

Robot Re-creates a Tetrapod's Moves

Activity Guide for Students: Tracing Tracks and Guessing Gaits

Directions: As discussed in "[Robot re-creates a tetrapod's moves](#)," researchers tried to reconstruct the gait of *Orobates pabsti*, a creature that lived between 280 million and 290 million years ago, based on its fossilized skeleton and tracks. Inferences about a wide variety of prehistoric creatures, from worms to dinosaurs to hominids, have been made based on the tracks these animals left behind. And studying the tracks and gaits of living creatures can help us better understand everything from the population sizes and ranges of endangered animals to how to design prosthetic limbs to reconstructing crime scenes.

In the first part of this activity, you will work in pairs to make tracks on paper. Follow your teacher's instructions to find a place where other students from the class can't observe you.

In the second part of the activity, you will trade trackways with another pair of students. You and your partner will use what you know about human range of motion, gravity, friction and balance to analyze the trackways and try to infer how your classmates made the unfamiliar tracks and what style of gait was used.

Making tracks

1. Spread out newspaper sheets and tape them together securely to make a paper path at least 3 meters long (about 10 feet). Then flip the path over, so the tape is on the bottom, where it won't interfere with making and measuring tracks.
2. Choose a gait to use to go down the paper path. You can choose to travel either forward or backward; to walk, run, hop, skip, etc.; to walk with your feet, with your knees, on all fours, crawling like a crab, etc.; to use different shoes, socks or go barefoot. Your gait should have the same approximate speed and method for the entire path — no speeding up or slowing down, no changing style along the way. Your partner can choose the same gait as you or a unique gait.
3. Once you have decided on your gaits, use a bowl of water or wet paper towels to wet your feet and any other parts of you that will come in contact with the paper. You want to leave good prints.
4. Now make your prints. Go down the same paper path, one at a time, to make the prints. It's OK for you and your partner's trackways to overlap, but try to avoid too many cases where individual prints overlap since that will make measuring the tracks difficult.
5. Have your partner time how long it takes you to get to one end of the paper to the other.
6. Immediately after making wet tracks, trace around each track with pencil or marker to outline the tracks before the water dries.
7. Write down information about your tracks on a separate sheet of paper:

Student 1 time:

Student 1 gait (describe in as much detail as possible):

Student 2 time:

Student 2 gait (describe in as much detail as possible):

8. When you are done creating your paper trackways, roll up your paper (adding additional tape for support if necessary) and put rubber bands around it. Do not write your names or other information on your paper trackways.

9. Give the paper trackways and the student information sheet to your teacher.

Studying tracks

1. Obtain from your teacher paper trackways that were made by another pair of students.

2. Can you determine two distinct sets of tracks even if the tracks overlap? How did you figure it out?

3. Use a tape measure to find the following information about one set of tracks and record your results.

Length and width of each type or shape of print (make a note if you can distinguish footprints from handprints).

Average length and width for each type of print (if they vary in size).

Student 1 length (along the trackway) from one track until that same sort of track is repeated (how far the student traveled while going through one complete cycle of motion for that gait). If there are several cycles of a given type along the trackway, measure and record them all, then calculate the average.

Are there any other quantitative measurements you could take? If so, take those measurements and record them below.

4. What type of information might be inferred about the physical dimensions of the human from the quantitative track data collected?

5. What qualitative observations can you make about the tracks? Record any observations that could be helpful in determining the gait used. Consider, for example, the shape of the prints and track and how uniform the track looks across its length.

6. Based on the quantitative and qualitative track data you collected, predict the style of gait you think the student used.

7. At what speed do you think the student traveled down the path? Do a quick test using a measuring tape and a timer if you need a rate to use as a reference.

8. Test your gait hypothesis by trying to reproduce similar tracks with your own motions. If your first hypothesized gait cannot generate a similar track, generate and test other hypotheses. Describe the gaits you try and which one best matches the track pattern. Can you reproduce the exact gait? Why or why not?

9. Repeat steps 3 through 7 for the second set of tracks.

10. Obtain the written descriptions for how the other students actually made the tracks. How well did you do at figuring it out? What were the easiest aspects to figure out, and what were the hardest aspects?

11. How close were you on your speed estimates? Would knowing the speed have helped you figure out the gait?

12. Think about the qualitative and quantitative track data that you collected. Predict how each of the following factors could change the tracks from each student's gait.

An increased range of motion of the ankle joint in humans.

A decrease in the gravitational force on Earth.

An increase in the frictional force between the surface and the body part in contact with the surface.

13. What have you learned about methods of analyzing tracks?

14. What have you learned about the scientific method in general?