



Determining height and speed using dinosaur footprints

By Erik Kvale and Kim Sowder

Generally when people think of fossils, they think of dinosaur bones. Bones are a special type of fossil called a *body fossil*; body fossils would also include skin impressions, teeth, or any other physical part of the animal. Another type of fossil that teaches us about ancient animals is a *trace fossil*; trace fossils are evidence of the activity of an animal, such as walking, feeding, or burrowing. Examples of trace fossils include footprints or burrows. Footprints of a bipedal dinosaur can tell us the size of the animal and also how fast it was moving when it made the footprints.

Determining Height

To determine the height of our two-legged dinosaur, first print out copies of the right and left footprints included in this document. Since our dinosaur essentially walked on its toes, you need to establish an approximate position of a heel. Draw a line along the long axis of the outer toes from toe tip through the back of the print (see red lines in the diagram at right). The point of intersection is the projected heel point. Measure the length of the footprint from the toe tip to the heel point. Use this equation to determine height:

$$\text{hip height} = 4 \text{ or } 5 \times \text{footprint length}$$

These footprints are 17.8 cm (7 inches) long. This animal would have been between 71.2 and 89 cm (28 and 35 inches) at the hip. This method also works on humans and can be used to demonstrate the accuracy of this exercise. Measure foot without shoes and use the top of the hip bone as the hip height.

Determining Speed

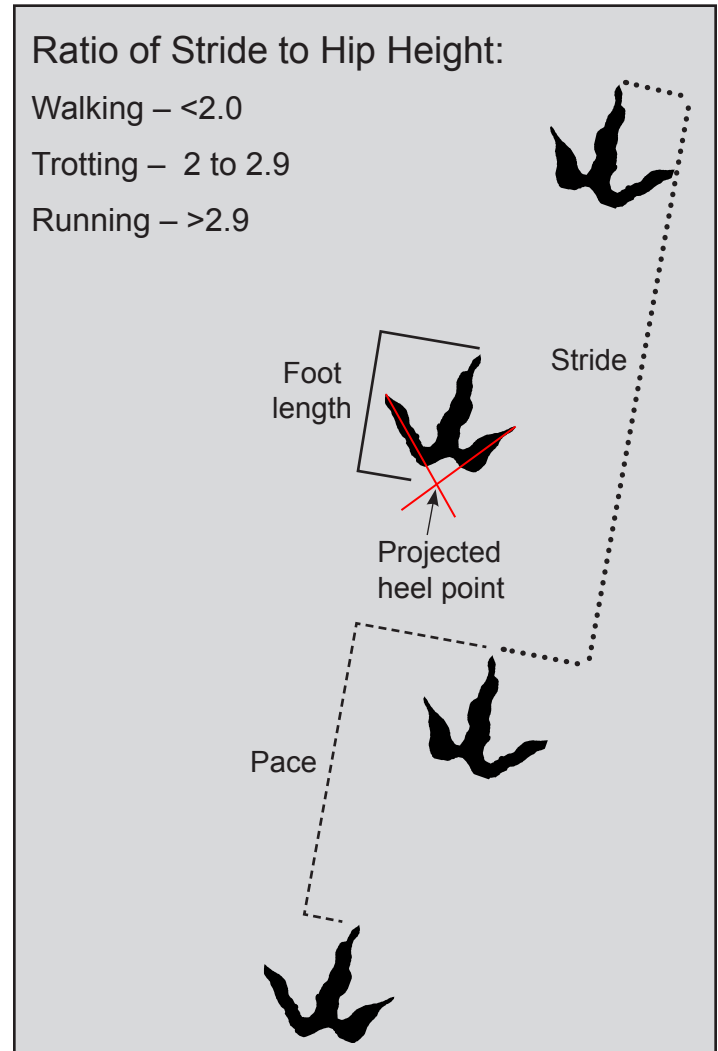
Determining the actual speed of the animal uses a formula known as Alexander's Equation:

$$\text{Speed (meters/second)} = (0.25) \times (\text{gravitational constant})^{0.5} \times (\text{stride length})^{1.67} \times (\text{hip height})^{-1.17}$$

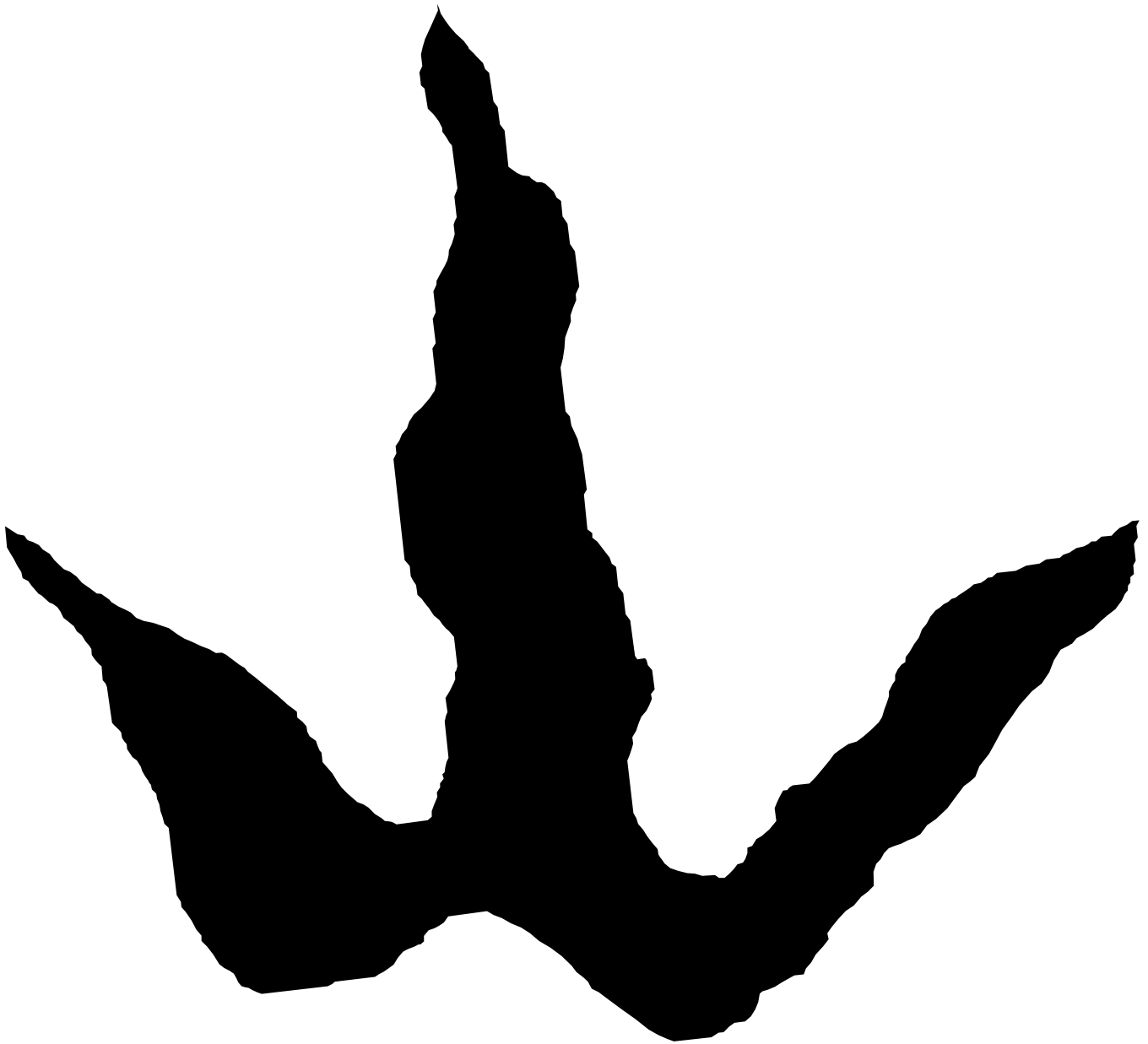
$$\text{Gravitational constant} = 9.8 \text{ meters/second/squared (m/s}^2\text{)}$$

A simpler determination can be made to establish whether the animal was walking, trotting, or running. For this activity, place several footprints on the floor (taping them down will help). Measure the distance between them from toe tip

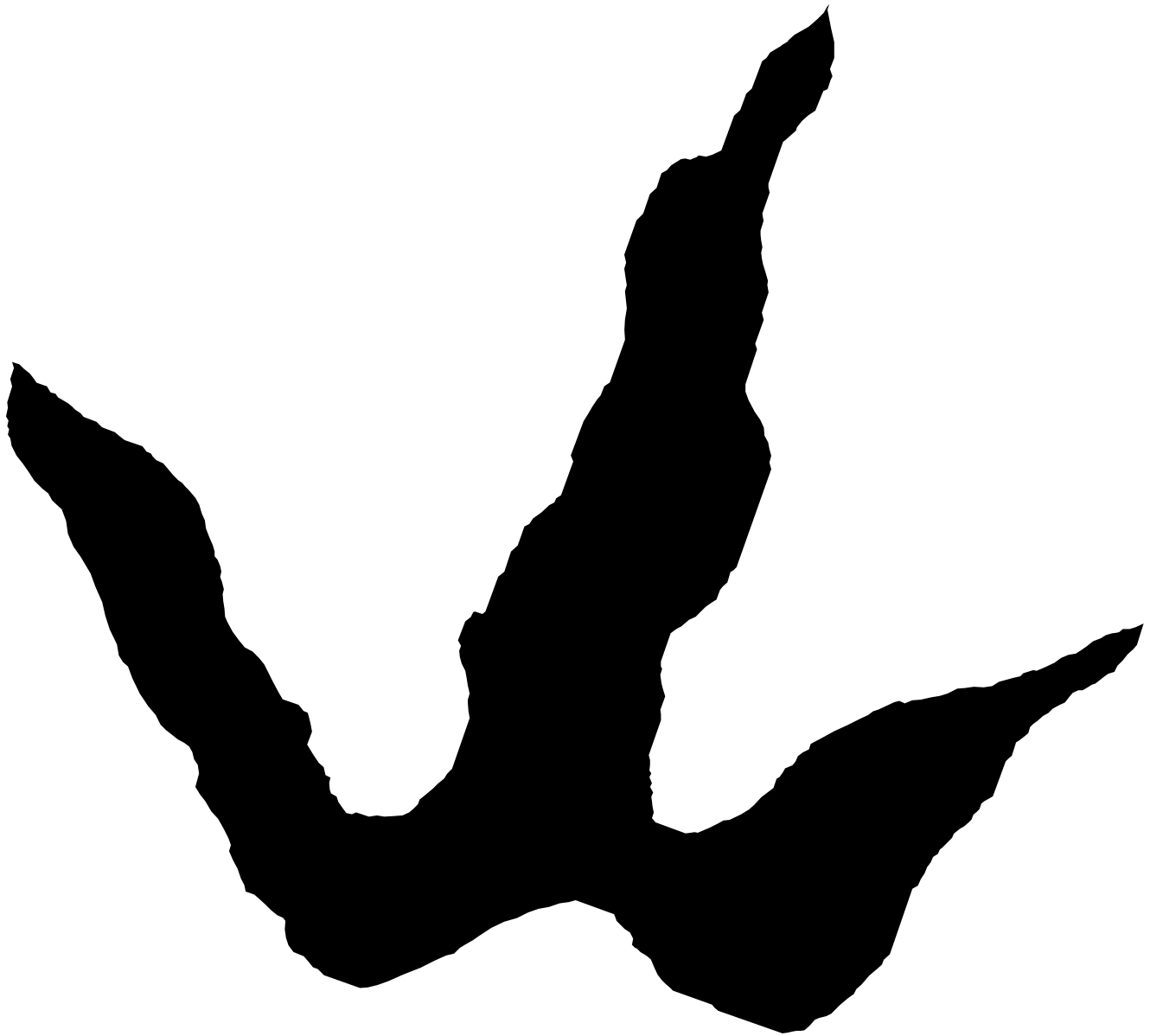
to toe tip. The distance from right toe tip to left toe tip is the *pace*. Place enough footprints to make a minimum of three paces. The distance from the tip of one footprint to the tip of the imprint made by the same foot is the *stride*. Measure the stride. Then divide the stride by the hip height. This gives you a ratio. Use the chart below to determine speed.



Most known dinosaur tracks show that dinosaurs generally walked rather than ran. These track outlines were drawn from actual dinosaur tracks found at Red Gulch Dinosaur Tracksite. For more information, go to <http://www.wy.blm.gov/rgdt/>.



Right foot



Left foot