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



Curriculum Grid Env. Science Terrestrial



Curriculum Grid Env. Studies



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	0.1439	
2	MAPLE	0.2369	0.104	0.1329	
3	MAPLE	0.3533	0.164	0.1893	
4	MAPLE	0.6266	0.267	0.3596	
5	MAPLE	0.4436	0.2132	0.2304	
6	MAPLE	0.5503	0.1731	0.3772	
7	MAPLE	0.3624	0.1201	0.2423	
8	MAPLE	0.3173	0.1583	0.159	
g	MAPLE	0.3436	0.1343	0.2093	
10	MAPLE	0.7392	0.3976	0.3416	
			Average	0.23855	
			std dev	0.090864114	
			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				
		O	1	2		
		0.5	0	0		
		0	0.5	0		
	year 1	year 2	year 3	year 4	year 5	year 6
	10	30	15	20	22.5	17.5
	10	5	15	7.5	10	11.25
	10	5	2.5	7.5	3.75	5
total						
рор	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



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?
- Used to calculators?



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