

Team-based learning in a nanotechnology course:



*Enhancing critical thinking
through course structure*

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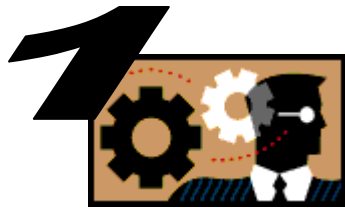
Teaching team: Matthew Ritter (Biology), Barbara Schader (Library Science), Peter Schwartz (Physics), Katherine Chen (Materials Engineering), Richard Savage (Materials Engineering), Lynne Slivovsky (Electrical Engineering), Lars Tomanek (Biology)

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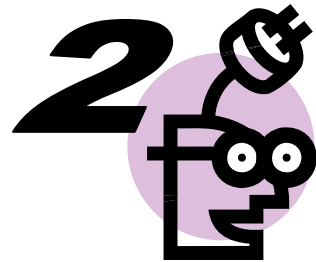
Learning domains: nanoscale science and technology, biology, ethics and society



Broad Course Goals



Systems thinking

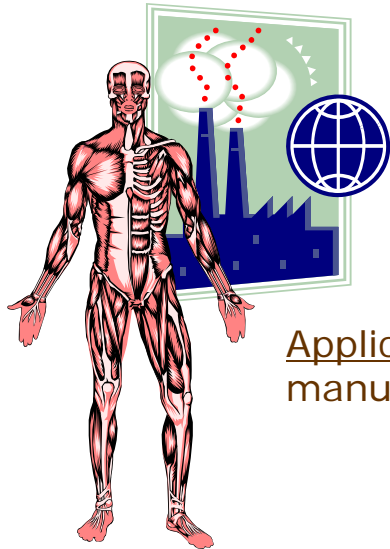


Critical thinking



Motivation to learn

Four technologies serve as the learning context

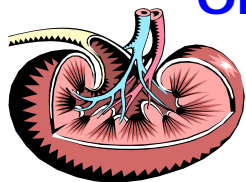
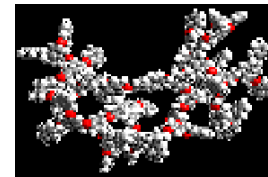


Ecological Level

Application: molecular manufacturing

Cellular Level

Application: gold nanoshells for cancer treatment

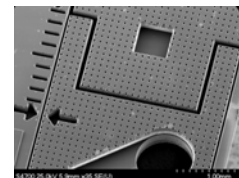


Organ Level

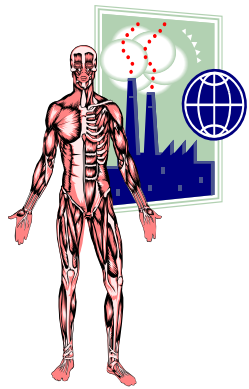
Application: tissue engineering of an organ

Biological Systems Level

Application: microfluidic glucose sensors



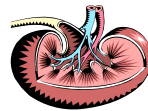
Team-based learning* strategy used throughout



Ecological Level

Application:
molecular
manufacturing

Organ Level



Application: tissue
engineering of an organ

**Debate
preparation**

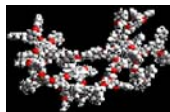


10-week quarter →

Team Debates

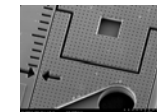
Cellular Level

Application: gold nanoshells for
cancer treatment



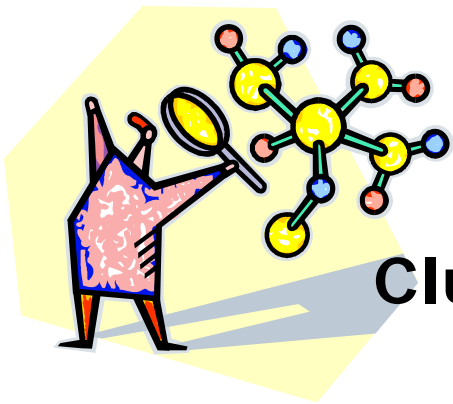
Biological Systems Level

Application: microfluidic
glucose sensors



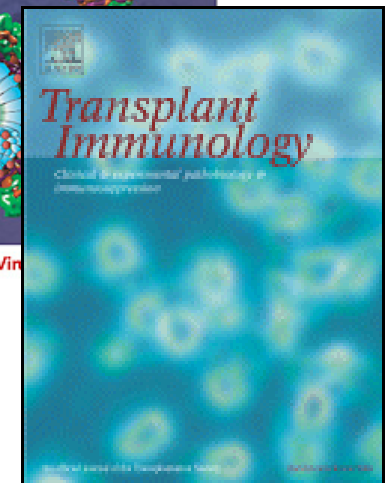
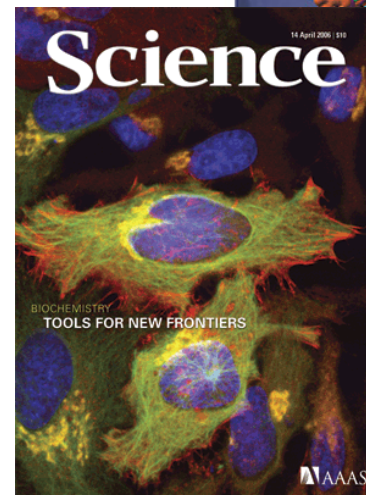
*Team-based Learning, ed. by L. Michaelsen, A. B. Knight, L. D. Fink

Primary source readings assigned before each class



Clues for...

- Author's authority
- Publications' merit
- Voo-doo "science"



Each learning module begins with the application



SOCIETY AND ETHICS



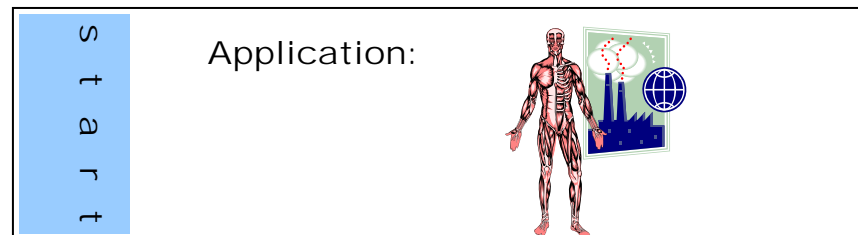
SCIENCE

Implications of technology
and its development?

Which biological system?
How does it function?



What, how, why?



ENGINEERING

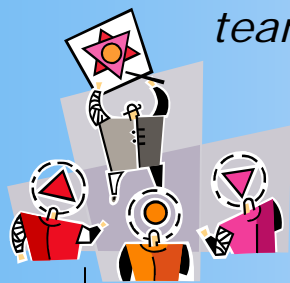
Class periods: activities to apply concepts



Individual preparation

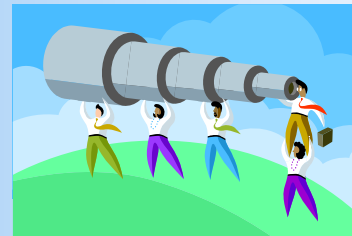


In-class Activities



team quiz

Group activities (1-2 hours)



Solo quiz

Team written appeals



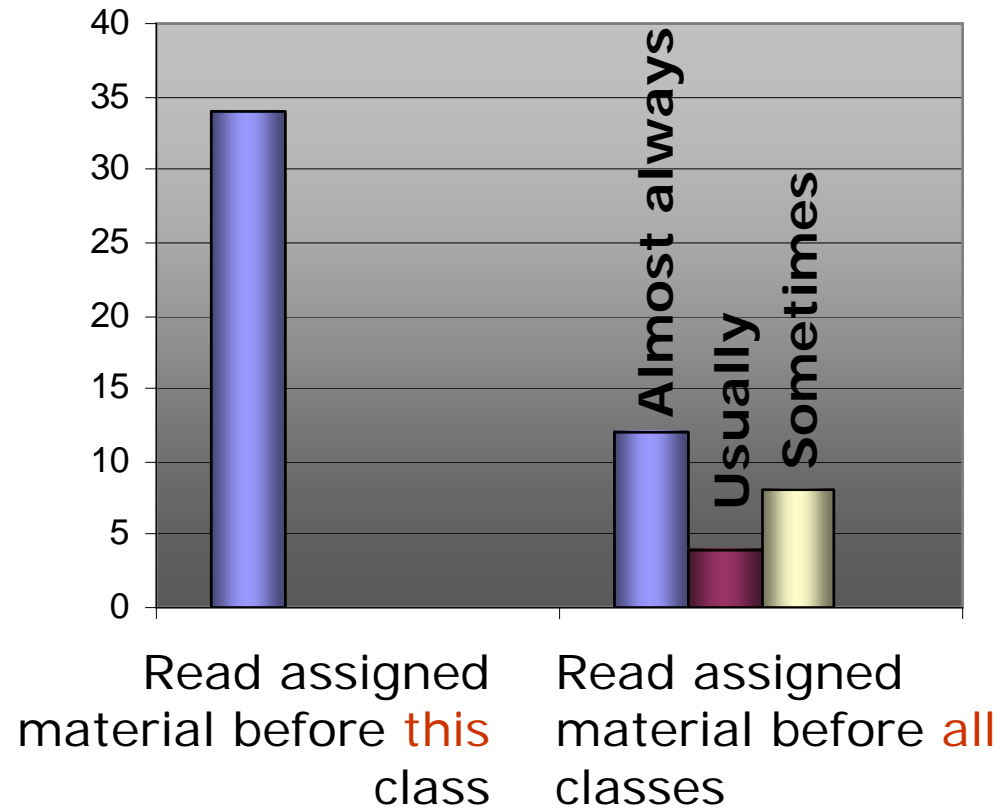
Instructor input



Report results

Students exhibit high levels of interest and involvement

3

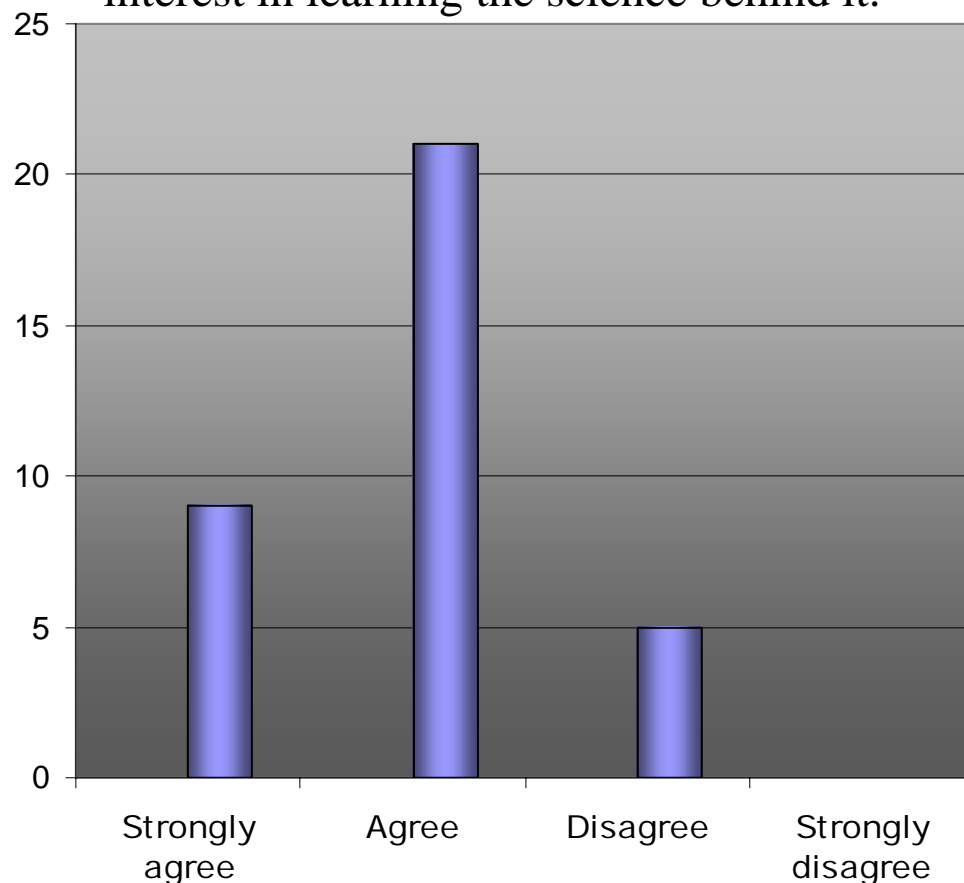


Motivation boosted by learning nanotech application first

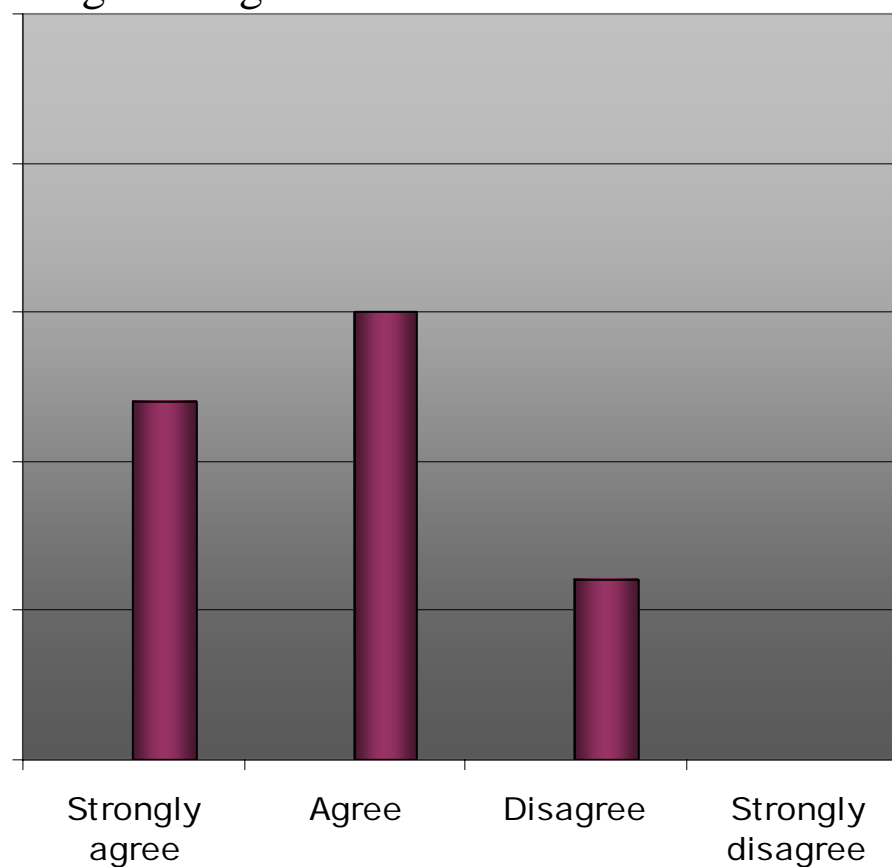
3



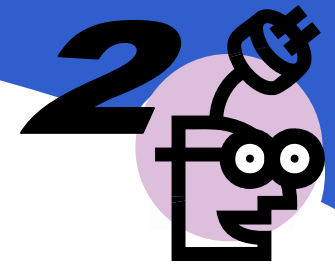
“Learning the application increased my interest in learning the science behind it.”



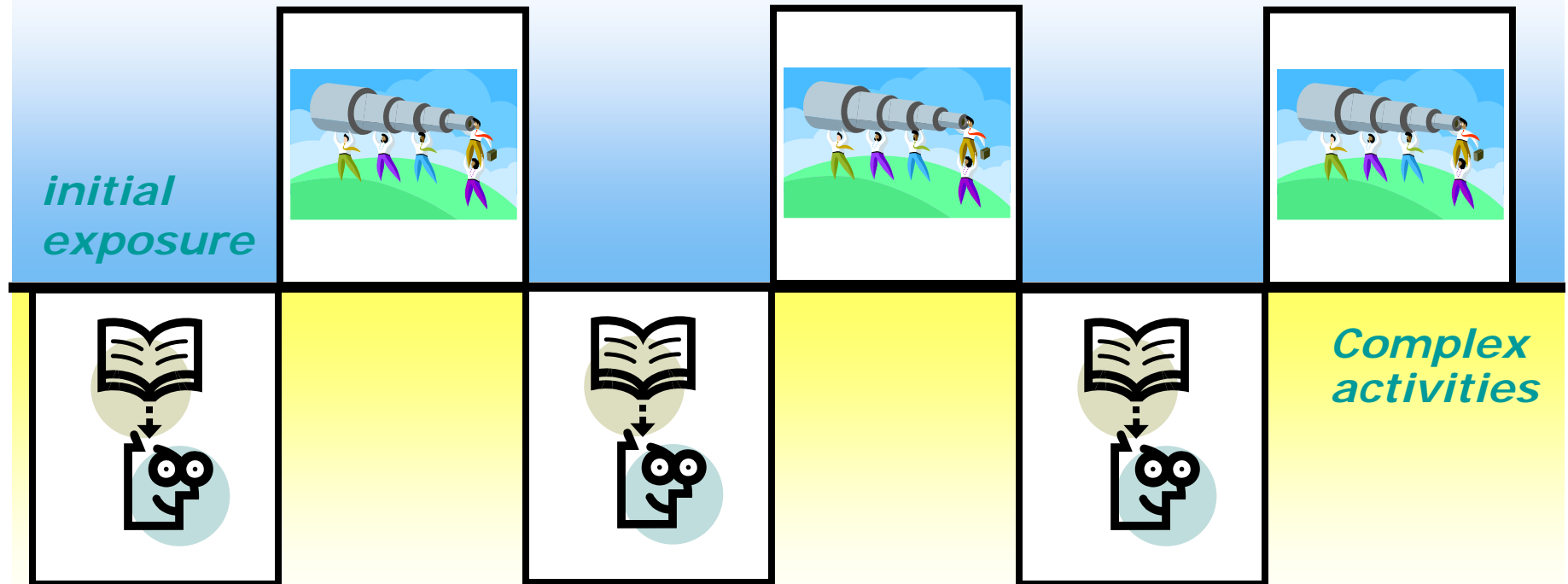
“Learning the application increased my motivation for learning nanoscale science and engineering.”



Complexity of activities increased to build critical thinking

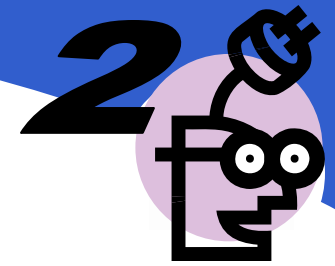


Group work – Inside of Class (6 hours)

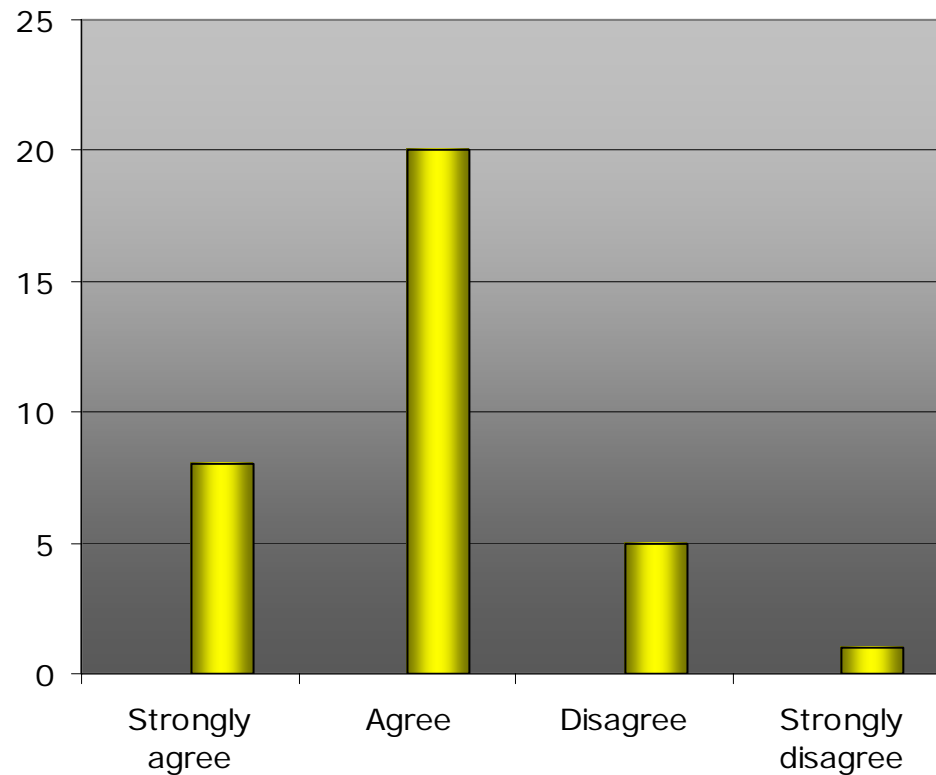


Individual work – Outside of Class

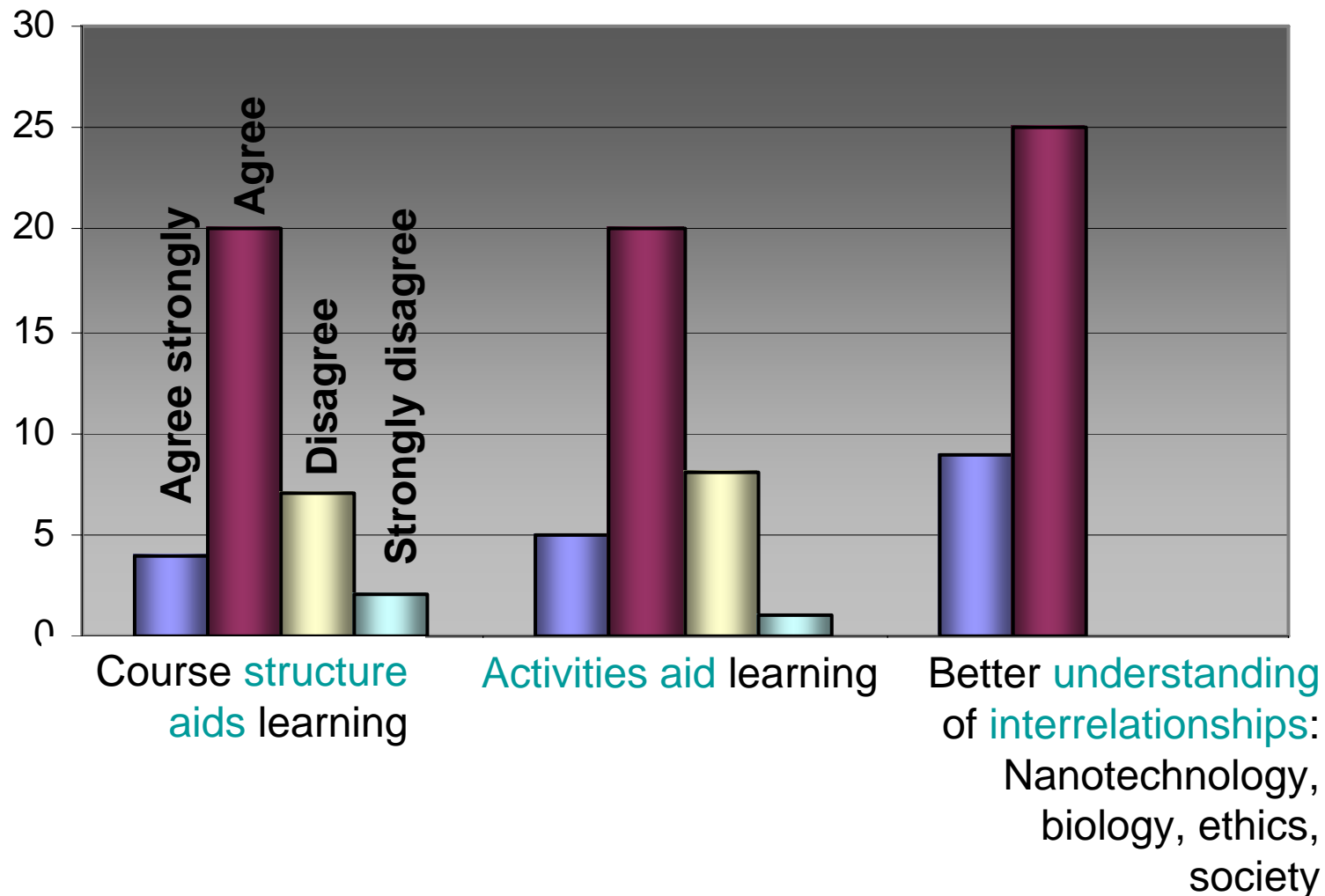
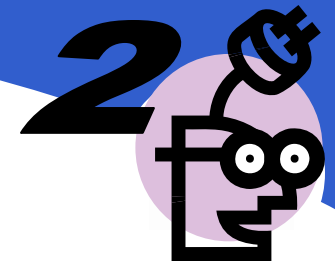
Most sense a greater ability to critically evaluate information



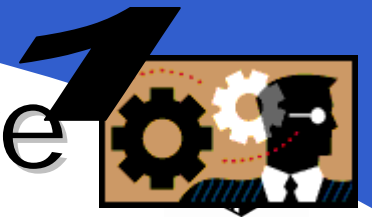
“I have a greater ability to critically evaluate information about nanotechnology because of taking this course”



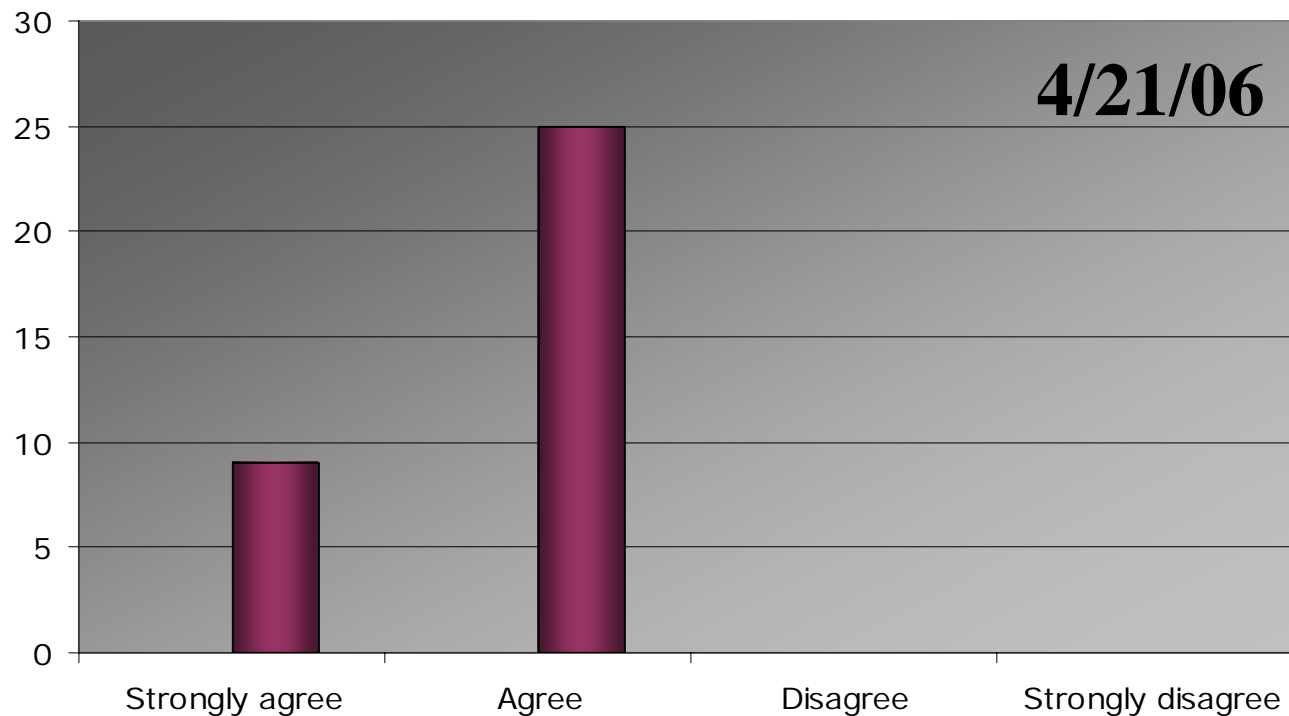
Most believe that course structure aids learning



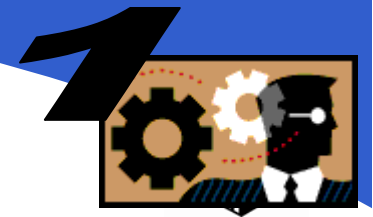
Students perceive they are better at systems thinking



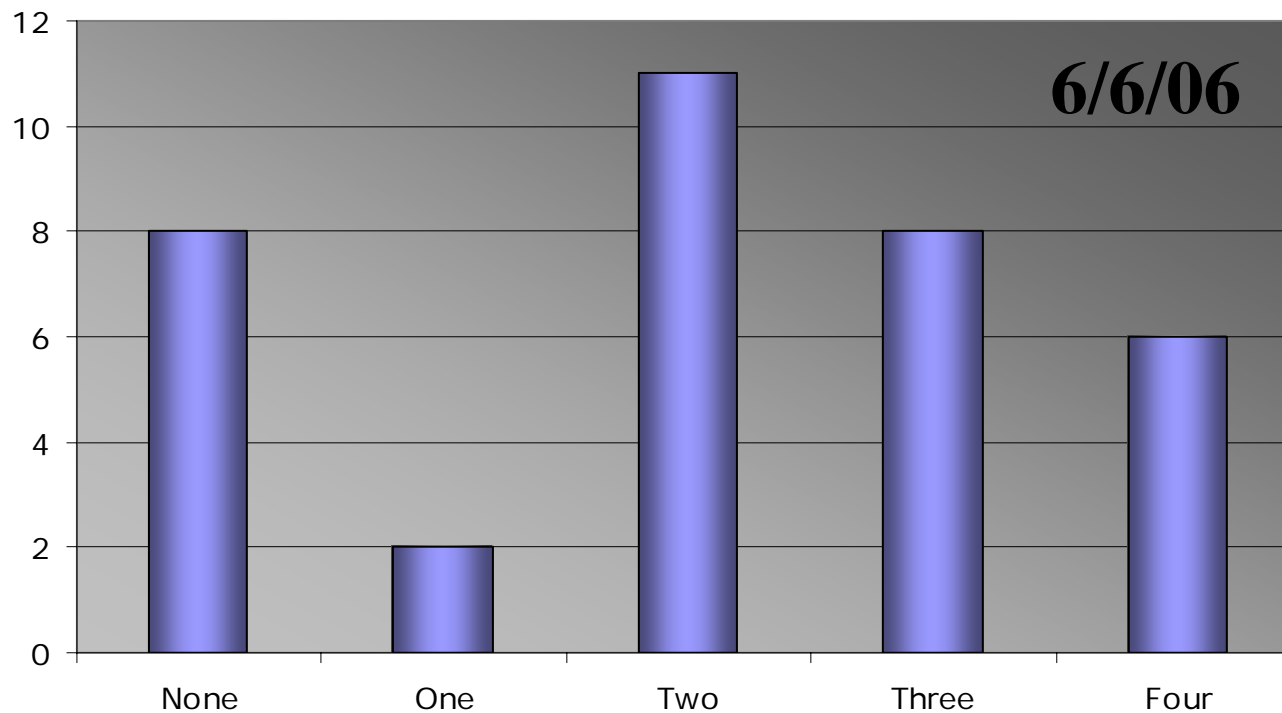
“I have an expanded understanding of the relationships between nanotechnology, biology, ethics and society”



A direct measure of performance says...



“Give an example of the interrelationships between nanotechnology, biology, ethics and society”




One Big lesson:



*Performance exams
MUST be a graded part
of the course*

Team-based learning structure aids development of critical thinking attributes



1  Systems thinking
Initial signs

Structure,
Complex
applications



2  Critical thinking
Sense of mastery

3  Motivation to learn
Application first