CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S2207

Project Title
Jumping Galls: A Novel Mechanism for Motility

Abstract

Objectives/Goals
In four experiments,my goals are to determine why the galls jump, at what optimum temperature range,how much energy do the galls require to jump/how do the galls jump (with a model), and how far can the galls jump? This research could be applied, using the same principle of momentum transfer, to develop a landing rover for Mars which has no external moving parts, using fuel efficiently.

Methods/Materials
Materials:
1: Sensing humidity:*30 galls, 3 Petri dishes, wash cloth, calcium carbonate, thermometer. 2: Optimum temperature: 10 galls, a pan, petri dish, water, ice. 3: Energy, jumping mechanism, model: E=mgh, calculator, mousetraps, fishing weights, ruler. 4: jumping distance: calculator, photographs of galls jumping at 5, 1 min intervals.
Methods:
1: Can galls sense humidity? Measure the jumping rate of the galls at one minute intervals. 10 galls in each of the following environments: dry (created by calcium chloride in the petri dish), humid (created by a washcloth soaked in water), and control
2: Optimum Temperature. *Record jumping rate/min beginning at 0*C and continuing at intervals of 5*C.
3: Energy, Jumping Mechanism, Model. Test hypothesis. Using the model, measure distance that the mousetrap will jump using different amounts of weight.
4: How far can a gall jump? * Use photographs to find distance galls jump/min, multiply by length of galls jumping cycle

Results
Galls jump at a higher rate in dry environments than humid environments. Galls do not jump below 20*C. The jumping rate increases until about 30-35*C, where it begins to level off. Each gall must contain 1.857x10^-7 g fat to jump for the duration of its life cycle. I compared this to the result that each gall contains 6x10^-3 g fat. Galls use fat to jump through momentum transfer.(see model)
Galls can jump for over a mile.

Conclusions/Discussion
Galls jump at a high rate in dry environments, most likely to avoid drying out.Galls do not jump at all below 20*C, which means galls are active primarily during the day when the temperature is above this threshold. Each gall has ample fat to sustain an above average jumping rate for its lifetime.Galls jump by

Summary Statement
The purpose of this project is to learn more about how and why the Neuroterus saltatorius (Jumping Oak galls) jump, and to apply these findings to the construction of an extremely fuel efficient vehicle without any external moving parts.

Help Received
David Deamer, Professor Emeritus of Chemistry at UCSC, gave advice on experiments (primarily email), helped with editing report, assisted with the graphs, and provided some experimental materials.