

What do College Students Know about the Ocean?

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The Dream: I want to be a science teacher

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The Nightmare

"Surely you were aware when you accepted the position, Professor, that it was publish or perish"



Research Vs Teaching ...

Research About Teaching!



Goal:

Measure impact of my teaching

- Teach better => Ocean Literacy
- Write papers => get tenure

Ocean Literacy

- What is it?
- Can I measure it?
- Can I teach it?



Defining Ocean Literacy

(oceanliteracy.org)

An ocean literate person

- **understands** ... the functioning of the ocean
- can **communicate** about the ocean in a meaningful way, and
- is able to make informed and responsible **decisions** regarding the ocean and its resources

Seven Essential Principles (EPs)

1. The Earth has one big ocean with many features
 - 70% of earth, 97% of water
 - Connected circulation
2. The ocean and life in the ocean shape the features of earth
 - Tectonics & geochemical cycles
 - coastal erosion

Seven Essential Principles (EPs)

3. The ocean influences weather and climate
 - heat cycles, carbon cycles
 - climate change, El Nino and hurricanes
4. The ocean makes the Earth habitable
 - origin of life, source of oxygen
5. The ocean supports a great diversity of life and ecosystems
 - vast space, varied environments
 - biological diversity, lots of microbes

Seven Essential Principles (EPs)

6. The ocean and humans are inextricably interconnected
 - water supply, food, resources
 - natural hazards
 - personal responsibility
7. The ocean is largely unexplored
 - less than 5% explored
 - observations and models
 - interdisciplinary

Questions: Student Background

1. What interests students about the ocean?
 - student motivation
 - 'hooks' for teaching
2. Where have undergrads learned about the ocean?
 - relate teaching to prior knowledge
 - edutainment??

Questions: Ocean Literacy

3. Is ocean literacy measurable?
4. How literate are students at the start of class?
5. Does class improve ocean literacy?

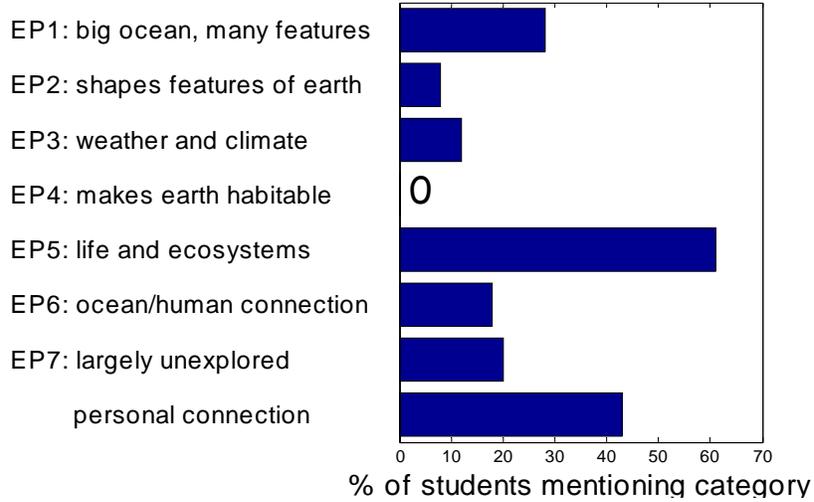
Methods

- survey based on Essential Principles
- open format questions

- administer at start and end of intro class
- 119 pre-class surveys, early Jan, 2006
- 111 post-class surveys, late April, 2006

- 2 ways to make quantitative
- compare ocean literacy, grades, demographics

Essay: what interests you about the ocean?



"There is so much that we don't know, and that's very intriguing. We probably know more about outer space than we do about deep-sea ecosystems,"

"It makes my imagination go wild."

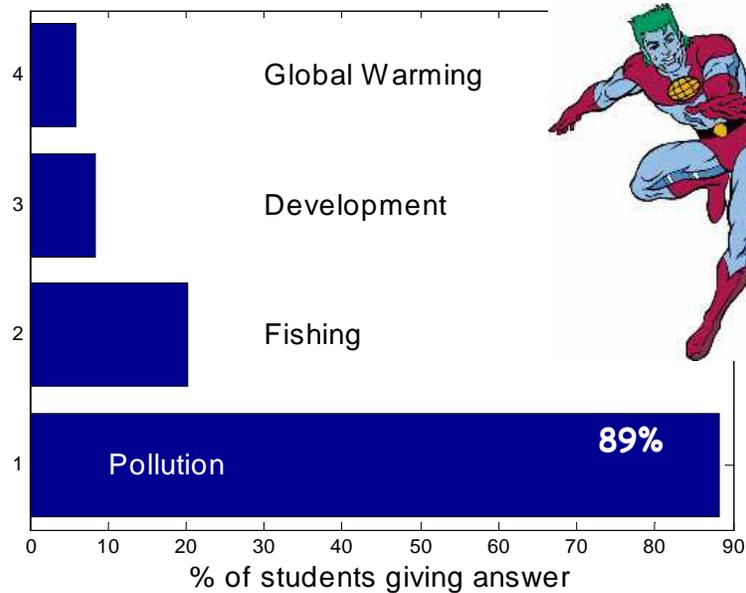


- "Every moment brings something new."
- "I feel a type of completeness
I don't feel anywhere else."
- "I like the power, energy, motion,
and sounds of the waves."
- "Mysterious and scary...
beautiful and intriguing."
- "The ocean is the last semi-sacred place on Earth,
where humans haven't colonized and totally
demolished the place."

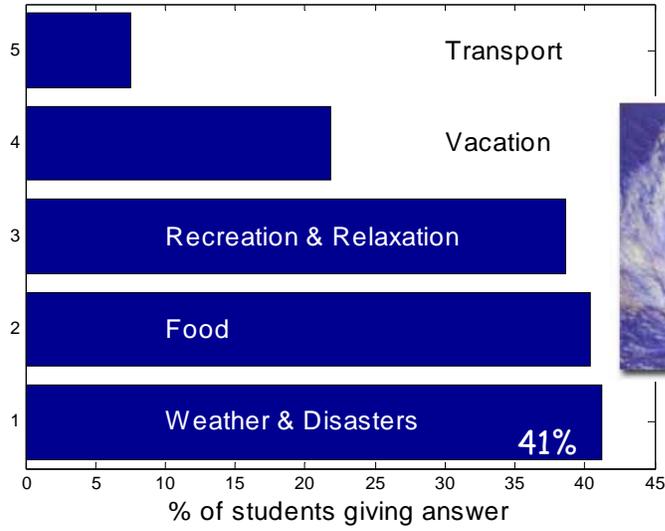


Can teachers channel this passion?

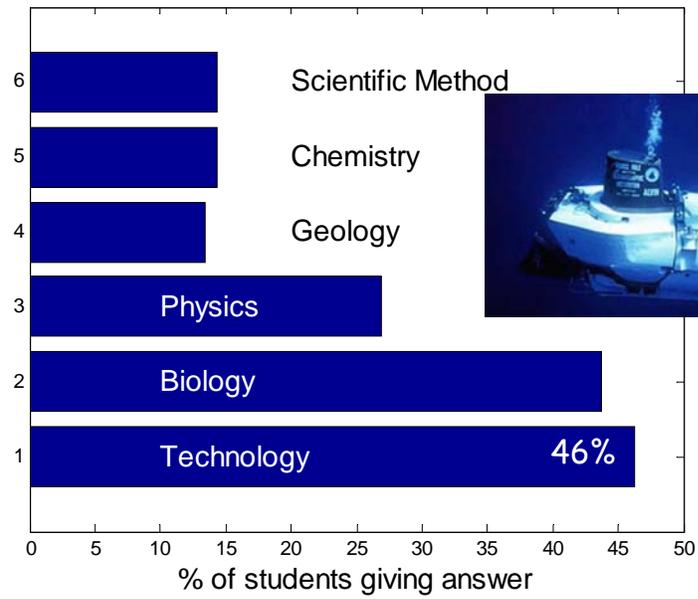
How do your actions affect the ocean?



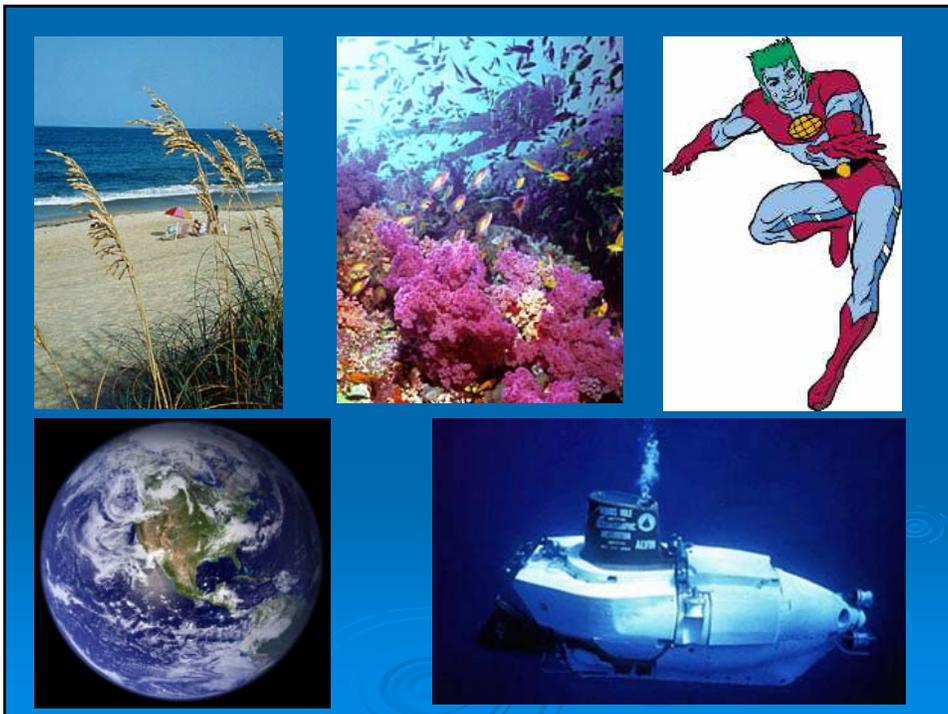
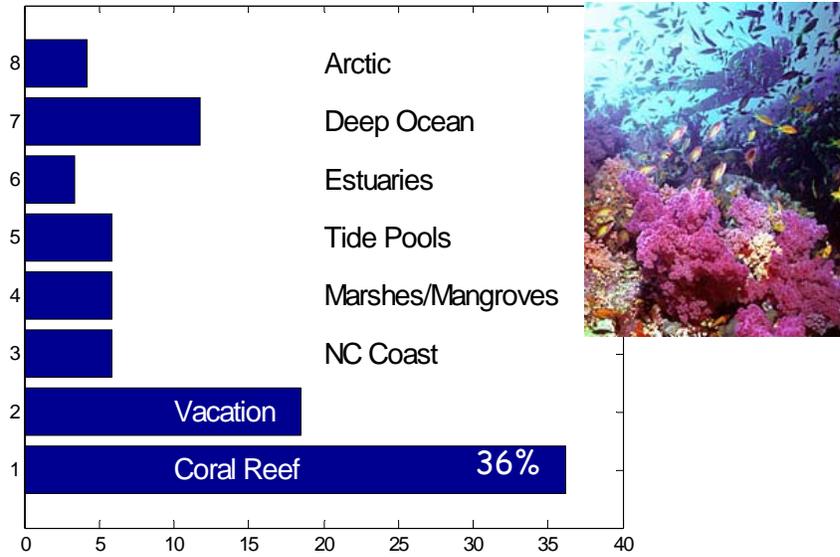
How does the ocean affect you?

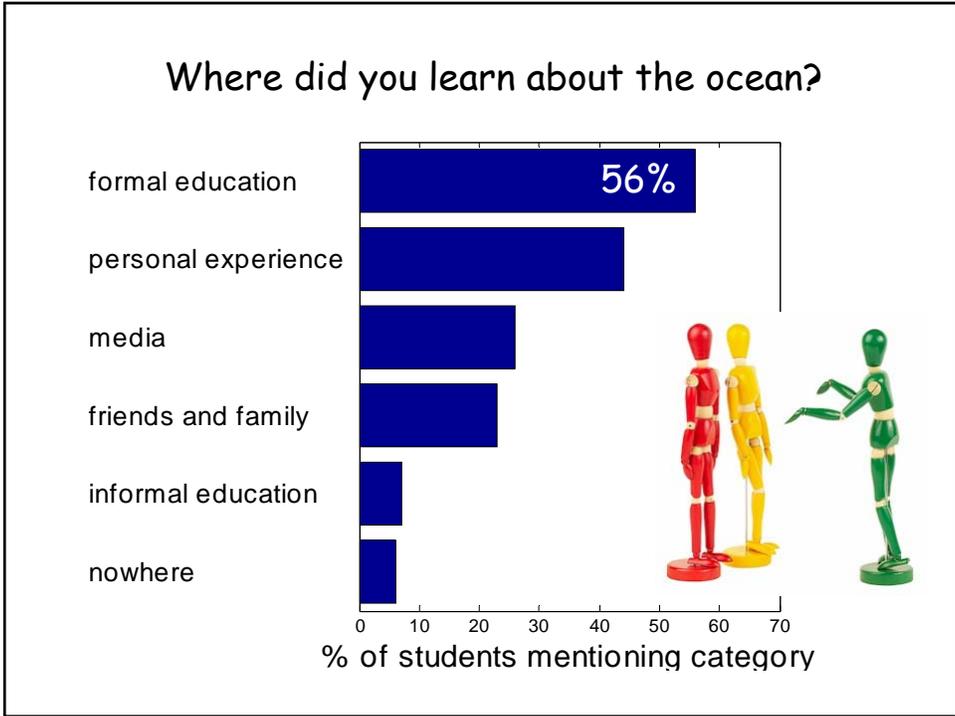


How do scientists study the ocean?



Describe an oceanic ecosystem





The role of conversation in Ocean Literacy

Pre-class:

"[I want to] impress girls at the beach with my knowledge of why the ocean does what it does."

Post-class:

"It seems like now anytime I hear someone... speak about the ocean, I just want to jump in and explain everything I know."

Attitudes, Awareness Whatever!

What do the students actually know?

**EP1: The earth has one big ocean
with many features.**

Questions:

- How deep is the ocean, on average?
- What familiar size or distance is similar to the depth of the ocean?

Answers on Pre-test:

- | | |
|----------------------|-----|
| • 2-6 km | 28% |
| • mountains or miles | 34% |
| • football fields | 9% |
| • 20,000 leagues | 1% |

Depth of the Ocean

Interpretation:

- Appalachians (too short) Himalayas (too tall)
- express in personal terms - e.g., running

Intervention:

- Class discussion: how far is 4 km?
- Draw a correct scale diagram of the size of the earth and the depth of the ocean



Result:

- correct depth: 70% (up from 28%)
- correct scale: 50% (up from 33%)

EP1: The earth has one big ocean with many features.

Questions:

- How much of the Earth is covered with ocean?
- What fraction of the water on Earth is in the ocean?

Pretest correct answers:

- coverage: 70-80% 78%
- fraction: 90-99% 48%

Size of the Ocean

Interpretation:

- educators mention the size of the ocean often
- "3/4" is easy to visualize, "97%" is not

Intervention:

- 100 students stand, all but 3 sit
- 1 student, hand, pinky
- will we run out of potable water?

Result:

- 90% know how big the ocean is (up from 78%)
- 70% know how much water in the ocean (48%)
- a few got the numbers reversed

EP2. The ocean and life in the ocean shape the features of earth

Questions:

Describe one or two processes that affect
the shape of the coast.

Not yet scored

EP3. The ocean is a major influence on weather and climate

EP4. The ocean makes the Earth habitable.

Question:

Our earth system runs on heat, water, carbon and oxygen, all of which cycle through the earth, ocean, atmosphere and biosphere. For any of these cycles, discuss the importance of the ocean.

Not yet scored

EP5: The ocean supports a great diversity of life and ecosystems

Question:

- Is there a greater variety of living organisms on land or in the ocean?
- 93% of students chose ocean at start of class
- contrast general public: 39% right (Ocean Project)

EP5: The ocean supports a great diversity of life and ecosystems

Question:

- Describe an oceanic environment you find interesting, and the ecosystem in that environment.

Ecosystem Scoring Rubric

Brandon Puckett and Ray Mroch

0 pts: no answer or just name ecosystem

1 pts: name components but not linkages
e.g. Coral reef because it is beautiful and amazing and houses lots of types of fish.

2 pts: interactions between components
e.g. Coral filter the water and provide havens for the fish, some fish clean the coral.

Pre-test average: 0.5/2; Post-test average: 0.9/2

EP7: Humans and the ocean are inextricably interconnected

Question:

- Discuss some ways your actions affect the ocean.

Human Impact Scoring Rubric - BJP & RM

0 pts: one word, no explanation
e.g.: "pollution"

1 pt: type or effect of impact
e.g.: "pollution, littering, harsh chemicals"

2 pts: cause and effect
e.g.: "pollution can affect the purity of the water, it could contaminate or kill the animals"

Human Impact Scoring Rubric - BJP & RM

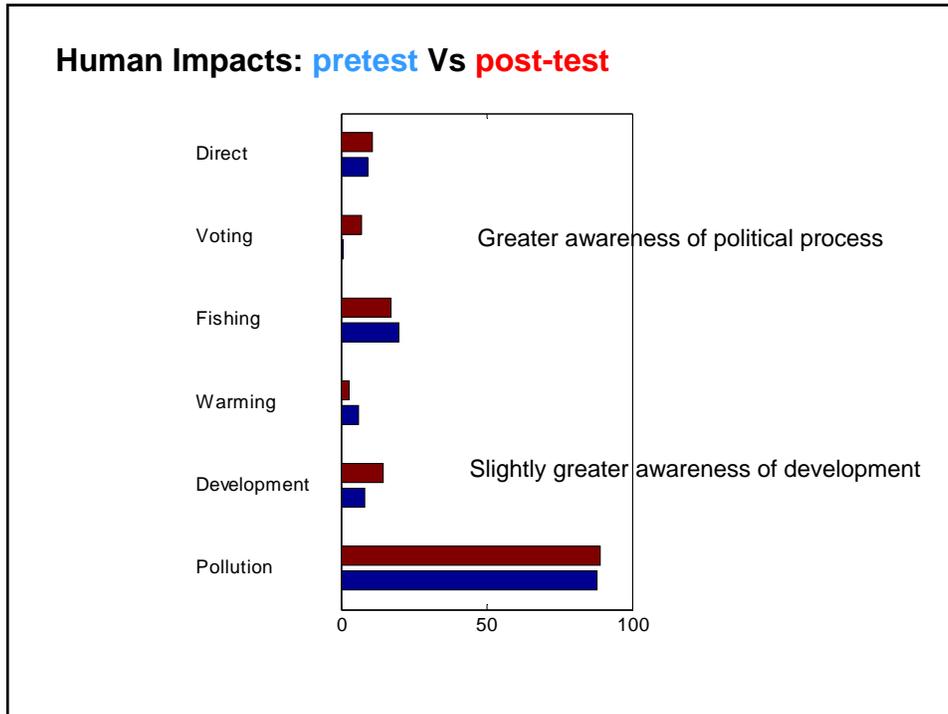
3 pts: cause, effect and linkage

eg: I enjoy eating seafood, so I may play a part in depleting certain fish populations - my eating at least supports the fishing industry. I'm sure I generate a lot of dirty runoff material, which could end up polluting the ocean. As much as I love visiting the beach, I do know that my visiting could be changing the dynamics of our beaches, or at least contributing to an unnatural evolution.

- only 3-4 answers were this good
- pre & post avg= 1.3/3

Human Impact Scoring Rubric - Cudaback

- credit for mentioning impacts besides pollution
- count types of impact mentioned (0-3)
- pre-test avg = 1.4, post test = 1.9
- future tests: 2 questions - list and describe
- improved awareness of voting and development?



EP7: The ocean is largely unexplored

Question:

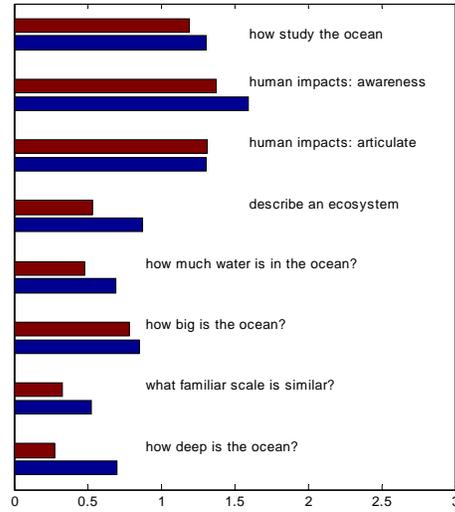
- Describe a few ways scientists study the ocean.

Scoring:

- **1 pt:** name technology, method or study topic
e.g.: "study crab movements, clams, contamination"
- **2 pt:** describe connection
e.g.: "scientists study blue crabs and ways to prevent their extinction or increase their population. Their population is affected by construction near coastline, overfishing"

Preliminary Average Combined Literacy Score

red = pre, blue = post



2

3

3

2

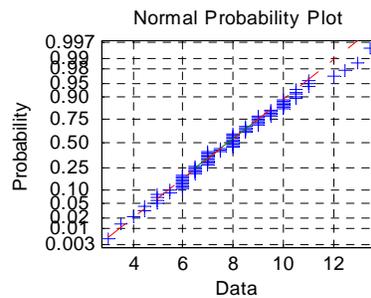
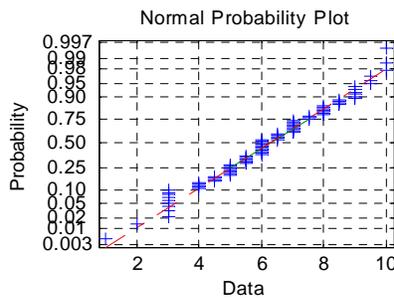
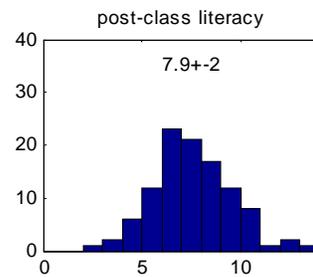
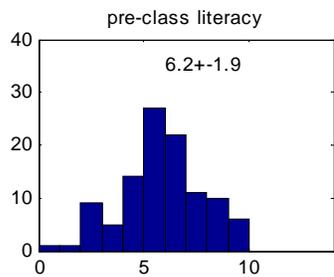
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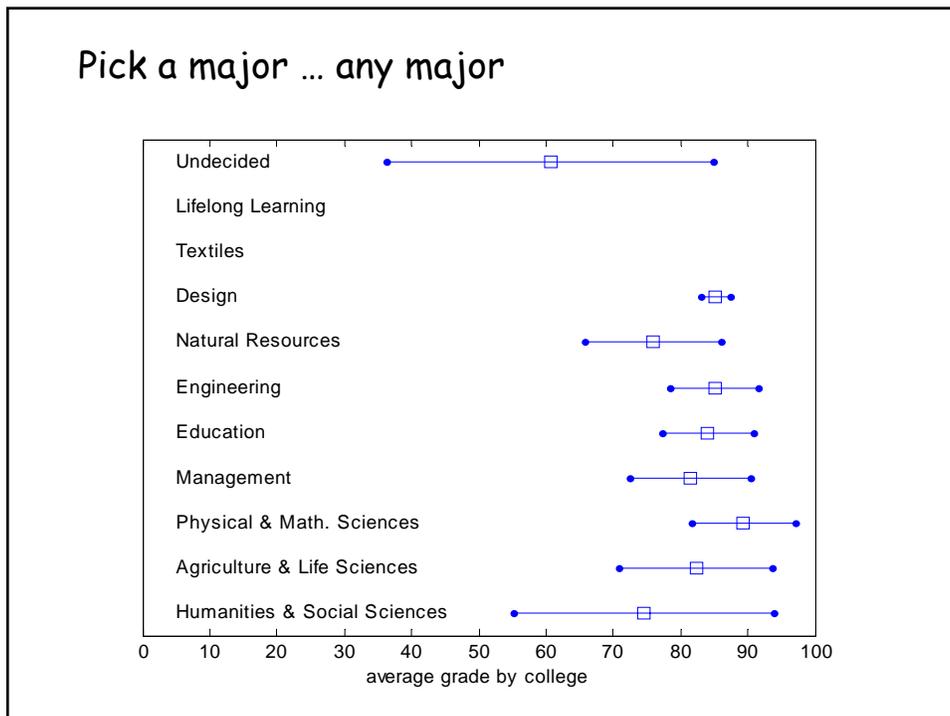
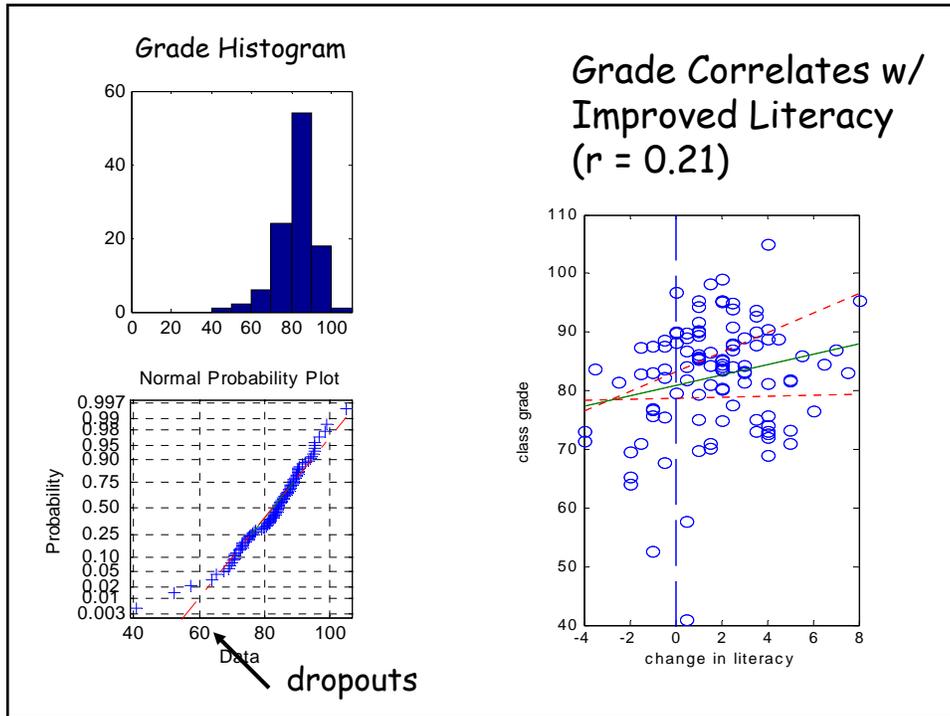
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Summary

- literacy survey is a work in progress
- probably reliable measure of student interest
 - big blue marble
 - personal connection
 - human impacts
 - cool technology
 - exotic biology
- preliminary scoring
 - students more literate than population as whole
 - class improves literacy

"I feel this class has opened my eyes as an environmentalist to protect and make informed decisions ... tourism positively affects the economy and sometimes negatively affects the sea creatures."

"Pretending we are scientists trying to figure out ... the source of beach contamination, now that is cool. And I actually learned it, not so much memorized it. I think learning something is definitely easier when it hits closer to home."

"I understand the ocean a little better now. It's a pretty much undiscovered part of the world, and hopefully one day I can contribute to discovering something new."

"Beaches are places where everybody can go to relax; the sound of the waves, smell of salt, and beach life are things that make the beach so soothing. We need to protect these and keep them for future generations."

Until I saw the sea
I did not know
that wind
could wrinkle water so.

I never knew
that sun
could splinter a whole sea of blue.

Nor
did I know before,
a sea breathes in and out
upon a shore.

Until I Saw the Sea
by Lillian Moore

<http://nessus.gunslingers.org>