How MWrite Prompt 1: *A Single Bound*

You are working with a biologist from Saint Louis University, Dr. Hopskip, who is interested in studying the movements of a new species of flea. These interesting little insects cannot fly. Instead, they are known to leap large distances, sometimes further than 1 meter. You have joined Dr. Hopskip's research team to help provide insight into the physics that governs how these fleas move.

Dr. Hopskip has recently gathered new data and emailed you. You can view the email below.

Surprising Flea Jump

Abigail Hopskip <hopskip@stlouisu.edu>
to me

10:13 AM (6 minutes ago)

Good morning [redacted]

Yesterday in the lab, I was able to capture a slow motion video of one of our new fleas jumping. As you are aware, these fleas are part of a species recently discovered two weeks ago; Xenophillys cerritulus. These fleas arrived last week, so this was actually the first slow motion video taken of them.

In my experiment, the flea jumped 1 meter. This is not unheard of for fleas. However, as we disscussed during our group meeting the other day, the tests we performed looking for resilin came back negative. These fleas don't have the protein that stores the energy and jumping power that other flea species, like Ctenocephalides felis, need to have in order to jump these large distances. Since Xenophyllys cerritulus do not have resilin proteins, we are hoping to discover what biological mechanisms they do use to make these large leaps.

Not only is the biology of these fleas weird, but their movement was surprising to me as well. I plotted the motion on a graph (attached below), marking where the flea was at each 20 millisecond interval. I need you to take a look at it, and give me an explanation of whats going on. I really haven't had a physics course since my undergrad days, but I remember that things launched from the ground should move in some sort of arc, like the St. Louis Arch. What causes that anyhow? I vaguely recall that things on Earth should only accelerate downward, is that right? Which way is acceleration at the beginning? What about at the top? I don't know, but in any case, the flea's movement is weird, it doesn't look like the Arch. What's different about this — why does it look different?

Oh, and if you are able to give us any estimates on the velocity of these fleas that would be very helpful in narrowing down what Xenophillys cerritulus use instead of resilin. The velocity at the beginning and at the highest part should be what we would need!

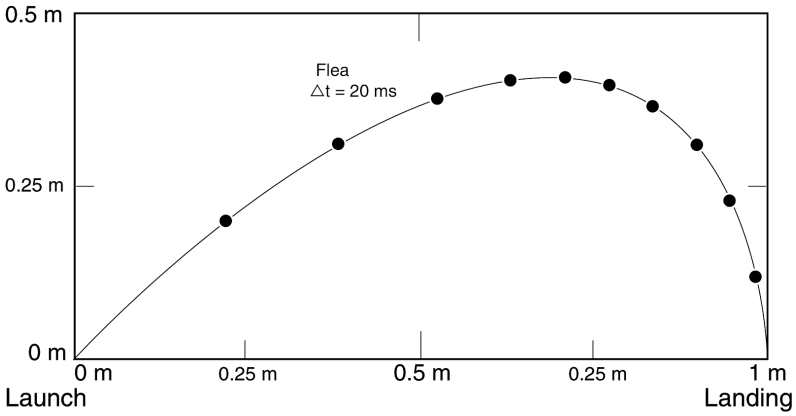
Thank you for your help.

Best,
Dr. Hopskip

P.S. Since you are new to St. Louis, I've attached a picture of the Arch below. If you haven't been, you should go check it out!

Dr. Abigail Hopskip
Saint Louis University
Charles Darwin Professor of Biological Sciences
Joint Professor of Biology and Chemistry at Cambridge University

You must respond to Dr. Hopskip's email respectfully, using your knowledge of physics. The graph and picture that were attached to her email are included on the next page.



In your response be sure to…

- Describe how the shape of the flea's motion is different from what Dr. Hopskip expected.
- Comment on the differences between the accelerations of the flea's actual motion and the motion that Dr. Hopskip expected, and explain why this might explain the different shapes.
- Describe the direction of acceleration early in the flea's jump (after it left the ground) and at the highest point of the trajectory.
- Estimate both the flea's initial velocity and the velocity at the highest point of the trajectory.

Keep in mind…

- Make sure to convey your physics understanding clearly and precisely
- Do not include your name (to preserve anonymity for peer reviews)
- Stay within 300-500 words
- Write your response to resemble the body of an email
- Use an appropriate tone of voice for your role and audience
- Outside sources are not needed, but if used, please cite them in a citation style of your choice