NGSS in the Classroom

Strategies for preparing every child for success in STEM

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Math Science Partnership Conference Presentation
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Overview of Presentation

- What inspired me to become a **scientist** who **teaches** science?

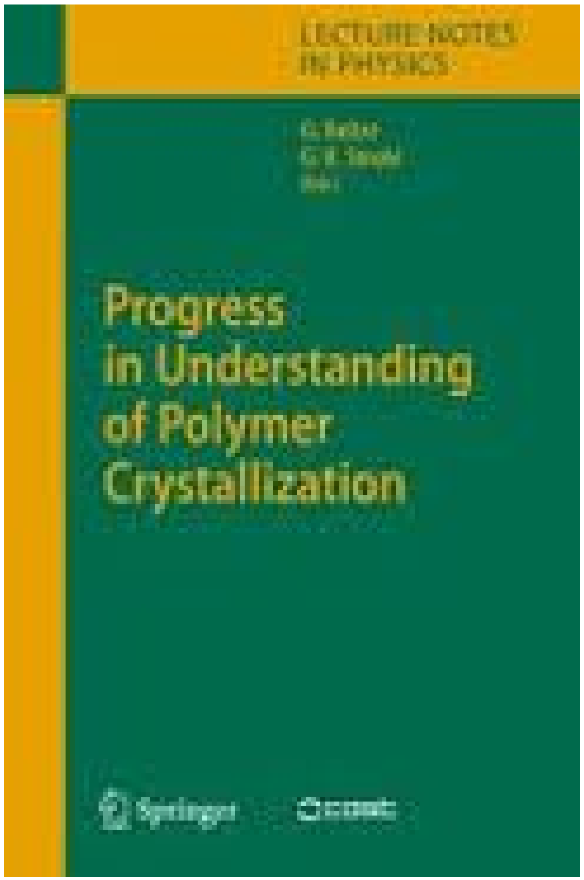
- What can **science teachers** do to increase student achievement in science?

- How do we **motivate** kids to choose to study science in high school and in college?

It Takes a Village

- Parents
- Extended Family
- My husband, Lars
- My son, Henry
- My teachers - elementary, middle and high school
- My college and graduate school professors
- Mentors
  - Prof. Catherine Koehler (SCSU)
  - Julie Christianson (CREC)
  - Mrs. Audrey Boutaugh (Principal, High School Inc)
  - Mrs. Medria Blue-Ellis (Principal, ESUMS)

The Joy of Scientific Research



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Poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) nanocomposites with optimal mechanical properties

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ABSTRACT

With the ultimate goal to design renewable polymer nanocomposites with optimal mechanical properties, this study reports an investigation of structure–property relationships for a model system – silica/poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) (PHBHx) nanocomposites. Two molecular weights of PHBHx (M_w = 903,000 g/mol and M_w = 633,000 g/mol) and two types of silica nanoparticles (nominally spheres and fibers according to the manufacturer) were used to prepare the nanocomposites. Small-angle X-ray scattering shows that the sphere and fiber nanoparticles had similar surface areas and primary particle size, but differed in degree of aggregation of the primary particles. The thermal stability of the PHBHx matrix was slightly improved by the addition of nanofillers. Simultaneous improvement of both stiffness and toughness was observed at 1-wt% loading for the higher molecular weight matrix. The more highly aggregated SiO_2 fibers had a greater toughening effect than the SiO_2 spheres. Compared to the unfilled polymer matrix, a 30% increase in Young's modulus and 34% increase in toughness were obtained for the 1-wt% SiO_2 fiber/PHBHx072 nanocomposite. The addition of SiO_2 spheres to PHBHx072 resulted in the same increase in Young's modulus (30%) but a smaller increase (11%) in toughness. The dramatic increases in modulus for PHBHx072 cannot be explained on the basis of two-component micromechanical models. Apparently the filler alters the character of the semicrystalline matrix. When the loading was 3 wt% and above, Young's modulus continued to increase, but the strain at break and toughness decreased. The ultimate strength did not change compared with the unfilled polymer. In order to understand the mechanical properties observed, the thermal behavior, spherulitic morphology and the deformation mechanisms of the nanocomposites and the dispersion state of the nanofillers were studied. We found that a high molecular weight of the polymer matrix, weak interfacial adhesion and a good dispersion of the nanofillers are necessary to improve toughness and stiffness simultaneously.

1. Introduction

The progressive dwindling of fossil resources, coupled with increasing public preference for environmentally friendly plastics, has increased academic and industrial interests in biodegradable polymers prepared from renewable sources [1]. Polyhydroxyalkanoates (PHAs) are biodegradable and thermoplastic polyesters produced by a variety of bacteria from renewable resources like corn sugar and oil. In comparison with petroleum-based plastics, PHAs need less energy for production [2], can reduce the green house gas emissions [2] and generate less landfill waste. PHAs can replace petroleum-based amorphous and semicrystalline polymers currently in use for packaging, adhesives, and coating applications.

PHAs have recently attracted considerable interest because of their biodegradability and biocompatibility [3–14]. Since PHAs are produced from renewable resources and biodegrade to carbon dioxide and water, they are often described as environmentally friendly plastics [15].

PHAs also offer significant advantages in medical applications, particularly in tissue engineering [6,16,17]. Recent studies [18,19] have shown that poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) (PHBHx) tissue scaffolds have better mechanical properties and biocompatibility than other biodegradable polymers, such as polylactic acid (PLA). In addition, the use of PHAs in biodegradable personal hygiene articles, such as diapers, has already been described [8].

The Science Teacher: Motivating Issues

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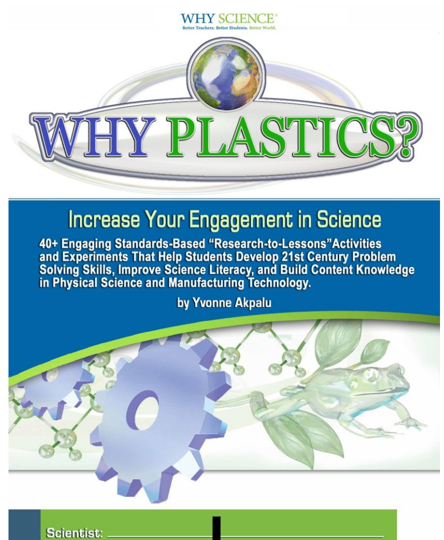
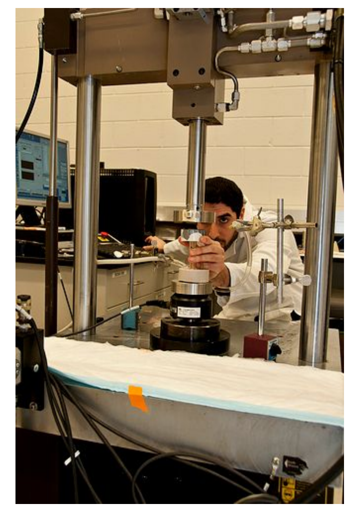
Why Plastics? Curriculum

What molecule(s) is it made from?



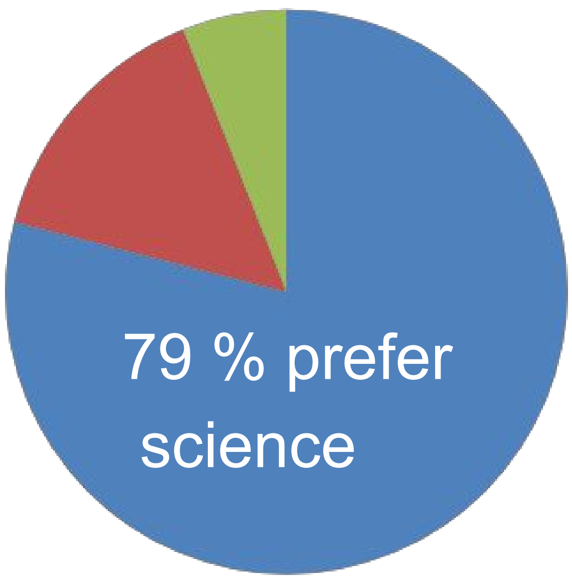
Does it break or become squishy when I apply a force?



Can I make foams, ropes, sheets or films from it?

Students Prefer Science when it is Hands-on & Minds-on

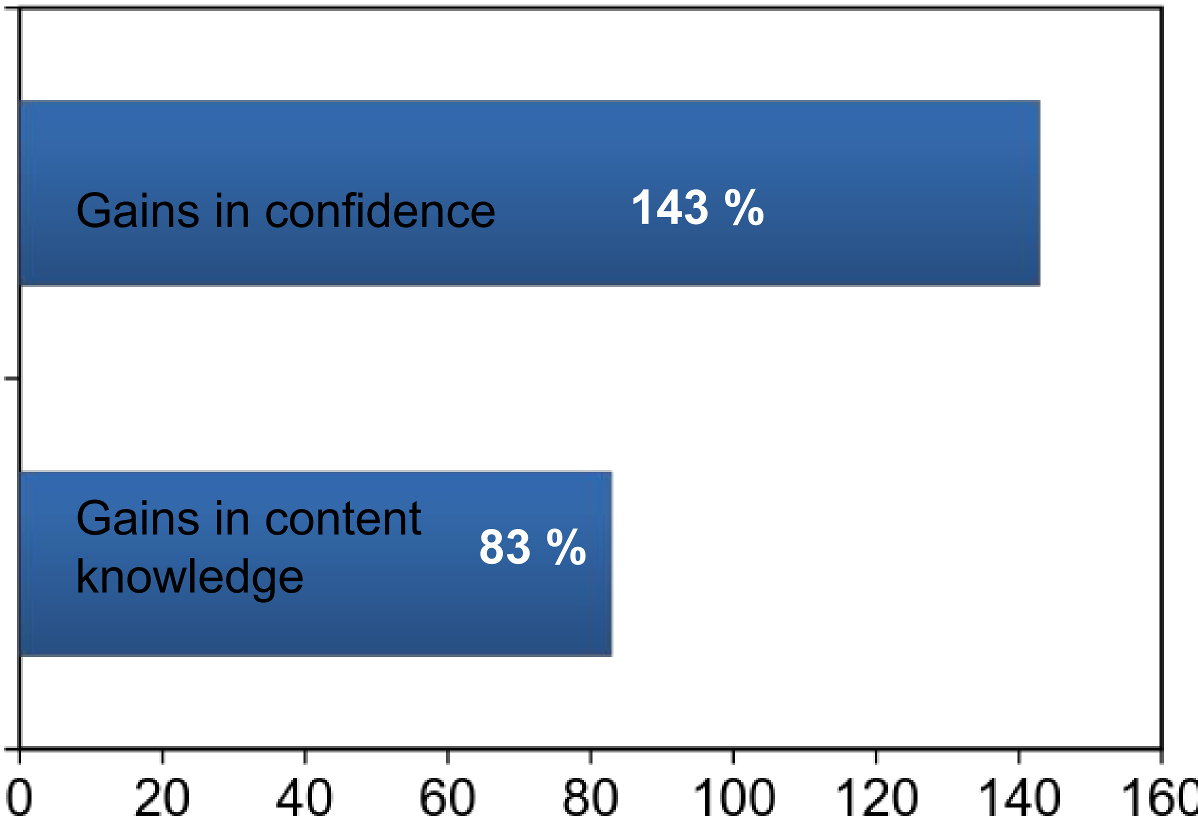
Why Plastics? science lessons offered along with traditional enrichment programs including leadership & dance.



- 79 % Prefer science (Ranking of 4= **very good** & 5 = **excellent**)
- 15 % Neutral (3)
- 6 % Do not like science (Ranking of 2'sand 1's).

*Statistical sample is 30 student participants in Grades 3 – 9. Survey conducted in 2006 with student demographic breakdowns being representative of the US population. Students from 30 schools were surveyed.

Hands-on Minds-on Increased Teacher Confidence



Southern Connecticut State University

Yale University

Education Connection

*Participants in Why Science teacher workshops. Survey conducted in 2009 - 2012 with teachers from over 20 districts in the State of Connecticut.

The Science Teacher: Motivating Issues

EDUCATION CONNECTION

UCONN

Recognition for Teaching & Learning


RENSSELAER POLYTECHNIC INSTITUTE

The Martin Luther King, Jr. Faculty/Staff Award

Presented by the Office of Minority Student Affairs

to a faculty or staff member in recognition of his/her continuing contribution of service and devotion to the advancement of the minority community at Rensselaer.

Dr. Yvonne Akpalu, PhD

What can science teachers do to increase student achievement in science?

Gaps in Foundational Literacy

In high school, students enter the science classroom with the following challenges:

- Students **cannot find key information** and understand the **main concepts** in written material for the course.

- Students cannot **access prior knowledge** to answer text based questions or **solve problems** assigned in course.

Gaps in Problem Solving Skills

1. Asking Questions and defining problems
2. Developing and using models
3. Planning and carrying out Investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Designing explanations and designing solutions
7. Engaging in argument from Evidence
8. Obtaining evaluating and communicating information

Property Challenge Unit

Essential Question:

How do scientists solve problems?

Primary Science and Engineering Practices:

1. Asking Questions and **Defining Solutions**
2. **Developing and Using Models**
3. Analyzing and Interpreting Data

Property Challenge Unit: Your Charge

1. **Examine** the student materials provided
2. **Turn & Talk**: Determine how the student materials provided can be used to close gaps in foundational literacy and problem solving.
3. On the student materials provided, **write SEP** student performance expectations for each activity discussed in your group.

How do we motivate kids to choose to study science in high school and in college?

Catch the Feeling Today and Share!