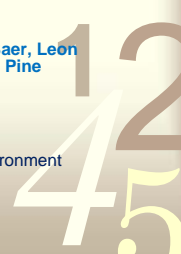


## An Across-The-Curriculum Approach to Quantitative Literacy in Environmental Studies

Ben Steele, Semra Kilic-Bahi, Nick Baer, Leon Malan, Laura Alexander, Harvey Pine

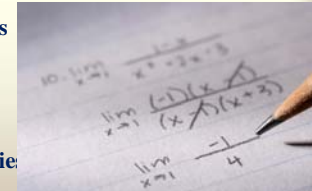

Colby-Sawyer College  
New London, NH

Quantitative Reasoning and the Environment




## Need for Quantitative Skills

- Understanding issues
- Careers
- Informed Citizenry
- Environmental Studies and Environmental Science


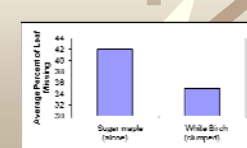

## Across the curriculum Approach

- Encounter different skills and different applications throughout the curriculum
- Use skills in context
  - learning advantage
  - Habit of mind
- But hard to ensure students get all skills
- Harder to assess



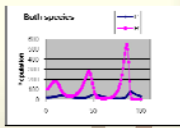


## Skills

- Basic arithmetic
  - proportion; percent
  - Unit conversions
  - Rate of change
- Data presentation and analysis
  - error
  - graphing
  - Descriptive statistics


## Skills (cont.)

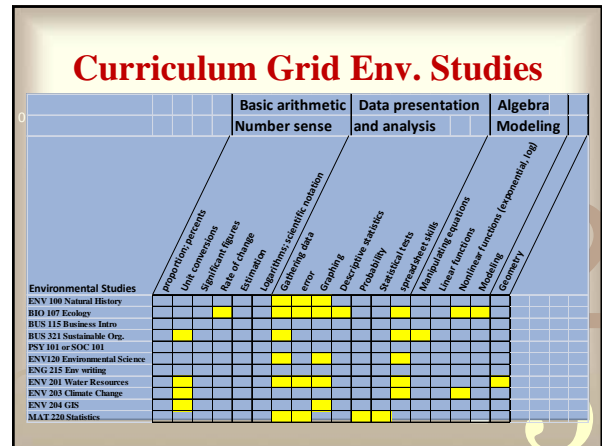
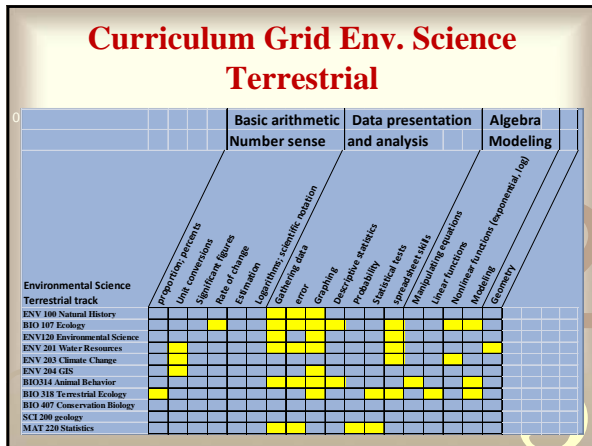
- Algebra; Modeling
  - Manipulating equations
  - Linear and non-linear functions
  - Modeling
- Geometry; Trigonometry
  - Circles
  - Squares, rectangles, Triangles
  - Trigonometric functions
  - Spheres
  - Cubes and other solid figures

## Curriculum Grid Env. Science Aquatic

	Basic arithmetic Number sense	Data presentation and analysis	Algebra Modeling
<b>Aquatic track</b>			
ENV 100 Natural History			
BIO 107 Ecology			
ENV 200 Environmental Science			
CHE 101, 102 Chem Principles			
ENV 201 Water Resources			
ENV 203 Climate Change			
SCT 200-level (geology)			
ENV 300 environmental chemistry			
BIO317 Aquatic Ecology			
MAT 200 Statistics			





### Examples: BIO 107 Ecology

- Data collection and presentation
- Preference of Fall Web Worms for maple versus cherry leaves
- Spreadsheets, means, standard errors, graphs

DISH	LEAF	WEIGHT BEFORE	WEIGHT AFTER CONSUMPTION
1	MAPLE	0.2462	0.1023
2	MAPLE	0.2368	0.1104
3	MAPLE	0.3533	0.1464
4	MAPLE	0.6266	0.267
5	MAPLE	0.4436	0.2132
6	MAPLE	0.5503	0.1731
7	MAPLE	0.3624	0.1203
8	MAPLE	0.3173	0.1583
9	MAPLE	0.3436	0.1343
10	MAPLE	0.7392	0.3976
	Average		0.2385
	Std dev		0.090864134
	Std error		

### Examples: ENV 201 Water Resources

- Quantifying Stream Discharge
  - Area calculations
  - Unit conversions
  - Data management
  - Spreadsheet skills
  - Graphing

### Examples BIO 318 Terrestrial Ecology

- Matrix model using survival and reproduction in several age classes.
- Stable population and age classes
- Effect of survival at different ages

	Matrix	year 1	year 2	year 3	year 4	year 5	year 6
		0	1	2			
		0.5	0	0			
		0	0.5	0			
year 1		10	30	15	20	22.5	17.5
year 2		10	5	15	7.5	10	11.25
year 3		10	5	2.5	7.5	3.75	5
total pop		30	40	32.5	35	36.25	33.75

### Does it work: Evaluation

- Overall: Basic Q skills and QL skills tests

### Does it work: Evaluation

- Pre/post test on module

Test Type	Grade (approx.)
Pre test	0.8
Post Test	2.5
End of semester	0.8

### Challenges

- Only one example of a skill: low retention
- Hindered by basic skills

**Task 1.** If the island is 267 ha and each bird needs 0.1 ha, what is the maximum population? (A hectare is 100m by 100m)

### Challenges: basic skills (cont.)

- Now design an experiment to answer the question:
  - Is it better for a one year old to produce more young or to put their energy into survival? Start by reducing the survival of one year olds by 10% and see what % change in fecundity is required to recreated a stable population.

### Challenges: basic skills (cont.)

- Extra credit:
  - What is 10% less than 0.7?
  - What is 20% less than 200
  - What is 5 % more than .01
- Average = 1.7, Range 0-3
- Lack of practice?

### Conclusions

- Quantitative Literacy skills are weak
- Across the curriculum makes sense
  - But does it work?
- Projection
  - Students need to encounter quantitative issues more often.

– bsteele@colby-sawyer.edu