CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
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Project Number
S1521

Project Title
Navigation of Physarum polycephalum

Abstract

Objectives/Goals
Physarum polycephalum is a simple slime mold that crawls over agar and sends out pseudopodia, long projections, searching for food. Physarum can also navigate by leaving behind slime, a sticky trail of sugar and protein Although it has no nervous system, a previous study showed that Physarum uses a basic form of spatial memory to help it navigate (Reid, PNAS, January 15, 2013), using its own slime to avoid places it had been where there was no food. When completely surrounded by slime, it took Physarum much longer to find food because it could not use its own slime trail as a navigational marker. This study did not figure out how Physarum behaved when it encountered its own slime. My first goal was to reproduce the conclusion that slime slows down Physarum's search for food. My second goal was to watch Physarum by time lapse to see if it behaved differently when traveling on agar versus slime.

Methods/Materials
I grew Physarum on a 2% agar plate with oat flakes as food. I introduced a plastic barrier between the a piece of Physarum and its food. The time it took for the Physarum to navigate around the barrier and reach its food was measured. In one test, Physarum was placed on a fresh agar plate; in the other, it was placed on a plate covered with slime. In a second experiment, I made time lapse movies of Physarum crossing a slime barrier to reach its food source(one frame per 33 min).

Results
The mean time for Physarum to get to the food for the control (2% agar) was 39.7 hours with a s.d. of 1.5 hr for 3 trials. In the slime experiments, the mean time was 54.5 hours with a s.d. of 2.1 hr for 2 trials (Physarum failed to reach the oat in the third trial). On 2% agar, Physarum makes a fan shaped front edge that moves around searching for food. When Physarum reached a line of slime, it was not immediately repelled and could cross it. In about half of the trials, the Physarum behaved different from controls, traveling sideways along the slime instead of going straight ahead.

Conclusions/Discussion
Based upon the study of Reid, I hypothesized that Physarum surrounded by slime will take longer to get around a barrier than without slime. My results supported this hypothesis. From this result, one might think that the Physarum might be completely repelled by the slime. Instead I found that Physarum could enter into the slime but could not efficiently travel straight to its food.

Summary Statement
I studied how Physarum navigates to find food and how its uses information from its previous paths, marked by its slime trail.

Help Received
UCSF helped me to make agar plates. My Dad showed me how to make time lapse movies.