

Promoting higher order thinking skills in biology: evaluation of a newly developed course using Bloom's taxonomy.

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The Challenge...



To build a "better" first year biology course.

By "better" we mean:

1. Increase engagement
2. Develop skills (oral communication and independent learning)
3. Emphasize inquiry
4. Encourage a deeper level of learning

The Challenge...



Replace 2 courses with 3 that will span different biological scales.

molecules
↓
cells
↓
tissue
↓
systems
↓
individual
↓
populations

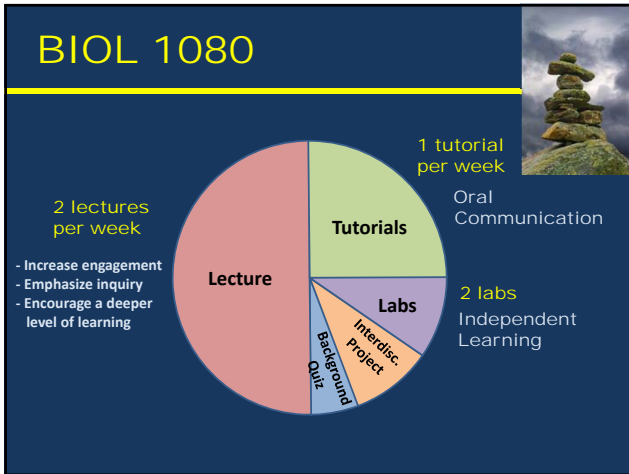
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} BIOL 1080
Biological Concepts of Health



But was it better?

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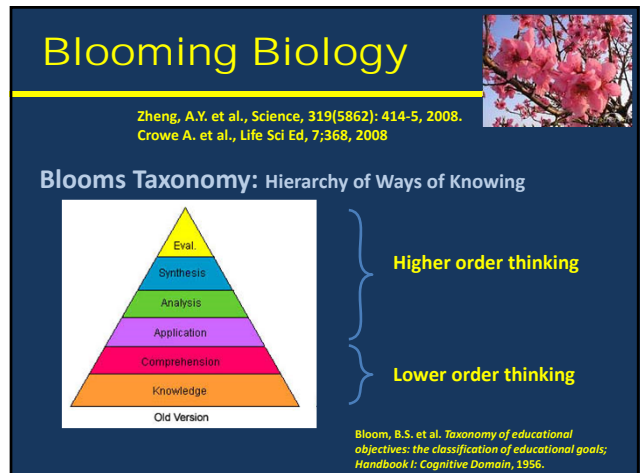
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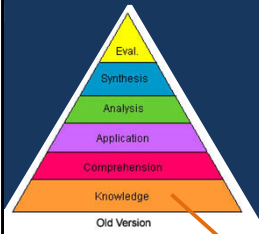
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Blooming Biology



(remembering) – what does the student remember, tested using language very similar to that in class.

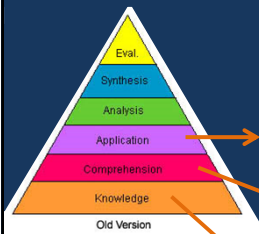
Blooming Biology



(understanding) – what does the student understand, tested using different language and examples from that given in class.

(remembering) – what does the student remember, tested using language very similar to that in class.

Blooming Biology

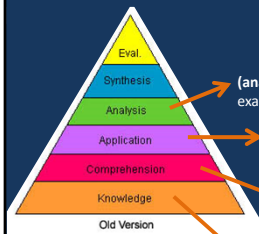


(applying) – students must apply what they know using principles and information not given.

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Blooming Biology



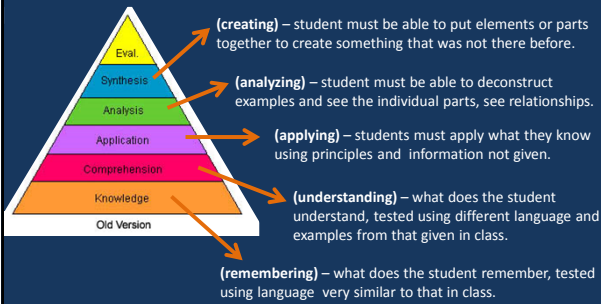
(analyzing) – student must be able to deconstruct examples and see the individual parts, see relationships.

(applying) – students must apply what they know using principles and information not given.

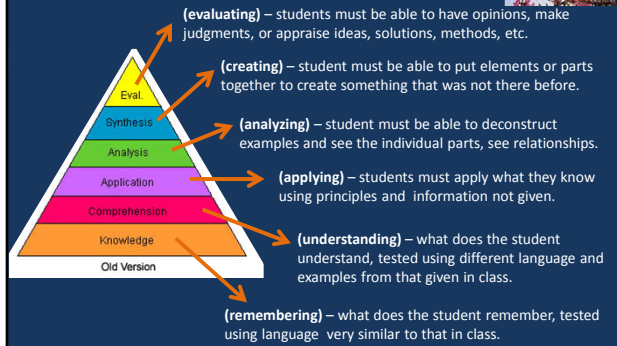
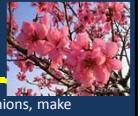
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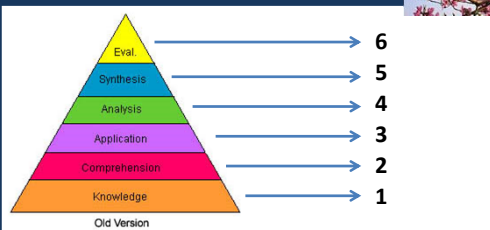
Blooming Biology



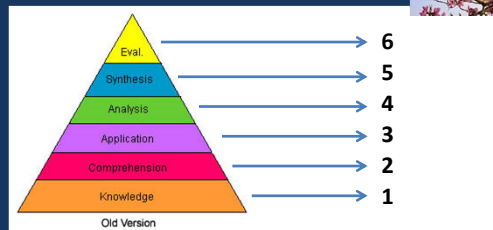
Blooming Biology



Blooming Biology

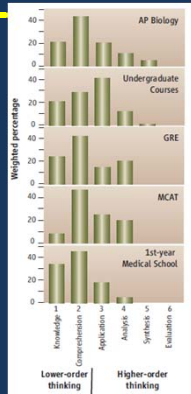


Blooming Biology



- assigned a bloom level to each test question and task of each component of the course that will be graded.

Blooming Biology



Zheng, A.Y. et al., Science, 25; 319(5862): 414-5, 2008.

Blooming process



Gathered team of bloomers

- we used team of 6
- must have an inherent and deep interest in teaching
- had different levels of familiarity with the courses to be bloomed.

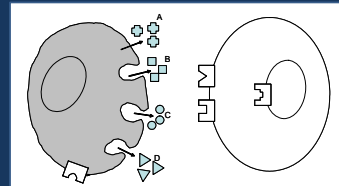
Blooming process



Team needs a leader

- to lead the training - gather resources for help in understanding levels especially as they applied to science-type courses.
- moderate group discussions
- collate data

Blooming training



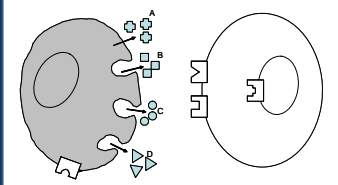
The grey cell and the white cell are two different cell types that reside in the same tissue. The grey cell is releasing 4 different signaling molecules.

When one cell produces a signaling molecule that stimulates a neighboring cell, the type of communication is called:

- Paracrine
- Autocrine
- Endocrine
- Neurocrine

KNOWLEDGE

Blooming training



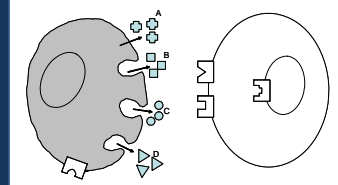
The grey cell and the white cell are two different cell types that reside in the same tissue. The grey cell is releasing 4 different signaling molecules.

Autocrine communication would be the result of:

- a) C binding to its membrane receptor
- b) B binding to its membrane receptor
- c) A binding to its membrane receptor
- d) D binding to its membrane receptor

COMPREHENSION

Blooming training

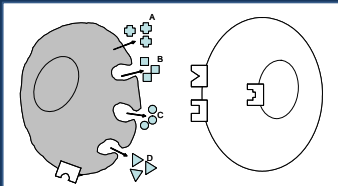


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Which signaling molecule is lipid soluble?

APPLICATION

Blooming training

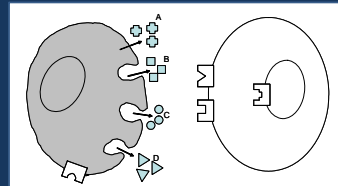


The grey cell and the white cell are two different cell types that reside in the same tissue. The grey cell is releasing 4 different signaling molecules.

What is the assumption about the biochemical nature of signaling molecule A?

ANALYSIS

Blooming training

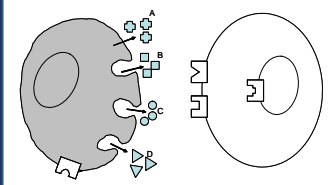


The grey cell and the white cell are two different cell types that reside in the same tissue. The grey cell is releasing 4 different signaling molecules.

Design an experiment to test whether the white cell has a membrane receptor population for molecule B.

SYNTHESIS

Blooming training



The grey cell and the white cell are two different cell types that reside in the same tissue. The grey cell is releasing 4 different signaling molecules.

Autocrine is an effective communication method. Explain why you agree or disagree with this statement.

Evaluation

Blooming practice



1. During exercise, blood flow decreases to which of the following tissues?

- A. heart
- B. kidneys
- C. skeletal muscle
- D. skin

54. Which of the following statements is **FALSE**?

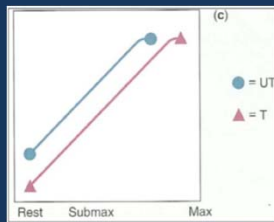
- a. Protein synthesis is increased following dynamic exercise
- b. Protein synthesis is decreased during exercise
- c. Protein breakdown is increased following dynamic exercise
- d. Untrained individuals show a greater increase in protein synthesis following exercise than trained individuals

Blooming practice



10. You come across the following figure and the y-axis is unlabeled. Which of the following variables is most likely to be the missing y-axis variable?

- A. Cardiac Output
- B. Stroke Volume
- C. (a-v) O₂ difference
- D. Heart Rate

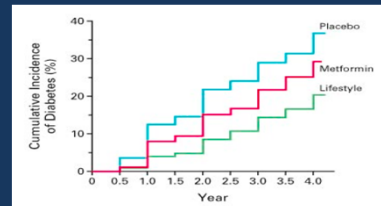


Blooming practice



41) The best interpretation of this graph is:

- a) Lifestyle intervention is positively associated with an increased incidence of diabetes.
- b) Lifestyle, metformin and placebo interventions all caused diabetes.
- c) Lifestyle intervention blunted the incidence of diabetes over time compared to placebo.
- d) The incidence of diabetes increased over time in the placebo group only.



Bloomer agreement



Must have rules for assigning each question/component a bloom level:

AGREEMENT = at least 4 out of 6 choose the same level

When 4 to 6 raters agree – choose common answer

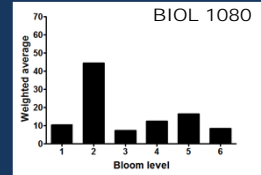
When only 3 raters agree and ratings differ by 1 (1,1,1,2,2,2) – average and alternate rounding up and down

When only 3 raters agree and ratings differ by 2 (2,2,2,4,4,4) – take average

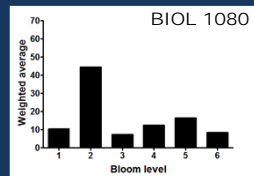
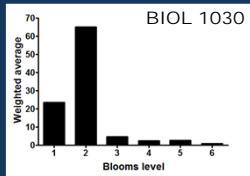
When 2 raters agree and ratings are sequential (1,1,2,2,3,3) – choose intermediate value

Wanted inter-rater agreement of 80%

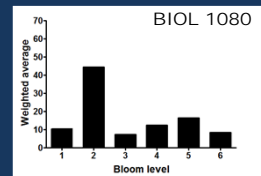
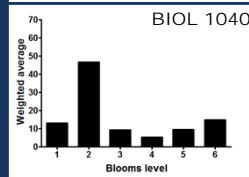
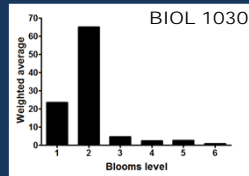
Blooming Results



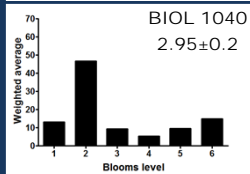
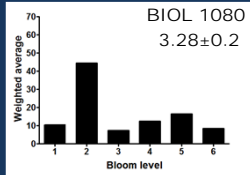
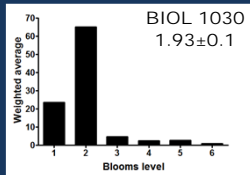
Blooming Results



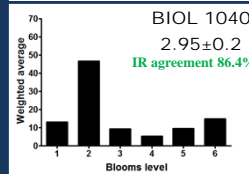
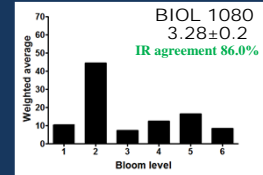
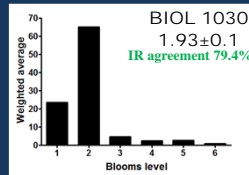
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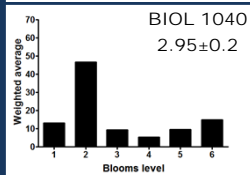
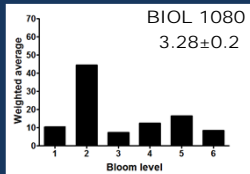
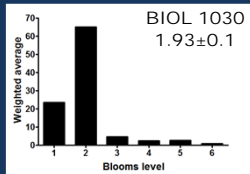
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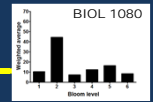


Blooming Results



Great Start!!!

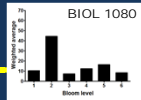
Blooming benefits



Professional

- can be used to compare to published data.
- can be used to compare to replaced courses.
- helps inform about the structure of course.
- have a baseline for growth of course.
- can build subsequent courses in curriculum with deeper learning.

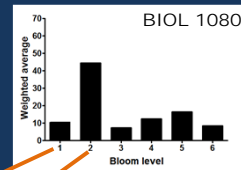
Blooming benefits



Personal

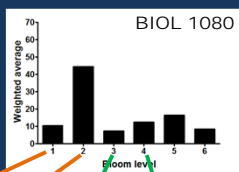
- great discussions on teaching and learning.
- enhanced test writing.
- increase awareness of status quo and motivational in need for change.
- provided a common language.
- difference between “hard” and higher order learning .

Blooming issues



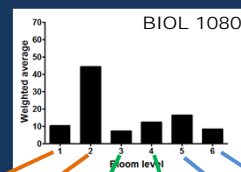
1. Knowledge
2. Comprehension

Blooming issues



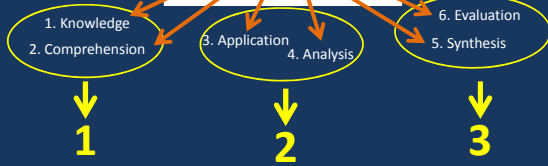
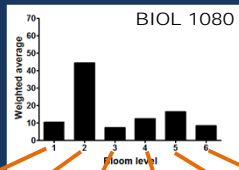
1. Knowledge
2. Comprehension
3. Application
4. Analysis

Blooming issues



1. Knowledge
2. Comprehension
3. Application
4. Analysis
5. Synthesis
6. Evaluation

Blooming issues



ICE taxonomy



3 levels of growth of learning when progressing from novice to mastery.

1. Ideas
2. Connections
3. Extensions

Young, S.F. Teaching, learning, and assessment in higher education: Using ICE to improve student learning. Proceedings of the Improving Student Learning Symposium, London, UK, 13, 105-115. Imperial College, London, UK, September, 2005.

ICE taxonomy



1. Ideas – building blocks of learning, information including facts, definitions, vocabulary, steps in processes, elemental concepts, details, etc.

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ICE taxonomy



1. Ideas – building blocks of learning, information including facts, definitions, vocabulary, steps in processes, elemental concepts, details, etc.
Blooms 1. Knowledge and 2. Comprehension
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ICE taxonomy



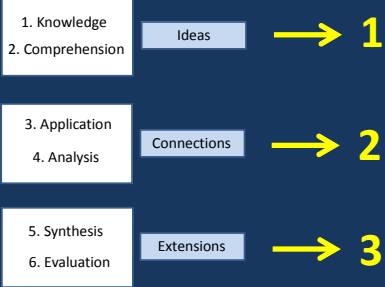
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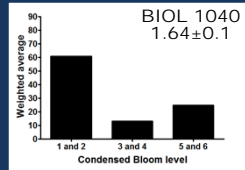
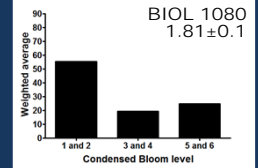
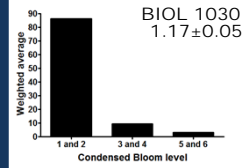


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2. Connections – establish and articulate relationships among ideas, combine ideas, relate to what they already know.
Blooms 3. Application and 4. Analysis
3. Extensions – use learning in novel ways, extrapolate, articulate implications, anticipate outcomes.
Blooms 5. Synthesis and 6. Evaluation

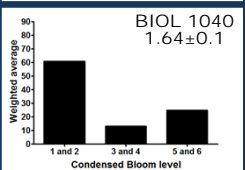
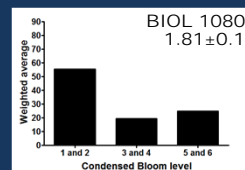
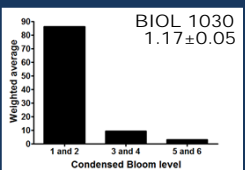
Condensed Blooming



Condensed Blooming

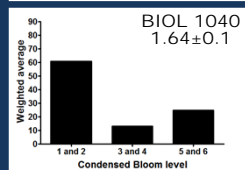
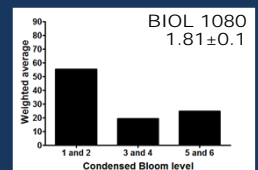
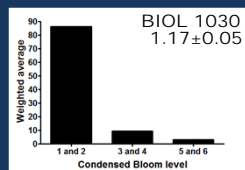


Condensed Blooming



Same conclusions!

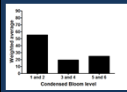
Condensed Blooming



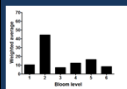
Same conclusions!

1030 - IR agreement 79.4% to 92.1%
1040 - IR agreement 86.4% to 96.8%
1080 - IR agreement 86.0% to 97.2%

Blooming vs ICEing



Condensed blooming
– faster, easier, less information



Blooming
- slower, harder, more information

ICEing
– can't ICE without Blooming first

Conclusions...



Yes, we built a “better” first year biology course.

1. Increase engagement
2. Develop skills (oral communication and independent learning)
3. Emphasize inquiry
4. Encourage a deeper level of learning

Conclusions...

For course developers:
More guidance with less assumption.

For Students:
More 3,4,5, and 6 with less 1 and 2.

Thank you!

QUESTIONS ?