is an excellent exercise to talk about all sorts of interactions between organisms, particularly those between predator and prey. Regarding carnivores, it also presents ample opportunity to talk about both intra- and inter-specific competition for herbivore prey. They might also think about how certain skull features could be used in competition, in addition to food procurement and processing! You could even have students think about which of the organisms represented by the skulls occur in the same area (basically all of them, except for the prairie dog and porcupine, and until fairly recently, the armadillo), and have them construct food webs (and fill in missing organisms that the skulls' owners eat)!
- ♦ For State Learning Expectation 8.2.3 - This learning expectation requires students to learn about the major biomes of the world. You may wish to have students think about what biomes the organisms represented by the skulls inhabit, and whether the skulls themselves reflect any adaptations to living in such environments.
- ♦ For State Learning Expectation 8.11.4 - This "Forces and Motion" Learning Expectation requires students to identify simple machines and their uses. You could incorporate some physics using the skulls in the box by talking about jaws as levers!

For High School Teachers

- ♦ This box is full of opportunities to talk about lots of other topics in greater detail, such as evolution, paleontology/the fossil record, biomechanics, functional ecology, food webs, etc etc. Let the given exercises be a springboard for you to explore other related topics of your own (and your students') interests, as well as a good launching point for more in-depth research on the part of your students!
- ♦ If you have your students do a larger research paper from the morphometrics exercise, you may wish to go over the proper way to cite outside sources they may use (addressing State Learning Expectation 1.1.6 in Scientific Research regarding copyright and patent laws)!
- ♦ You may also wish to have your students present the results of their studies as a group to relay their findings. In this manner, if several groups have investigated different traits, the class as a whole may gain a broader understanding of major significant traits in carnivore and herbivore skulls (thus also addressing State Learning Expectation 5.1 in Scientific Research regarding presentation of reports)!