a place of mind

THE UNIVERSITY OF BRITISH COLUMBIA

Developing Concept Inventories for Biology

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Project Goals

Decades of science education research have demonstrated that students do not arrive in science classes as blank slates without any knowledge or beliefs about the subject under study. Instead, they often hold deeply rooted misconceptions, beliefs and ideas that may diverge widely from scientific consensus (Duit, 2003). These fundamental misconceptions are often a significant barrier to learning. The goal of this project is to develop concept questions for biology that address common student misconceptions in fundamental areas of biology, and are validated to help students focus their learning while helping instructors focus their teaching.

Concept Inventory (CI)

What is it?

"A CI is an outline of core knowledge and concepts for a given field and a collection of multiple choice questions designed to probe student understanding of these fundamental concepts."
(Redish, 2000)

How is it different from student assessment?

- **CIs probe students' conceptual understanding.**
- **CIs are based on research into student misconceptions.**
- **CIs' distracters are chosen to reflect common student misconceptions.**
- **CIs use language suggested by students and based on their feedback.**

How can it be used?

- **Diagnosing misconceptions**
- **Assessing teaching techniques**
- **Measuring learning gains**
- **Checking student understanding**
- **Establishing a baseline for further instruction**

Methodology

1. Identification of key concepts

CONCEPTS

2. Qualitative research into student misconceptions

MISCONCEPTIONS

3. Development of a multiple choice questions in which student misconceptions are used as distracters

DISTRACTORS

4. Validation of multiple choice questions through think aloud interviews with students, and expert validation

5. Administration as pre (before instruction) and post-test (after instruction)., and statistical analyses of the data.

CONCEPT INVENTORY

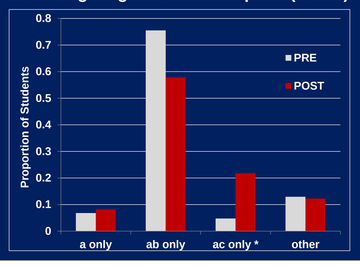
Project Outcomes

	Inventory	Team	Development Phase	Courses	# of Students Involved
Completed	**0. General Student Misconceptions in Biology**	Joan Sharp	Reviewed student misconceptions and questions designed to address them (preliminary work).		
Completed	**1. Meiosis**	Pam Kalas Carol Pollock Jennifer Klenz Angie O'Neill	18 questions were validated through student interviews and were classroom tested.	BIOL 121 BIOL 334	~800
Completed	**2. Operon**	Jared Taylor Elizabeth Imrie Karen Smith George Spiegelman	25 questions were validated through student interviews and were classroom tested.	BIOL 112	~1700
Completed	**3. Population and Community Ecology**	Malin Hansen Thomas Deane Greg Bole Brett Couch	19 questions were validated through student interviews and were classroom tested.	BIOL 121 BIOL 230 BIOL 304	~800
Completed	**4. Speciation**	Erica Jeffery Michelle Tseng Greg Bole	16 questions were validated through student interviews and were classroom tested.	BIOL 121	~600
In Progress	**5. Transcription and Translation**	Rosemary Oh-McGinnis Jared Taylor Sunita Chowrira	27 questions are currently being developed. Classroom testing will be done in BIOL 112 and BIOL 200.	BIOL 112 BIOL 200	~10
In Progress	**6. Experimental Design**	Thomas Deane Kathy Nomme Carol Pollock	25 questions are currently being developed. Classroom testing will be done in BIOL 140.	BIOL 140	~25
In Progress	**7. Microevolution**	Michelle Tseng Greg Bole	15 questions are currently being developed. Classroom testing will be done in BIOL 121 and BIOL 336.	BIOL 121 BIOL 336	~25

Two Example Applications for Meiosis Inventory

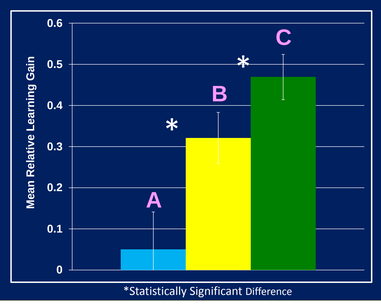
Diagnosing a Misconception

The instructor used the results of the pre-test to target her teaching to address this problem, making greater use of diagrams to illustrate ploidy. Clarified that diploid cells have two different versions of each chromosome and that this should not be confused with a haploid cell that has duplicated its chromosomes. Decreased the proportion of students holding this misconception by almost 20%, but clearly still have work to do on targeting this misconception (n=148).



Assessing Teaching Techniques

We tested 3 lecture sections:
A: pre-test, no lecture, no activity, post test (n=80)
B: pre-test, lecture, no activity, post test (n=148)
C: pre-test, lecture, activity, post test (n=133)



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