

Handout 11: Exponential Functions

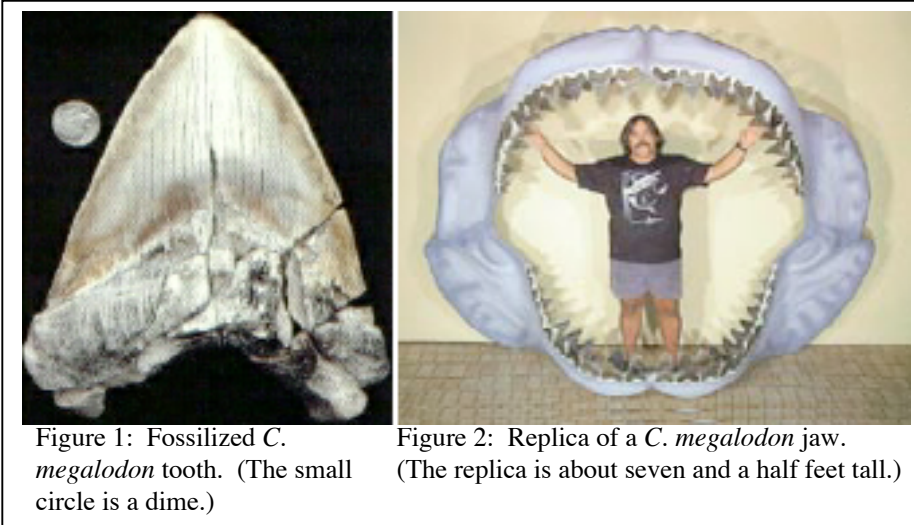


Figure 1: Fossilized *C. megalodon* tooth. (The small circle is a dime.)

Figure 2: Replica of a *C. megalodon* jaw. (The replica is about seven and a half feet tall.)

The “mega-tooth” shark (*Carcharodon megalodon*) is a giant shark that appears to have lived between 10 and 50 million years ago¹. Much of what we know about this shark comes from fossilized teeth

(see Figures 1 and 2²) that have been found in coastal regions of Virginia, North Carolina, South Carolina, Georgia and Florida. Based on the size of these teeth, many scientists believe that *C. megalodon* was approximately the size of a Greyhound bus³ (see Figures 4(a)⁴ and 4(b)⁵).

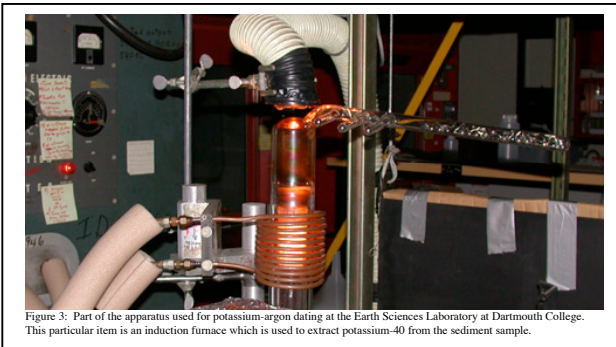


Figure 3: Part of the apparatus used for potassium-argon dating at the Earth Sciences Laboratory at Dartmouth College. This particular item is an induction furnace which is used to extract potassium-40 from the sediment sample.

Many scientists believe that *C. megalodon* died out a long time ago. This view is supported by radioactive dating of the sediments that *C. megalodon* teeth are found in. The specific technique employed for megalodon teeth is called potassium-argon dating.

In this technique, a sample of rock is chemically analyzed and the percentage of the rock that is potassium-40 determined (see Figure 3⁶). Typically for fresh sediment, 2.4% of the sediment is potassium-40. Potassium-40 is a radioactive isotope (half life = 1260 million years) of potassium that decays into the inert gas argon-40. This decay process occurs at a constant percentage rate of change.

¹ Ellis, R. and McCosker, J. Eds. 1995. *Great White Shark*. Palo Alto, CA: Stanford University Press.

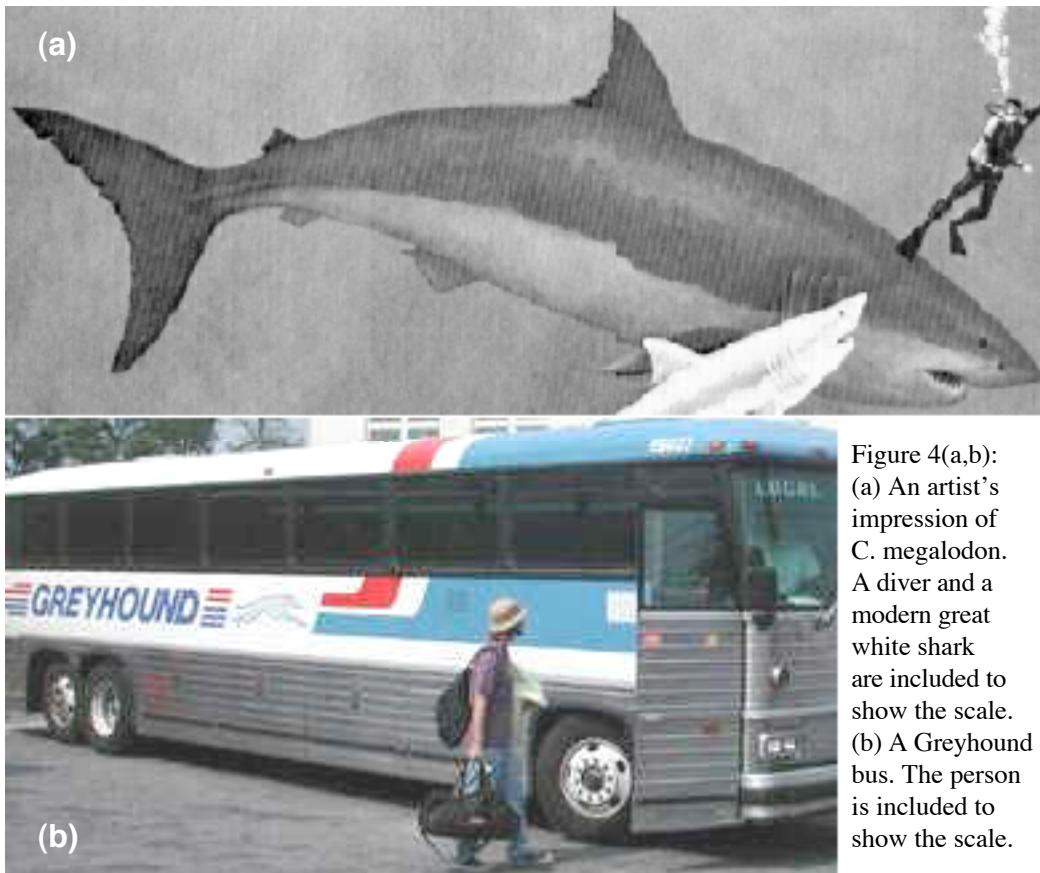
² Image source for Figures 1 and 2: <http://sharksteeth.com>

³ Gottfried, M.D., L.J.V. Campagno & S.C. Bowman. 1996. Size and skeletal anatomy of the giant “Megatooth” shark *Carcharodon megalodon*. In A.P. Klimley and D.G. Ainley. Eds. *Great White Sharks: The Biology of Carcharodon carcharias*. San Diego, CA: Academic Press.

⁴ Image source: http://www.csuohio.edu/internat/new_stu_transport.html

⁵ Image source: <http://hometown.aol.com/rjravalli/index5.html>

⁶ Image source: <http://www.dartmouth.edu/~earthsci/labs/KAr/lab.htm>



- (a) Use the information given on potassium-40 and its decay to complete Table 1 (below).

Age of sediment (millions of years)	0	1260	2520
Percentage of Potassium-40			

Table 1.

- (b) Is the data recorded in Table 2 perfectly exponential or not?
- (c) What sort of function will do a good job of representing this situation? Be careful to explain your reasoning.

(d) Find a formula for the function that gives the percentage of potassium-40 as a function of the age of the rock sample (expressed in millions of years).

(e) A *C. megalodon* tooth was found in a quarry in North Carolina. Lab tests determined that 2.38683% of the sediment that the tooth was found was potassium-40. Set up an equation that would give you the age of the tooth if you were to solve the equation.

(f) Use your graphing calculator to find the approximate solution of the equation that you set up in Part (e). Use the viewing window:

$$X_{\min} = 0 \quad X_{\max} = 20 \quad Y_{\min} = 2.3 \quad Y_{\max} = 2.5$$