

# Choosing a Topic from Your Own Interests: Examples



Interested  
in  
**Inventions**  
?



# Try Applied Mechanics/Structures & Mechanisms/Manufacturing



# Avid About Animals?



# Work in Behavioral Science



# Love Labwork?



# Try a Biochemistry/Molecular Biology Project

## A Single Amino Acid Substitution Switches a Protein Specificity

### Abstract

As one of the six Tumor Necrosis Factor Receptor Associated Factor (TRAF) family members, TRAF3 plays a critical role in regulating the non-canonical NF- $\kappa$ B pathway. TRAF3 mutations are associated with both human cancer and auto-immune diseases. The essential role of TRAF3 relies on its ability to specifically bind to NIK. Based on the sequence alignment and crystal structural studies, we found that tyrosine 441 of TRAF3 not only directly contacts with NIK but is also different to tyrosine 441 of other TRAF family members at the corresponding position. We hypothesized that tyrosine 441 of TRAF3 might be responsible for the binding and functional specificity of TRAF3. To test this hypothesis, we took a gene of function approach. By using the PCR mutagenesis method, we have generated a point mutation in TRAF3 to replace a TRAF3/410Y mutant, which substituted phenylalanine at the position 410 of TRAF3 corresponding to the position 441 of TRAF3 with tyrosine. In vitro binding assays indicated that while wild type TRAF3 did not bind to NIK, TRAF3/410Y mutant bound to NIK as strongly as TRAF3. Thus, we have demonstrated that a single amino acid substitution can switch the binding specificity of TRAF3 to that of TRAF5. Our studies may provide insight for drug design on TRAF proteins to treat cancer and inflammatory diseases.

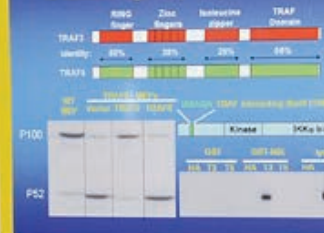
### TRAF3 is a critical regulator for the non-canonical NF- $\kappa$ B activation pathway



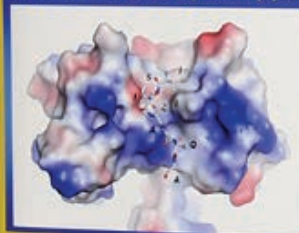
TRAF3 is an essential molecule involved in non-canonical NF- $\kappa$ B activation, which plays an important role in regulating normal immune responses.

Mutations of TRAF3 in humans are associated with cancer such as multiple myeloma and auto-immune diseases such as lupus.

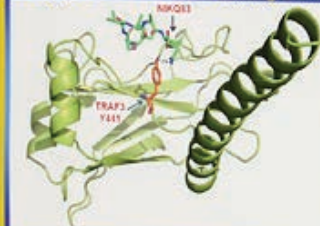
### TRAF3 but not TRAF5 can specifically bind to NIK and regulate p100 processing to p52



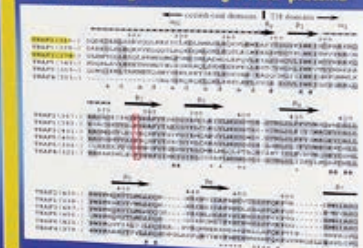
### TRAF3 electrostatic surface map with NIK peptide



### Y441 plays a critical role in TRAF3 binding to NIK



### Sequence alignment among 6 TRAF proteins



### Create cDNA clones with a point mutation in TRAF5



### A single amino acid substitution switches the binding specificity of TRAF proteins



### Conclusion

Based on the sequence alignment and crystal structural studies, we found that tyrosine 441 of TRAF3 not only directly contacts with NIK but is also different in sequence from all other TRAF family members at the corresponding position.

By using a PCR mutagenesis method, we have successfully replaced a TRAF3/410Y mutant, which substituted phenylalanine at the position 410 of TRAF3 corresponding to the 441 position of TRAF3 with tyrosine.

The *in vitro* GST pull down experiments have indicated that TRAF3/410Y but not wild type TRAF3 binds to NIK as strong as the specificity of TRAF3 to that of TRAF5.

Our studies have not only determined structural and functional specificity but also provide insight for future design of anti-multiple myeloma and auto-immune diseases.



# Want to Feed the World?



[illegible]

# Fascinated by Plants?



# Try a Botany Project

## The Effect of a Soluble Calcium Solution on an Aquatic Plant's Ability to Withstand Acid Rain (A Two-Year Study)

### STATEMENT OF PROBLEM

Acid rain is becoming an increasingly important problem in the environment. Scientists have been able to study the effects of acid rain on plants and animals in the field, but not in the laboratory. The purpose of this study was to determine the effect of acid rain on an aquatic plant, *Elodea canadensis*, in the laboratory. The study was conducted over a two-year period.

### INTRODUCTION

Acid rain is a major environmental problem. It is caused by the release of sulfur dioxide and nitrogen oxides into the atmosphere, which then combine with water to form sulfuric and nitric acids. These acids fall as rain, snow, or sleet. Acid rain can damage plants, animals, and buildings. It can also acidify lakes and streams, making them uninhabitable for many species of fish and other aquatic life. The purpose of this study was to determine the effect of acid rain on an aquatic plant, *Elodea canadensis*, in the laboratory. The study was conducted over a two-year period.

### HYPOTHESIS

It was hypothesized that the addition of a soluble calcium solution to the acid rain would increase the plant's ability to withstand the acid rain.

TABLE #1: NUMBER OF ZONES OF DEPLETION

Zone	Zone 1	Zone 2	Zone 3	Zone 4
Zone 1	12	15	18	20
Zone 2	15	18	20	22
Zone 3	18	20	22	24
Zone 4	20	22	24	26

Chart #1: Number of Zones of Depletion



### MATERIALS AND METHODS

- 1. *Elodea canadensis* (aquatic plant)
- 2. Calcium chloride solution
- 3. Distilled water
- 4. Beakers
- 5. pH meter
- 6. Test tubes
- 7. Test tube rack
- 8. Test tube holder
- 9. Test tube cap
- 10. Test tube label
- 11. Test tube marker
- 12. Test tube band
- 13. Test tube cap
- 14. Test tube holder
- 15. Test tube rack
- 16. Test tube label
- 17. Test tube marker
- 18. Test tube band
- 19. Test tube cap
- 20. Test tube holder
- 21. Test tube rack
- 22. Test tube label
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- 24. Test tube band
- 25. Test tube cap
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- 89. Test tube marker
- 90. Test tube band
- 91. Test tube cap
- 92. Test tube holder
- 93. Test tube rack
- 94. Test tube label
- 95. Test tube marker
- 96. Test tube band
- 97. Test tube cap
- 98. Test tube holder
- 99. Test tube rack
- 100. Test tube label

### RESULTS

The results of the study showed that the addition of a soluble calcium solution to the acid rain significantly increased the plant's ability to withstand the acid rain. The plants in the calcium solution groups showed less damage and growth compared to the plants in the distilled water groups. The results of the study are as follows:

### DISCUSSION AND CONCLUSION

The results of the study showed that the addition of a soluble calcium solution to the acid rain significantly increased the plant's ability to withstand the acid rain. The plants in the calcium solution groups showed less damage and growth compared to the plants in the distilled water groups. The results of the study are as follows:

### FURTHER RESEARCH

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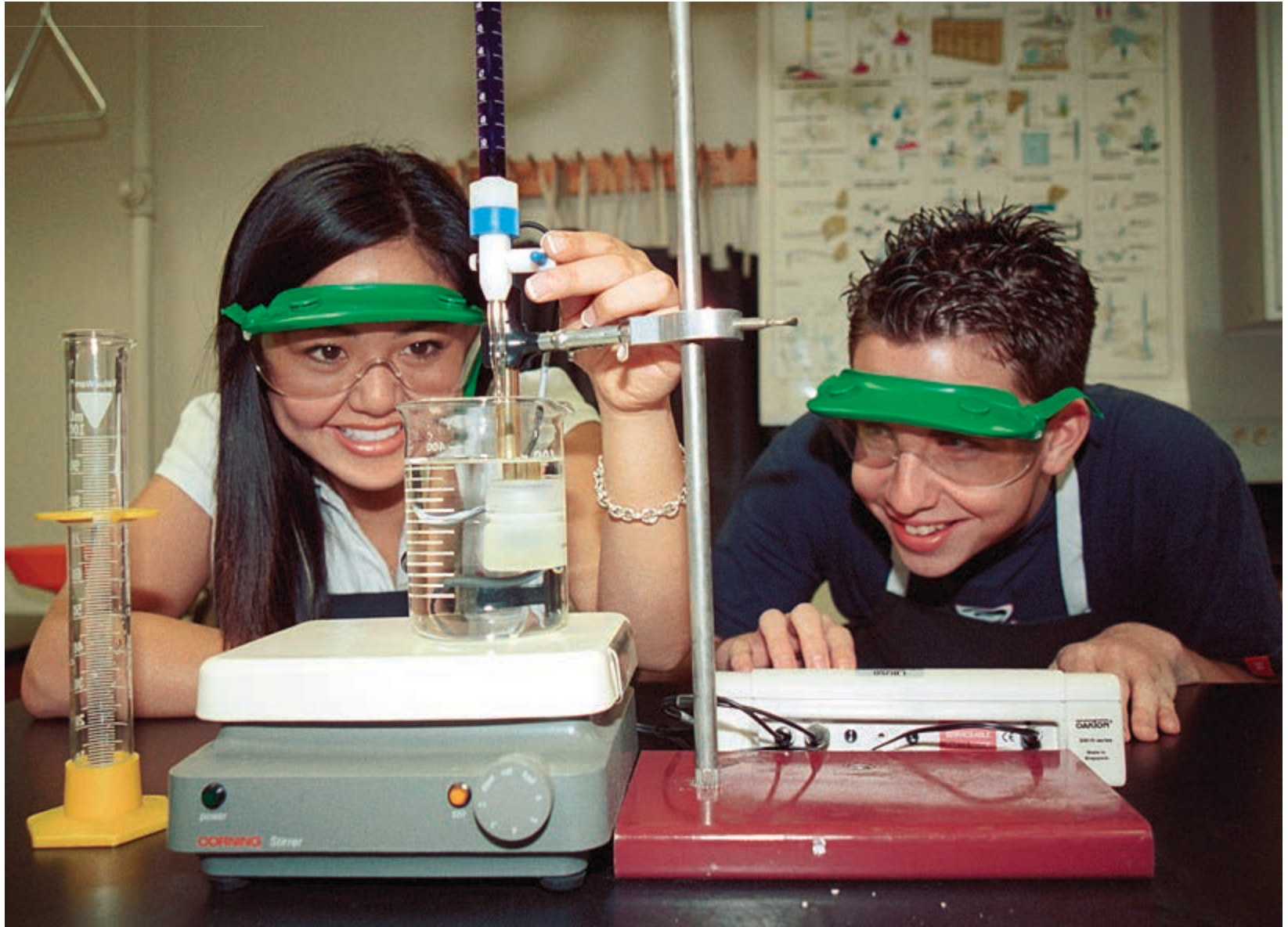
# Born with a Green Thumb?



# Investigate Botany Applications!



# Crazy about Chemistry?



# Study the **Chemistry** Behind Everyday things



# Coaster Crazy?



# Try a Cognitive Science Study



# Rocks Knock Your Socks?



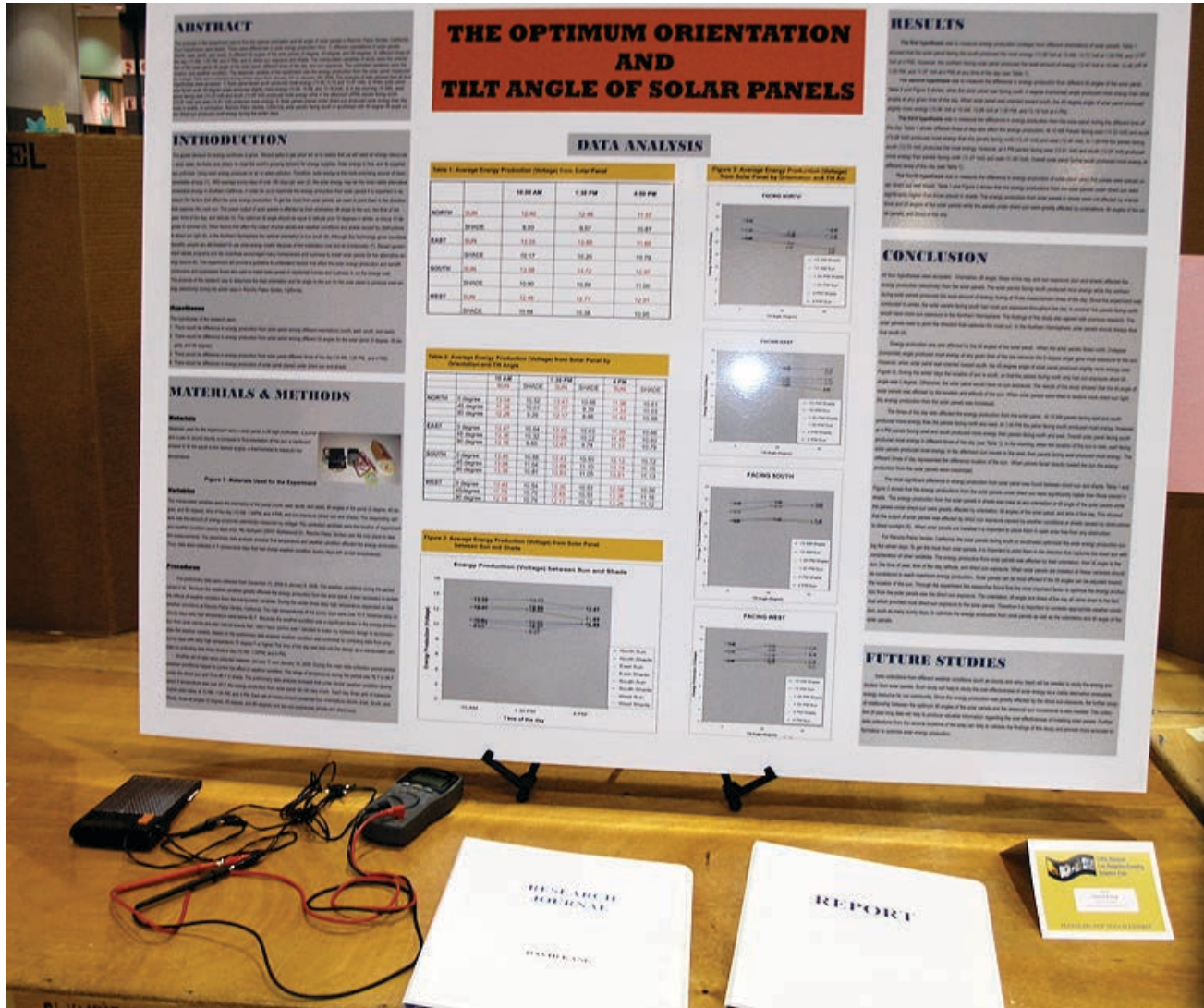
# **Delve into Earth Science/ Physical Environment**



**Electricity  
Give You a  
Charge?**



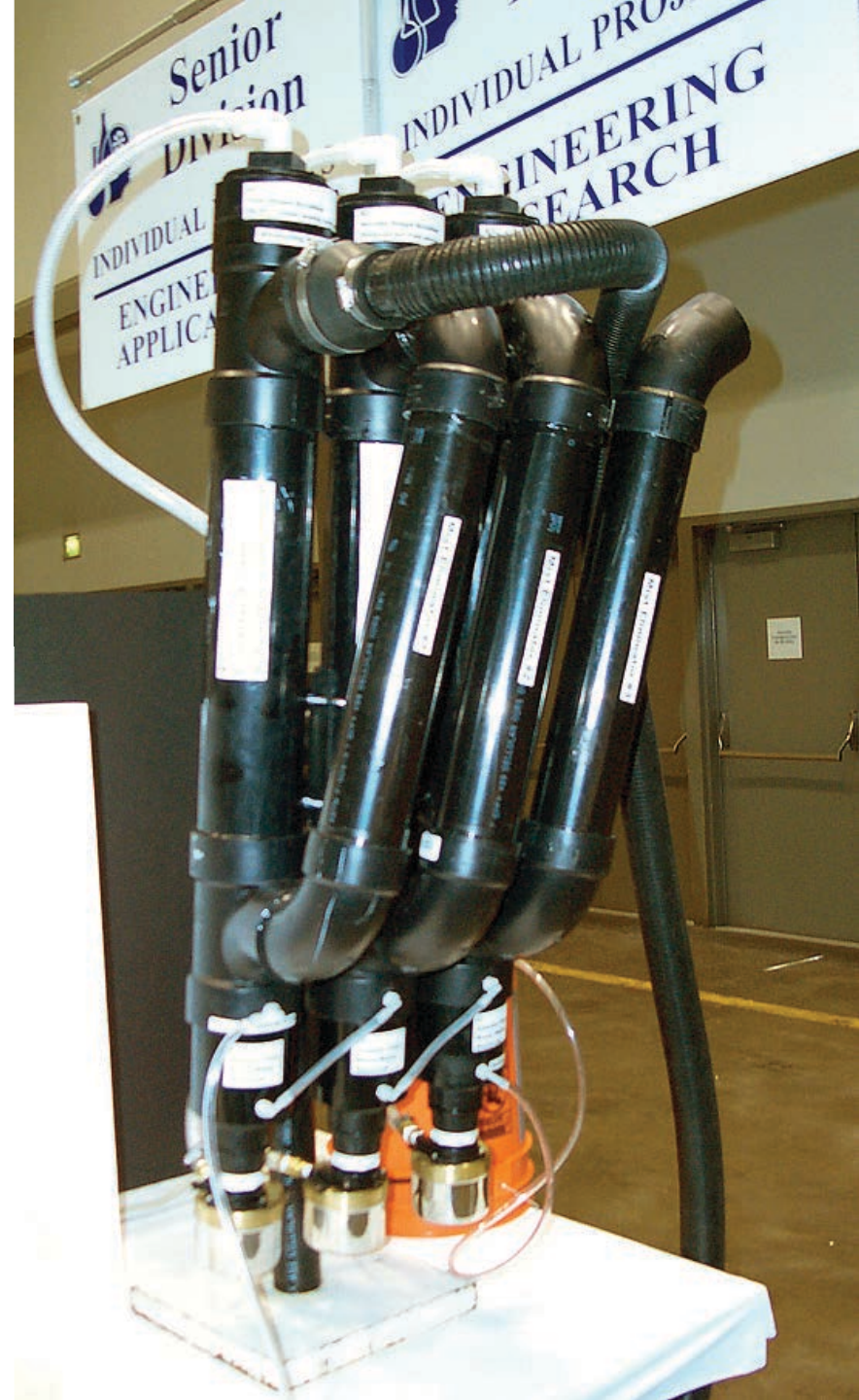
# Electricity & Electronics may be Your Bag



***Always  
Asking  
WHY???***



# Try Energy Conversion/A lternative Energy



# Care for Mother Nature?



# Do Environmental Science/Environmental Engineering

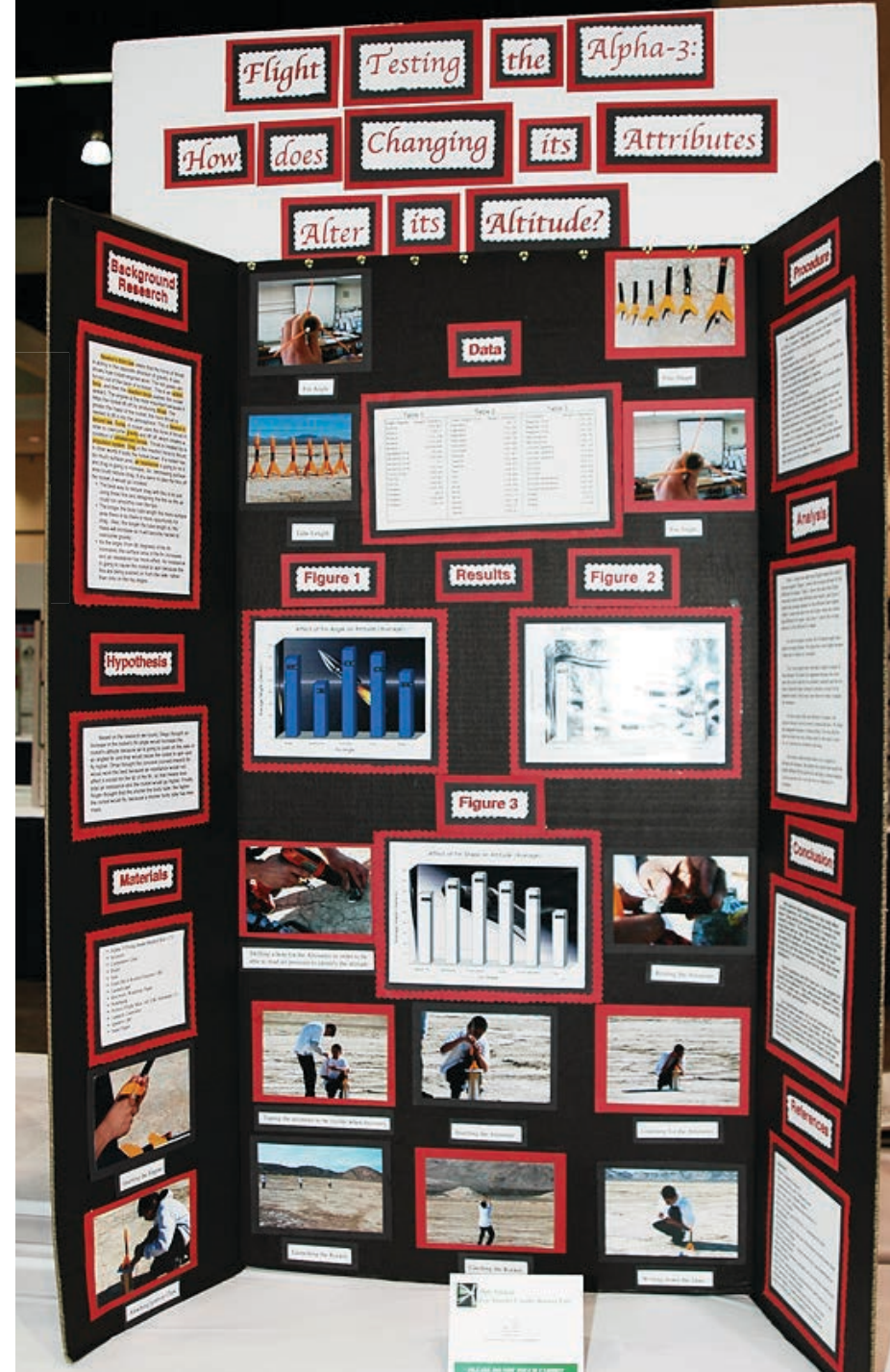
## Can Aquatic Plants Improve the Water Quality of Polliwog Pond?



# Love “Flying” in Water?



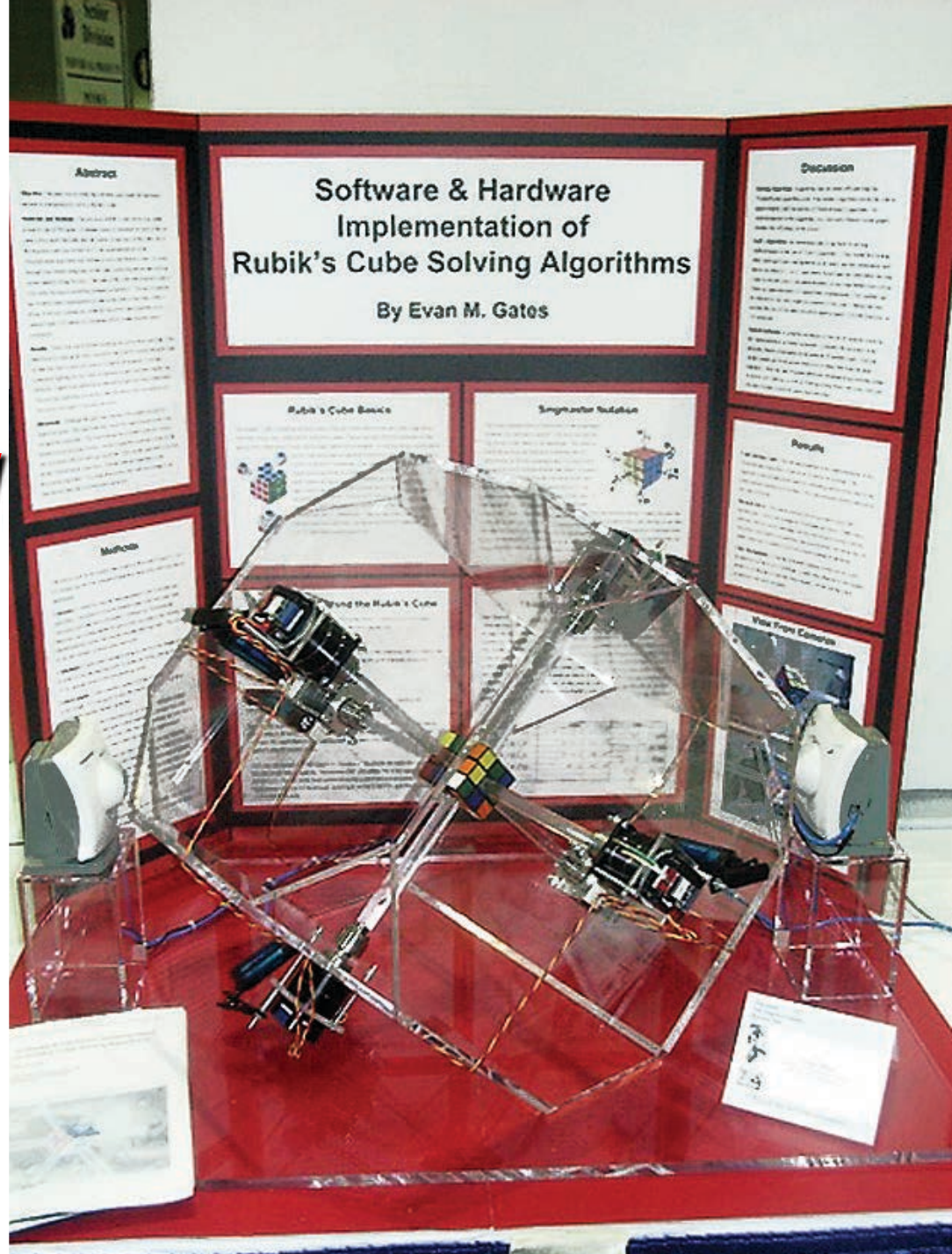
# Fluids/Aerodynamics are for *YOU!*



# Keen to Crunching #'s?

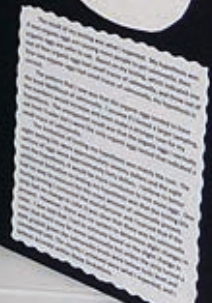


# Make a Mathematics/ Software Project



**Love to  
Look at  
Little  
Stuff?**



[illegible]



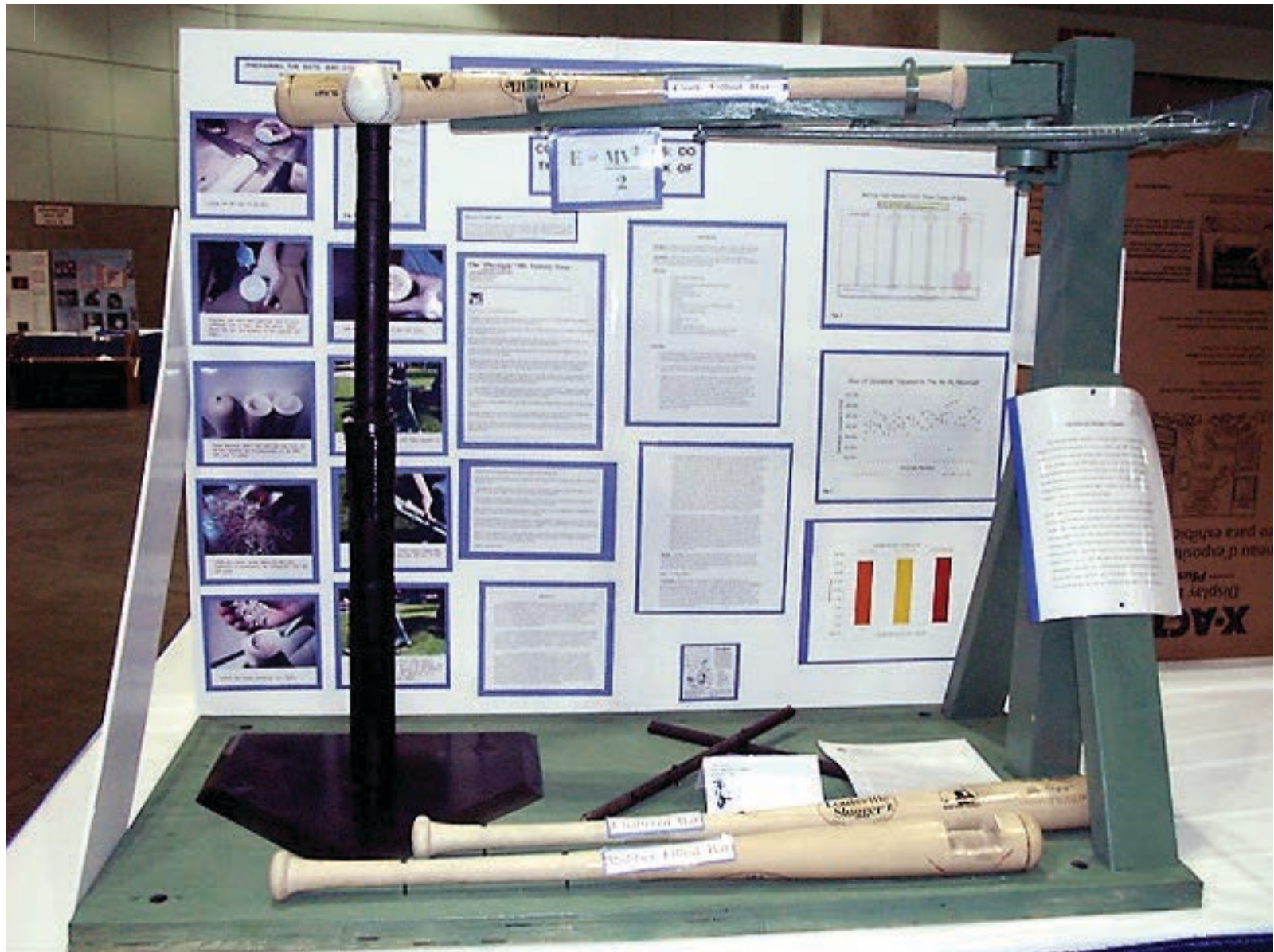
# Pharmacology/Toxicology



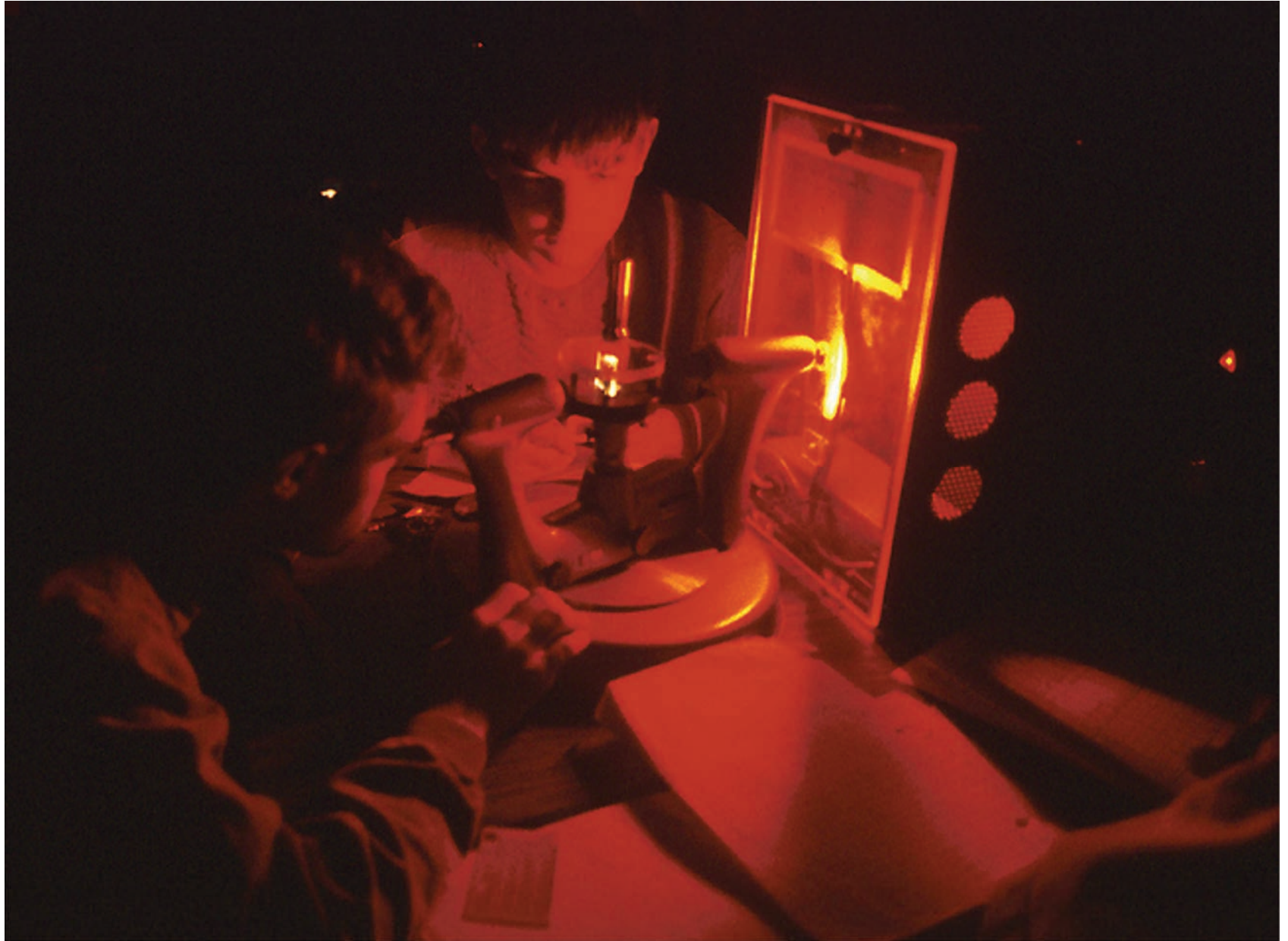
# Like to Compare Things?



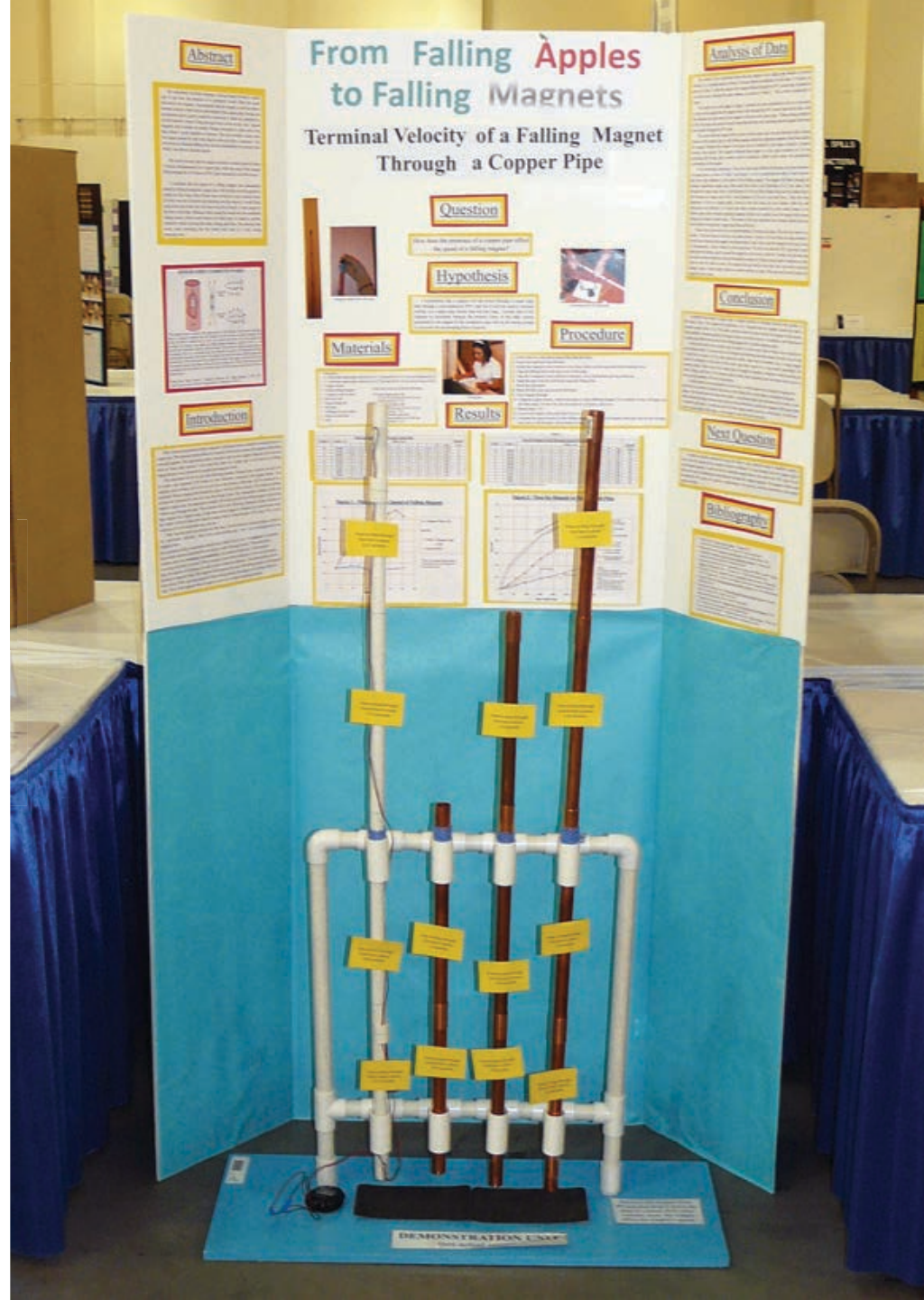
# Try Physical Product Science!



# Love Physical Science?



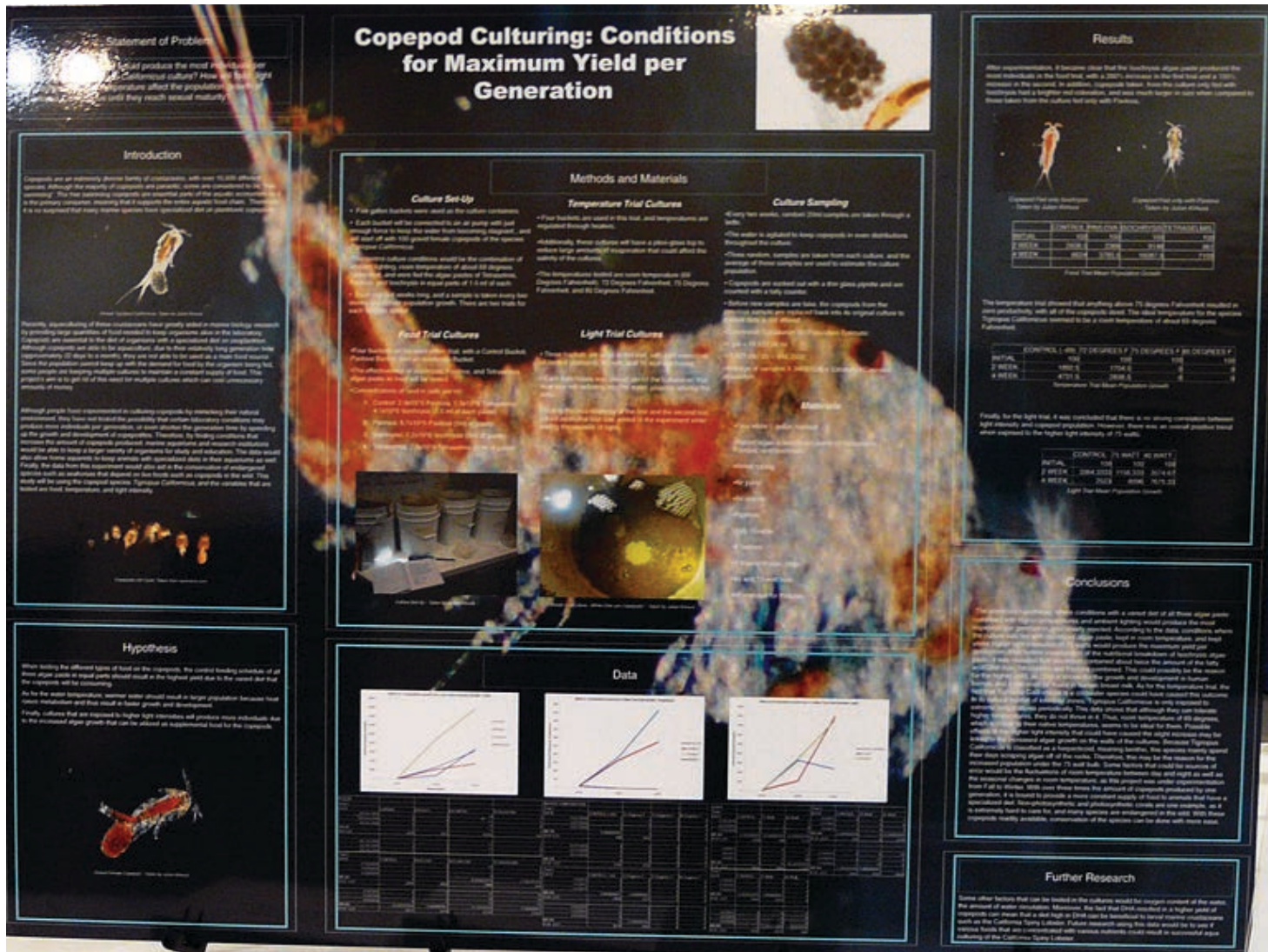
# Physics/Astronomy are for You



# Constant Competitor?



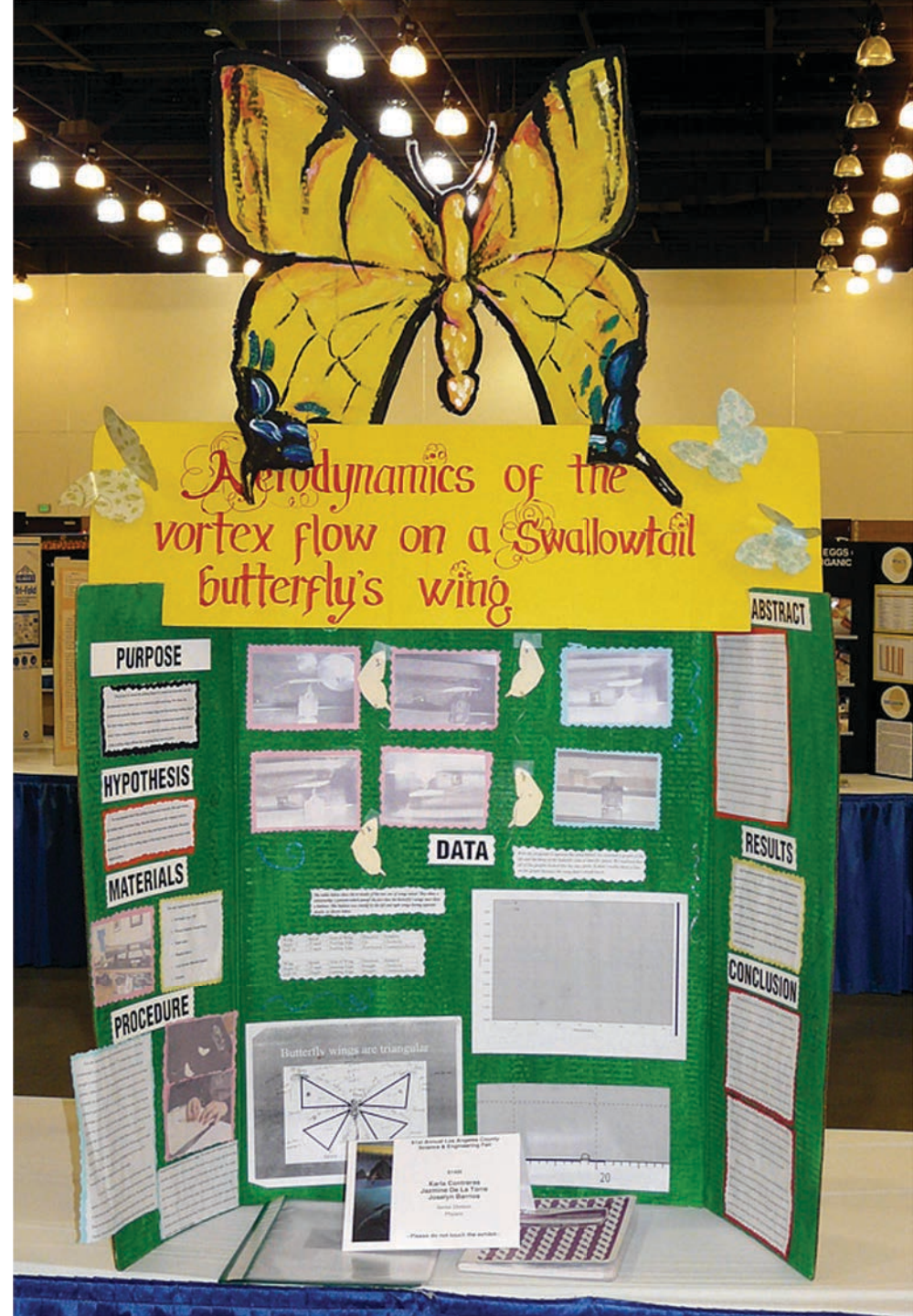
# Work on Physiology/Medical Biology!



# Boggled by Bugs?



# Experiment in **Zoology**



# Developed by

## ***Anne Maben***

***Science Consultant, UCLA Science Project  
For the***



**<http://www.ocsef.org/>**

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