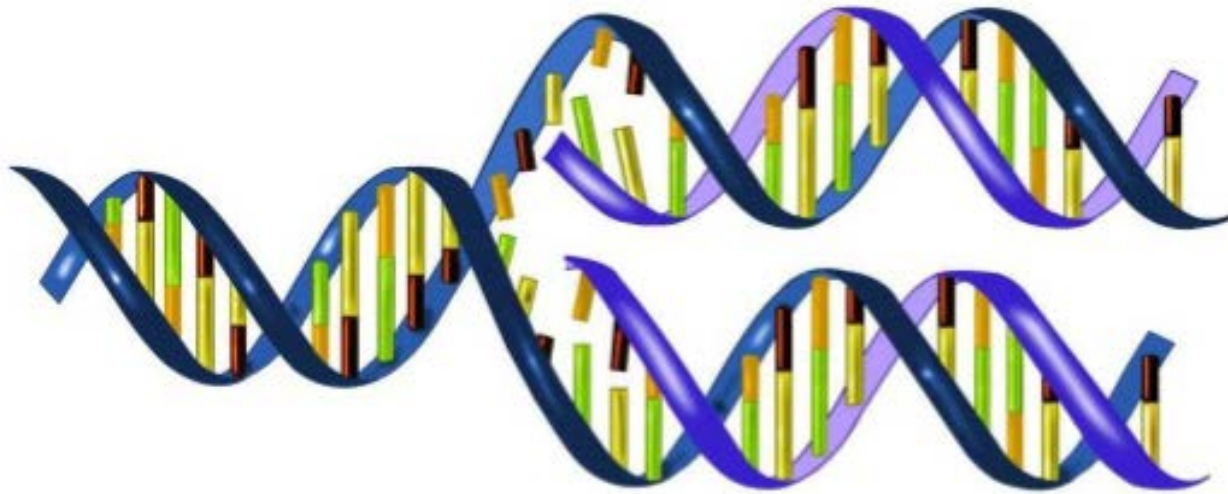


Exploring misconceptions as a trigger for enhancing student learning



<http://www.slideshare.net/mazz4/dna-replication-42836240>

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Why do they have them and why do we care?

Naïve simplistic view

Assumptions due to a rote learning approach

Assumptions based on half-remembered facts - including 'lazy' language

Subjective experience does not agree with scientific fact

Teleological thinking

Essentialist thinking

Anthropocentric thinking

Why do they have them and why do we care?

Naïve simplistic view

Assumptions due to a rote learning approach

Assumptions based on half-remembered facts - including 'lazy' language

Subjective experience does not agree with scientific fact

Teleological thinking

Essentialist thinking

Anthropocentric thinking

We care about student misconceptions because they inhibit the students ability to:

- apply knowledge to new situations
- assimilate new concepts

How to change an entrenched but incorrect 'understanding'?

Changing your mind is hard work

Biochemistry

Molecular
Biology

Concept inventory
leading into a
tutorial

The big reveal

Student-centred

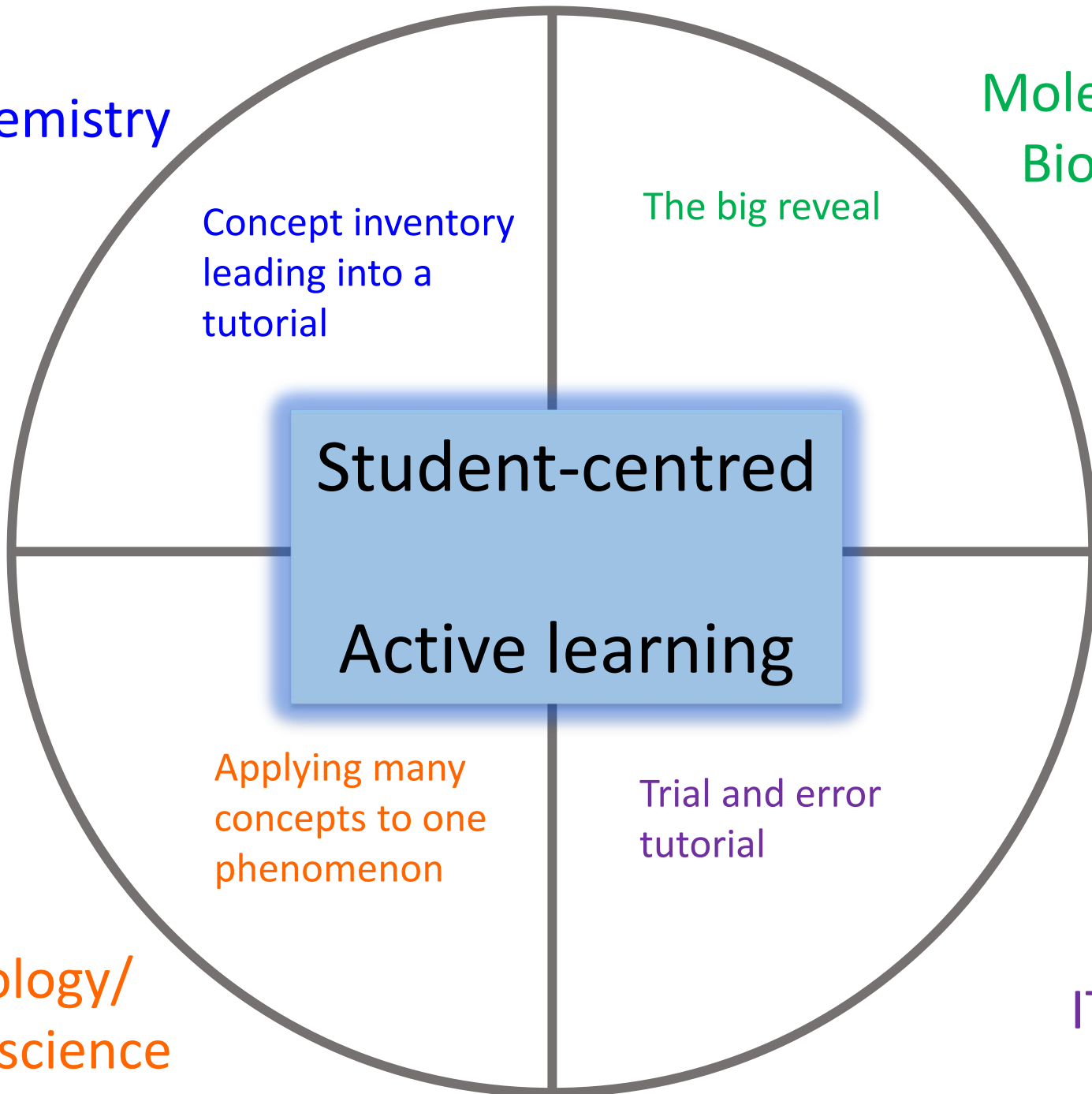
Active learning

Applying many
concepts to one
phenomenon

Trial and error
tutorial

Psychology/
Neuroscience

IT



Case 1: Biomedical science - Tutorial structured around a concept inventory

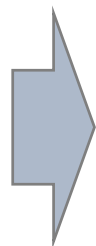
Concept inventory:

Multiple choice questions

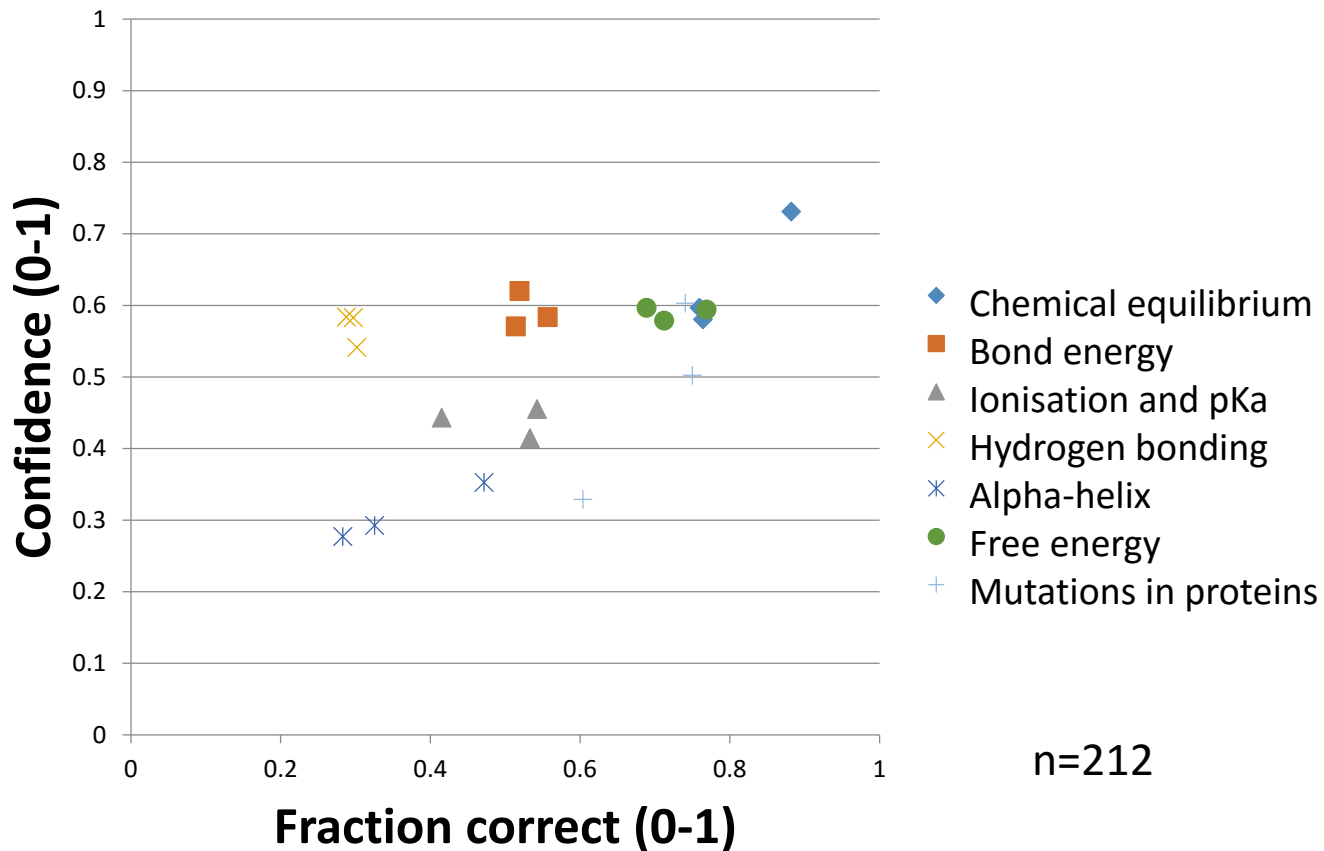
PLUS

What is your confidence in this answer?

- Very high
- High
- Moderate
- Low
- No confidence at all



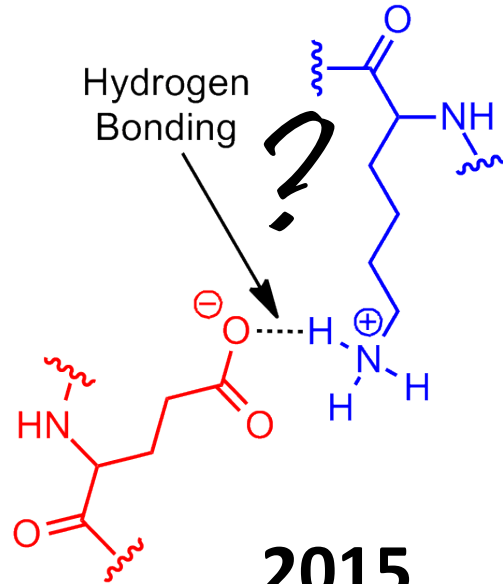
Semester 2 2016



Tutorial (150-250 students)

'70% of you got that question wrong.. discuss and then re-try'

Example: Hydrogen bonding



[https://en.wikipedia.org/wiki/Salt_bridge_\(protein_and_supramolecular\)](https://en.wikipedia.org/wiki/Salt_bridge_(protein_and_supramolecular))

| | 2015 Sem2 | 2016 Sem1 | 2016 Sem2 |
|-------------------|----------------------|----------------------|----------------------|
| Concept inventory | 23.9% | 22.1% | 29.6% |
| Tute (work alone) | 40.3% | 47.7% | 40.5% |
| Tute (pair-share) | 70.3% | 57.8% | 52.2% |
| Tute (extra info) | | | 68.8% |
| Final assessment | 71.9% | 67.8% | 82.2% |

Case 2: Biomedical science - The big reveal

Question: I am amplifying the following DNA sequence using PCR. Only the ends of the sequence are shown.

5' AGCTTCTATCACATTCTGAATT.....ATCCCTCCCGCGCAGGAACT 3'
3' TCGAAGATAGTGTAAGACTTAA.....TAGGGAGGGGCGCGTCCTTGA 5'

Which of the following primer pairs will amplify this DNA?

- A. 3' TCGAAGATAG 5' and 5' CGCAGGAACT 3'
- B. 5' AGCTTCTATC 3' and 3' GCGTCCTTGA 5'

eg. '60% of you are incorrect' (But I don't tell them the answer yet)



Ok, let's have a look in more detail

Question: I am amplifying the following DNA sequence using PCR. Only the ends of the sequence are shown.

Which of the following primer pairs will amplify this DNA?

A.

5' AGCTTCTATCACATTCTGAATT.....ATCCCTCCCGCGCAGGAACT 3'

3' TCGAAGATAG 5'

5' CGCAGGAACT 3'

3' TCGAAGATAGTGTAAGACTTAA.....TAGGGAGGGGCGCGTCCTTGA 5'

B.

5' AGCTTCTATCACATTCTGAATT.....ATCCCTCCCGCGCAGGAACT 3'

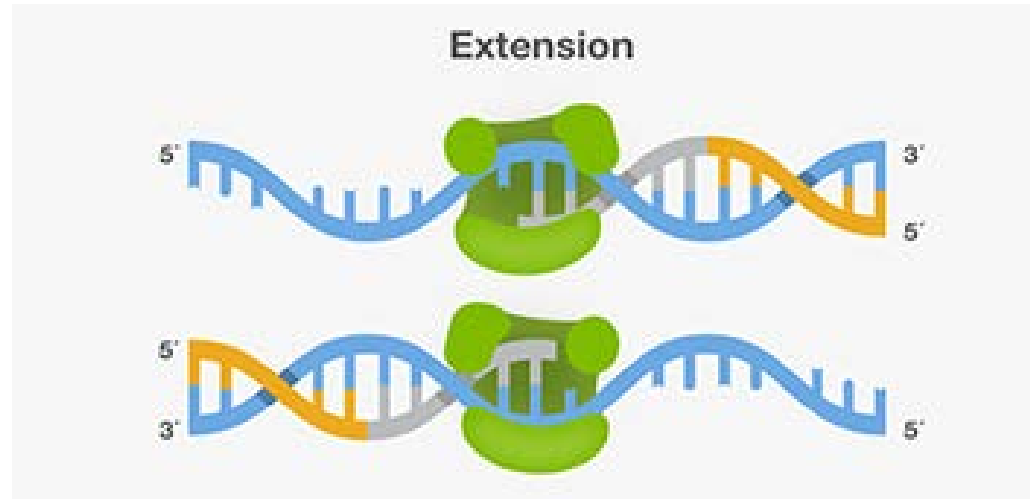
3' GCGTCCTTGA 5'

5' AGCTTCTATC 3'

3' TCGAAGATAGTGTAAGACTTAA.....TAGGGAGGGGCGCGTCCTTGA 5'

Tutorial eg: From 40.3% correct → 77.8% correct

Example: DNA replication in PCR



<https://www.thermofisher.com/au/en/home/life-science/cloning/cloning-learning-center/invitrogen-school-of-molecular-biology/pcr-education/pcr-reagents-enzymes/pcr-cycling-considerations.html>

| | 2016 | 2016 |
|------------------------------------|-------------|-------------|
| | Sem1 | Sem2 |
| Tutorial question (averaged tutes) | 52.5% | 55.9% |
| Same question – more information | 79.1% | 82.3% |

Interviews with students after the tutorials, case 1 and 2

Three themes emerged from qualitative analysis of the interviews

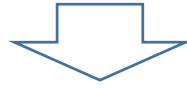
1. Students' prior knowledge predicts their degree of confidence.
2. Students' degree of confidence predicts their decision to change their mind after discussing with their peers.
3. Students' degree of confidence predicts memory.



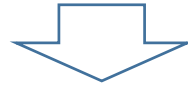
<https://sites.psu.edu/leadership/2017/02/13/self-confidence-good-or-bad/>

Case 3: Computing science - Trial and error tutorial

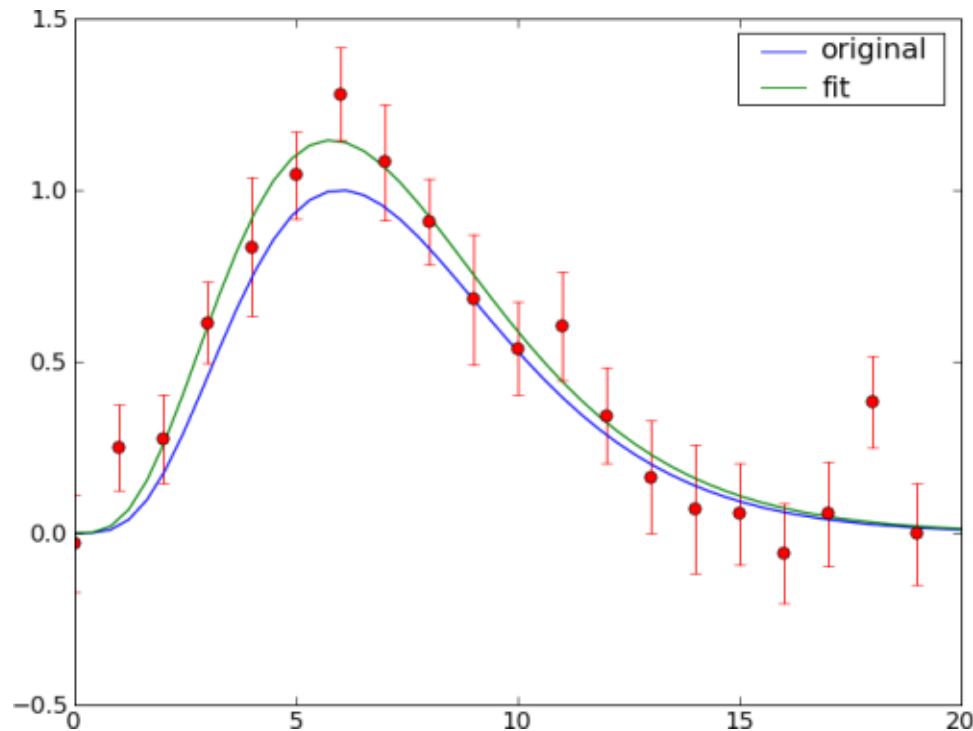
~30 students in a tutorial



Develop a statistics model to fit some sample data



How well does it describe the bigger data set?



Case 4: Psychological science. Applying many concepts to one phenomenon



Unifying factors



Supported by a University of Melbourne Learning and Teaching Grant 2016

→ Misconceptions and active learning guide

Out soon!



THE UNIVERSITY OF
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