

# Exploring Miracle Fruit

An Undergraduate Laboratory Exercise on Experimental Design



PRESENTER:

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## After completing an experimental design activity involving the taste-altering Miracle Fruit, students reported increased understanding of science process skills and biochemistry concepts.

**BACKGROUND:** There has been a recent upswing in the use of Course Based Undergraduate Research Experiences (CUREs) in undergraduate lab-based courses. However, many students enter CUREs unprepared because *traditional laboratory exercises often fail to provide sufficient background in experimental design and science process skills*. This activity aims to address this and prepare students for CUREs by providing experience with experimental design during a single lab session through investigation of a sensory biochemical phenomenon.

### LESSON/METHODS

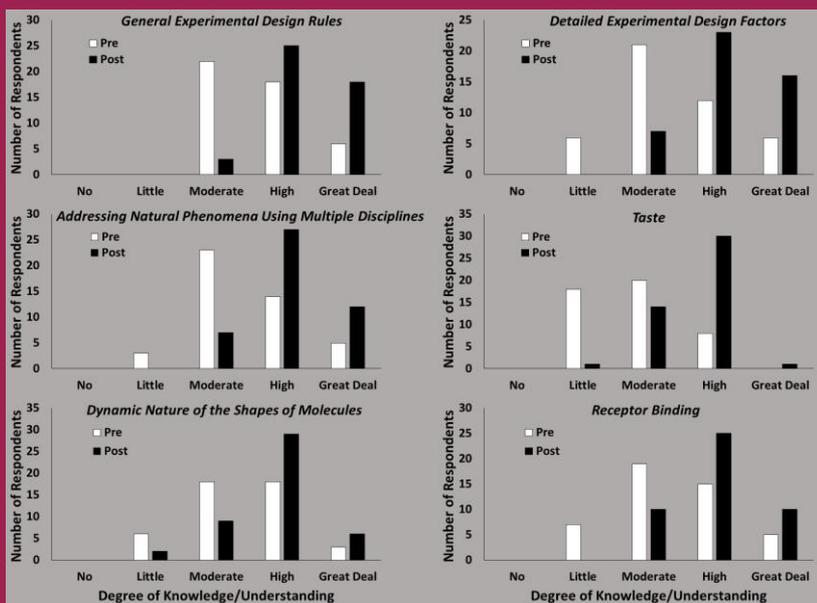
Students read and analyze “**Molecular mechanisms of the action of miraculin, a taste modifying protein**” by Takumi Misaka to prepare for pre-lab discussion

Students design experiments in small groups to answer a scientific question of their choosing regarding miracle fruit. They receive instructor feedback, then refine and conduct their experiments in class

Post-lab discussion of results and pH-dependent conformation change of miraculin protein

Students complete surveys, rating their knowledge before and after the activity both qualitatively and quantitatively

**RESULTS:** Students reported that the activity increased their knowledge in 3 categories related to experimental design and 3 categories related to biochemistry (See figure). When asked specifically what they learned, they highlighted the importance of identifying nested variables that are difficult to tease apart, particularly when resources, time, or subjects are limited.



The figure shows the increase in students' perceived knowledge of 6 experimental design/biochemistry concepts after completing the Miracle Fruit activity.

### INCREASES IN REPORTED STUDENT KNOWLEDGE AFTER ACTIVITY

Topic	$\chi^2$	P Value
General Exp. Design Rules	21.56	<0.0001
Detailed Exp. Design Factors	20.99	0.0001
Addressing Natural Phenomena Using Multiple Disciplines	18.53	0.0003
Taste	30.01	<0.0001
Dynamic Nature of Shapes of Molecules	8.56	0.0357
Receptor Binding	13.95	0.0030
pH	3.64	0.1622

**STUDENT ATTITUDES:** The figure below shows students' overwhelmingly positive responses to survey questions regarding their attitudes about the miracle fruit activity. Students enjoyed it and thought that it helped them learn, and that it should be used in the future with other students.



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