

Effective reading: getting students to critically read the textbook before class

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tips for running the workshop

- First slide: have participants generate a list of reasons THEY use the textbook (and what they hope the students get out of it)
- Ask participants for a guess as to how many students read the textbook on a regular basis (fun!)
- go into details about pre-reading; depending on your audience you might want to think about how much data to show
- Hands on part discussed on slide 24; if using a text, be sure to print off enough copies for all participants.



Why do YOU use a textbook?

Some reasons why I use a textbook:

- Content knowledge
 - Become familiar with definitions
 - Recognize features on a graph
- Resource for studying
- **Introduce new materials**



Pre-lecture assignments

GOAL: Students become familiar with material before class → time in lecture can be better used: e.g., for discussions and peer instruction, go deeper in the material

How?

Traditionally, tell the students to read the textbook

... but how many students *actually read* the textbook on a regular basis before class?

< 15% (Stelzer et al. Am. J. Phys. **77** p.184, 2009)

< 20 % (Podolefsky & Finkelstein Phys Teacher, 44, p.338, 2006)



Pre-lecture assignments

GOAL: Students learn some material before class, so that time in lecture is better used.

How?

Multimedia learning modules (MLMs) – animated videos with narration and imbedded questions

→ Limited amount of content

→ 50 h to design and produce

(Stelzer et al., Am. J. Phys., **78**, p.756, 2010)

Just-In-Time Teaching (JITT), including open-end questions (Novak & Patterson)

→ can be difficult for instructors to react in real time



Pre-reading assignments

Pre-reading assignments using any textbook

- Short reading (~1 hour) with **explicit prompts**
- an **online quiz** ~ 5-10 multiple choice questions

CLEARLY TIED TO TEXTBOOK

- Quiz should make the students OPEN the textbook.

CLEAR CONNECTION TO LECTURE

- Refer to – but do not *re-teach* – material in class

CLEAR EXPECTATIONS (and realistic)

- Questions that everyone can answer with the book; lower level of difficulty than for homeworks/exams.



traditional textbook assignment

- list of textbook chapters to be covered

example:

Read Chap 21.1, 21.2

Review Chap 21.2 and read Chap 21.3

important equations: 21.3, 21.6, 21.10, 21.11, (etc.)

chap problems: 21.5, 21.7, 21.9, (etc.)

- students expected to
 - tease out the important concepts
 - keep up on their own (no accountability)



Targeted pre-reading assignments

– reading < 10 pages with **explicit prompts**

specific figures,
equations, and
examples;
questions
posed

21.4 Standing Sound Waves and Musical Acoustics **Compare Fig. 21.16 to 21.11:**
Only certain wavelengths fit on a string or inside a tube. Make sure you understand what the boundaries (open or closed tube) impose on the wavelengths and where equations 21.17 and 21.18 come from. Look carefully at **example 21.5 and 21.6**
Why is the amplitude $2a$? Is a standing wave moving?

– an **online quiz** ~ 5-7 multiple choice questions

(reference figure
or equation)

Q. Look at the two containers in **Figure 15.13**
How would you describe the pressure at point p1 and p2?

(definition &
low-level knowledge)

Q. Which one of these quantities does not influence the separation between two adjacent bright fringes? ...



Targeted pre-reading example: PHYSICS

general instructions

Please READ the text FIRST and then start the quiz -- it will be more beneficial to you. Remember to click on "Save Answer" to save your answer and on "Finish" to submit your quiz. It is due before coming to lecture on Mondays (1:30 PM).

specific figures, equations, and examples; questions posed to focus reading

- 21.1 The Principle of Superposition. Make sure you understand why the resulting forms look the way they do (because of superposition). Try not only to visualize the superpositions, but also try to actually DRAW it.
- 21.2 Standing Waves. Read this section carefully (it will also help for the lab) and pay attention to Fig 21.5 and 21.6. Concentrate on how a standing wave is created, become familiar with nodes and antinodes, and look at how a standing wave is represented in equations. Compare the equation for a traveling wave to that of a standing wave. Why is the amplitude $2a$? Is a standing wave moving? If so, in what directions(s)? Pluck a rubber band; is this a standing wave?

selective reading (value their time)

- 21.3 Transverse Standing Waves. This is either preparation or review of your lab experiment. You may skip the section on standing electromagnetic waves (although it is interesting).
- 21.4 Standing Sound Waves and Musical Acoustics Compare Fig. 21.16 to 21.11: Only certain wavelengths fit on a string or inside a tube. Make sure you understand what the boundaries (open or closed tube) impose on the wavelengths and where equations 21.17 and 21.18 come from. Look carefully at example 21.5 and 21.6 .



Targeted pre-reading example: BIOLOGY

general instructions

Read section 46.5 (Movement) of **Chapter 46: *Animal sensory systems and movement*** from your text book (p. 1095-1100) and take the corresponding pre-reading quiz on VISTA. The pre-reading quiz for Tuesday's lecture closes 9am Tuesday, April 3rd

Skim the sub-headings "movement" and "skeletons" on p. 1095-1096. We will not be covering this material in any depth, so just focus on being able to answer the following questions:

- Why are muscles organized into antagonistic muscle groups?
- How does this facilitate locomotion?

Read section the next section ("How do muscles contract") p. 1097-1100 carefully. This is the most important part of the chapter, and will be the main subject of the lecture

In the section "The sliding filament model" make sure you understand:

- The relationship between muscle tissue, muscle fibers, myofibrils and sarcomeres (Figure 46.19)
- Why striated muscle has bands (striations) (compare Figure 46.19 to 46.20)
- What happens to the size of the bands during contraction

In the section "How do actin and myosin interact?" focus on:

- The steps shown in Figure 46.22
- Making sure you understand the role of ATP in the process
- You can skip Figure 46.21

You can skip the section "Muscle Types" (p. 1101)

selective reading (value their time)

Questions posed to focus reading: specific figures, equations, and examples;



Pre-reading quiz questions: Physics

DEFINITION

For standing waves, we will assume that ...

1. The two waves have the same amplitude
2. The two waves have the same frequency
3. The two waves have the same wavelength
- 4. all of the above**

REFERENCE FIGURE

In Figure 21.4, what does the blue line represent?

1. a wave traveling to the right.
2. a wave traveling to the left.
- 3 .a standing wave formed by the the superposition of two traveling waves.**
4. a standing wave on a string oscillating at its fundamental frequency

REFERENCE EQUATION

How does shortening the length of a fixed string under tension, for instance when you press down a guitar string, affect the frequency? (Assume that the tension remains the same.) Helpful equations: 21.13 & 21.14.

1. The frequency decreases.
2. There is no change to the frequency.
- 3. The frequency increases.**
4. Cannot answer this question without knowing the tension.



Pre-reading quiz questions: Biology

(worth marks, 2-5%)

DEFINITION

Antagonistic muscle groups:

- a. are pairs of muscles that work together to move a bone back and forth.
- b. are made up of a flexor and an extensor
- c. have coordinated movement due to motor neurons
- d. all of the above**

REFERENCE FIGURE

Look at figure 46.20. When a muscle fiber shortens (contracts) the:

- a. thick filaments shorten.
- b. Z lines shorten.
- c. thin filaments shorten.
- d. interaction of actin and myosin propels the thick and thin filaments past each other.**

OPEN-ENDED

Was there any material in this pre-reading that you found particularly unclear or difficult? Were there any parts that were too basic (or that you have covered extensively before)?



JITT-like open-ended question (Biology)

OPEN-ENDED: Was there any material in this pre-reading that you found particularly unclear or difficult? Were there any parts that were too basic (or that you have covered extensively before)?

Information
about
previous
coverage



- Covered quite a bit in Biol153
- I was a little unsure for question number two. Looking at diagram 46.22, and reading the corresponding section, I get the sense that ATP directly catalyzes both a) and b) options for question 2.
- both tropomyosin and troponin form the complex to block the binding sites?
- I found the last two questions to be unclear. Particularly #3, because in the book it states that the troponin/tropomyosin complex is what blocks binding site for contraction.
- how tropomyosin and troponin work together
- Troponin and tropomyosin they work together, but which one is the one that blocks the binding site on actin?
- The book says that "troponin and tropomyosin work together to block the myosin binding sites on actin" but question 3 does not have an answer consistent with this statement- I'm confused about this

Can scan to
find areas that
many students
struggled with.



Student survey data: pre-readings

168 students in PHYS 101 (response rate ~77 %)

254 students in BIOL 260 (response rate ~60 %)

Q1. I completed the pre-reading Quiz on VISTA ...

Q2. I READ the assigned pre-reading sections:

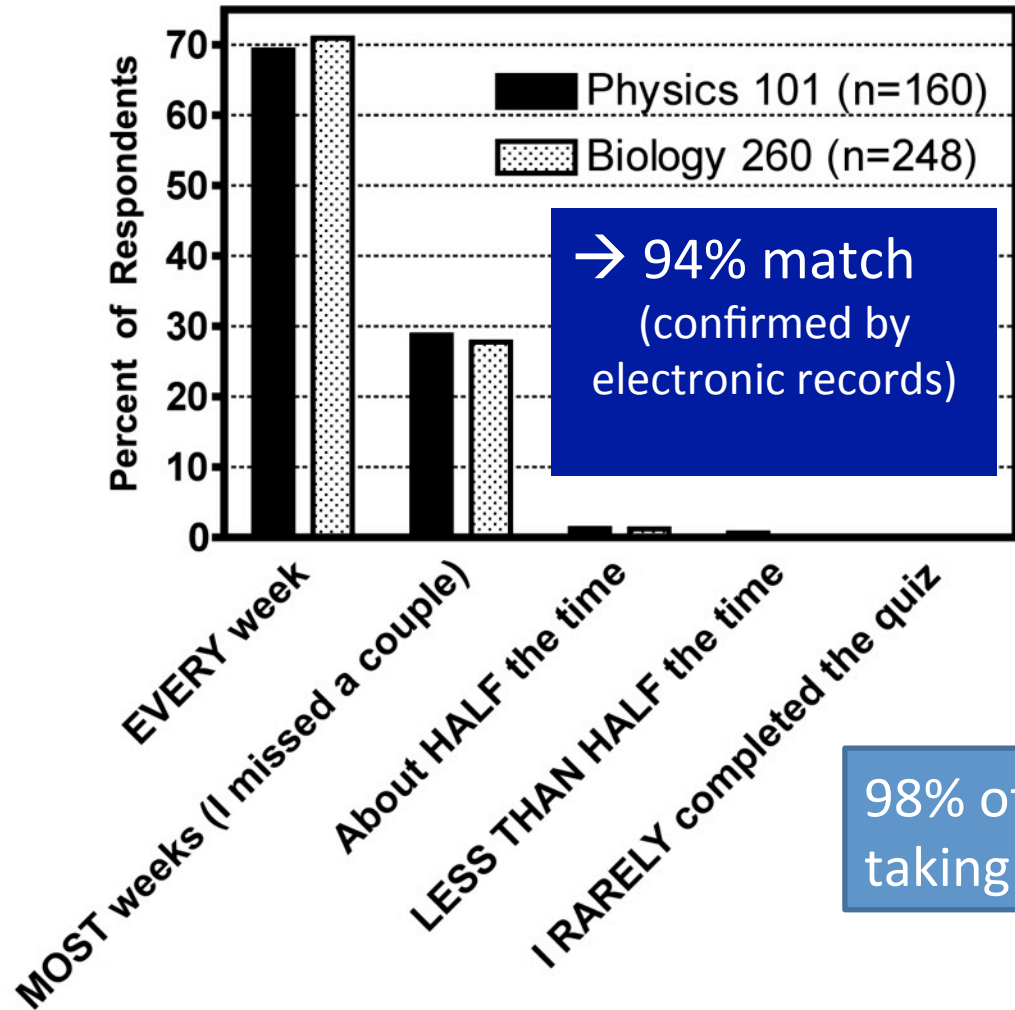
Q3. When I did the pre-reading assignment, I usually ...

Q4. When you did the pre-reading assignments, what MOTIVATED you to do so? (OPEN ENDED)



Student survey data: pre-readings

I completed the pre-reading QUIZ on Vista:



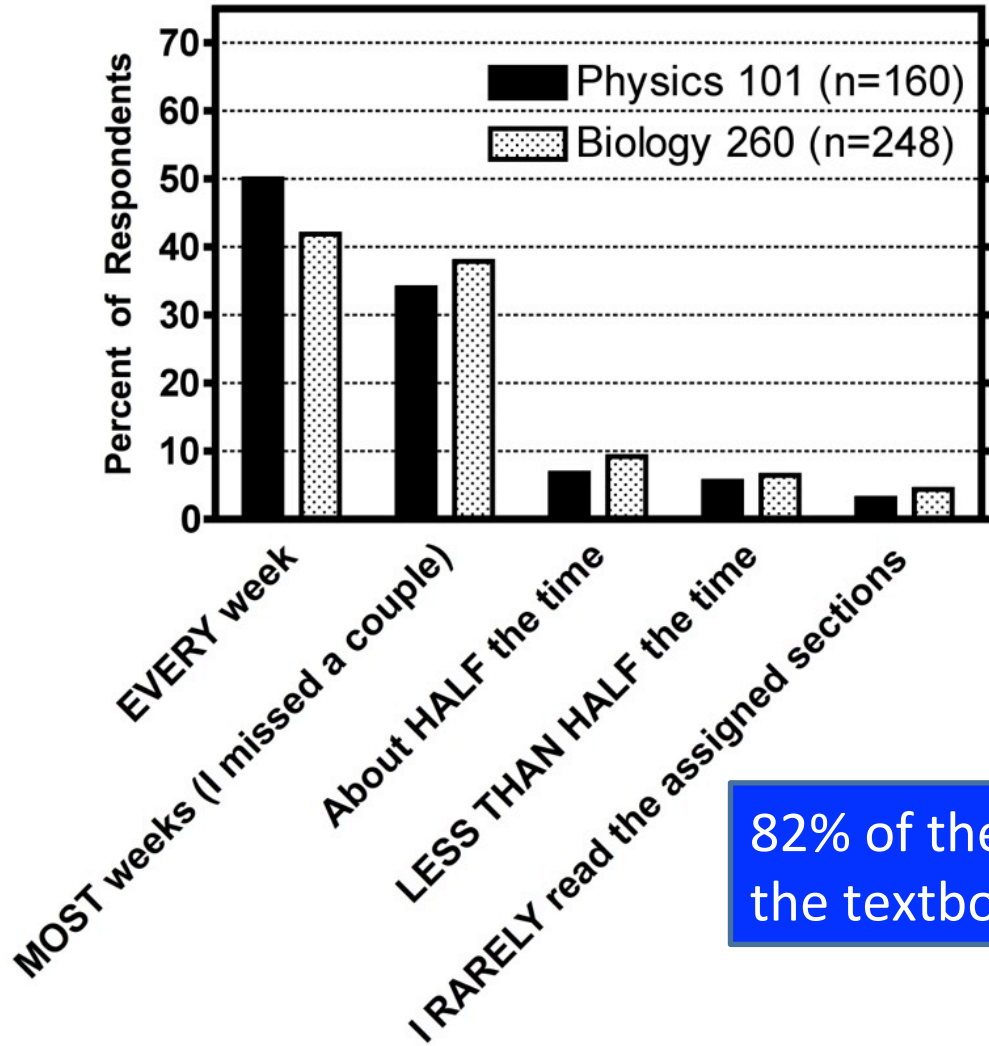
→ 94% match
(confirmed by
electronic records)

98% of the students report taking the quiz on a regular basis



Student survey data: pre-readings

I READ the assigned pre-reading sections:

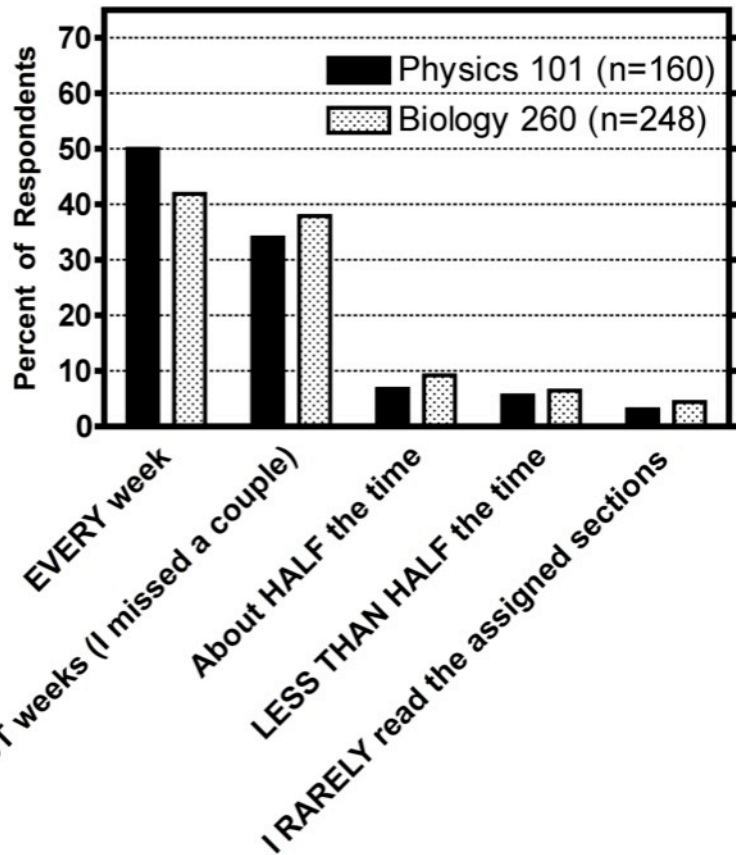


82% of the students report reading the textbook on a regular basis

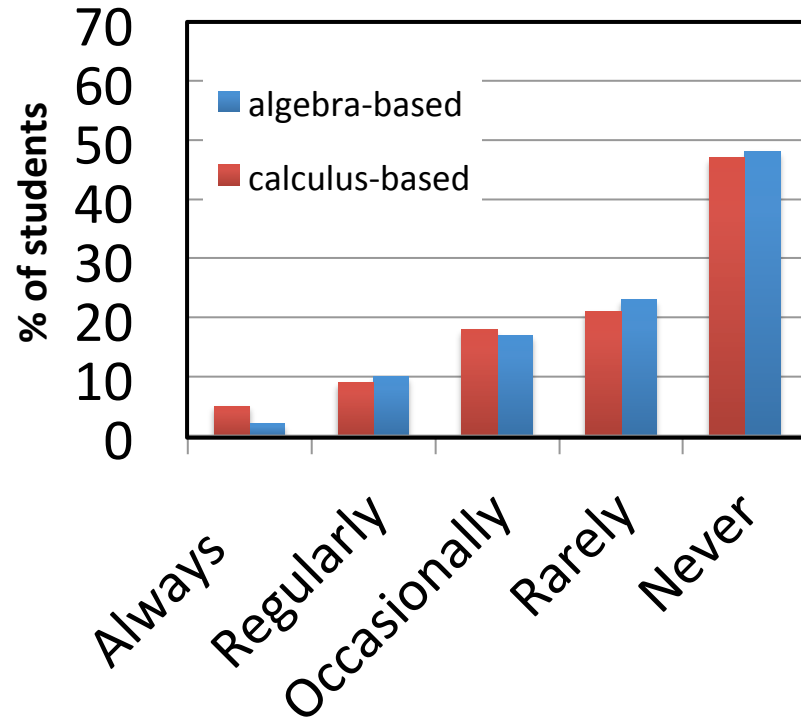


Student survey data: pre-readings

I READ the assigned pre-reading sections:



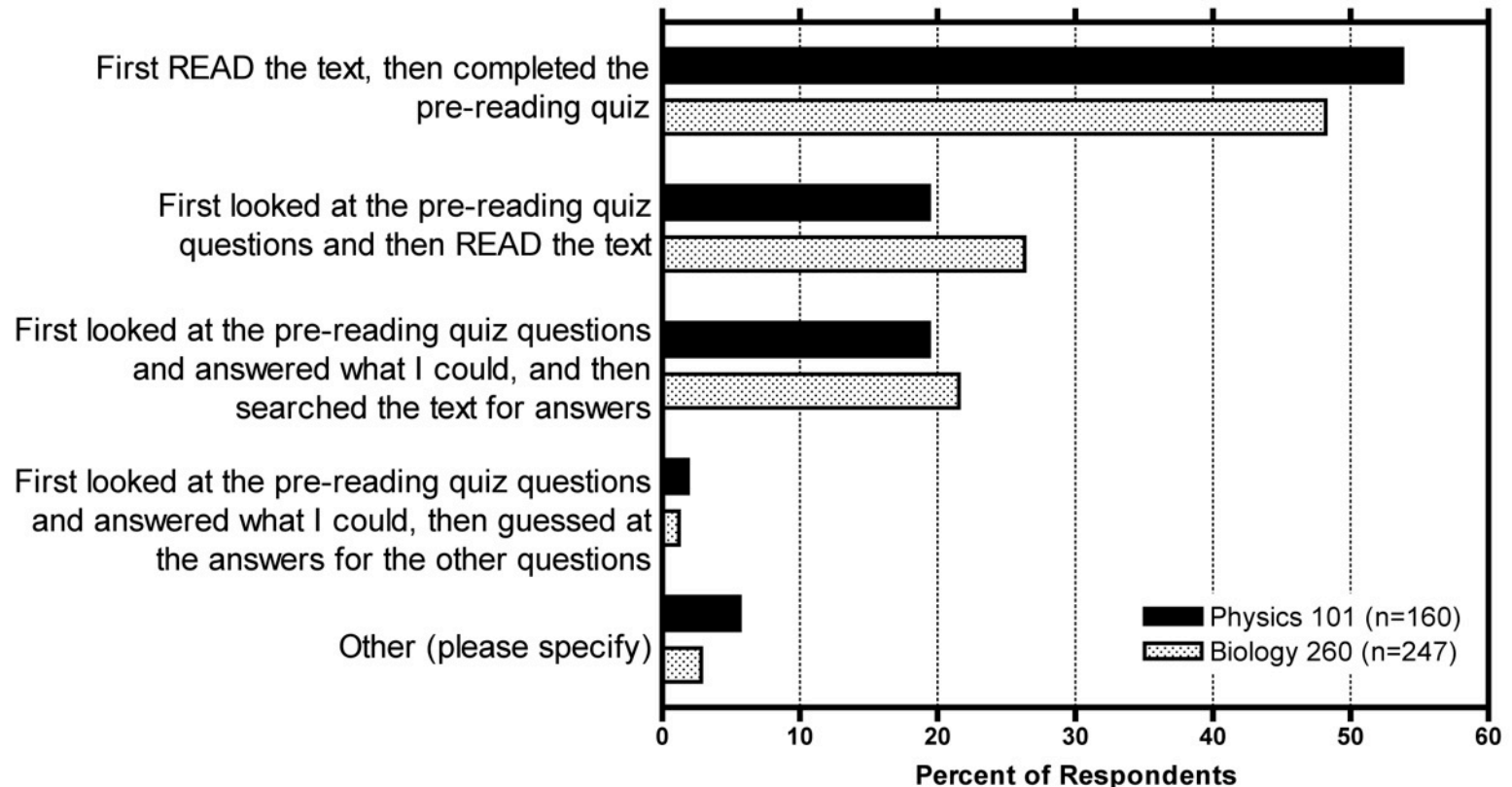
How often do you read the text before attending class?





Students' approach to pre-readings

When I did the pre-reading assignment, I usually:



- 74 % of students report reading assigned pages
- 96 % at least open the textbook



When I did the pre-reading assignment, I usually:

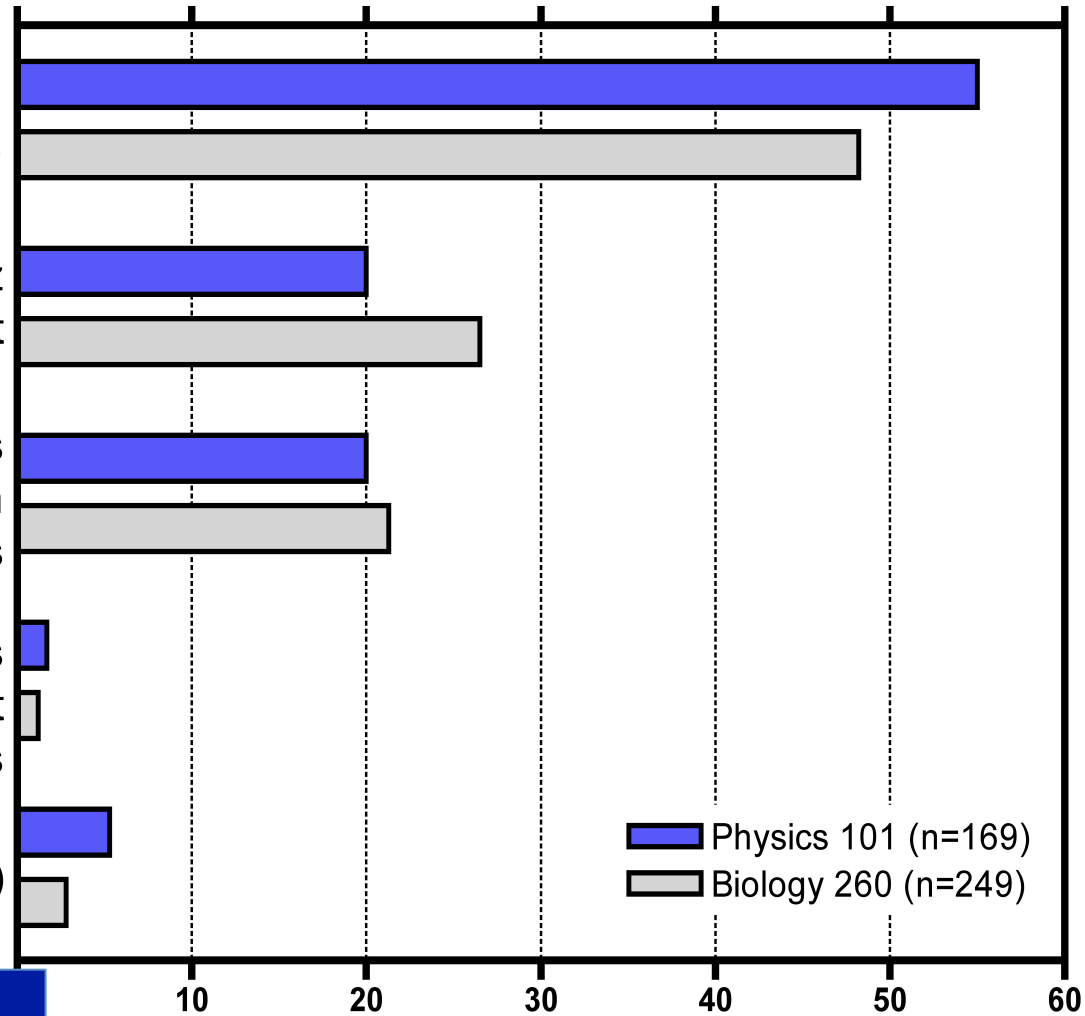
First READ the text, then completed the pre-reading quiz

First looked at the pre-reading quiz questions and then READ the text

First looked at the pre-reading quiz questions and answered what I could, and then searched the text for answers

First looked at the pre-reading quiz questions and answered what I could, then guessed at the answers for the other questions

Other (please specify)



Percent of Students

Heiner & Banet, in prep

- 75% read the textbook
- 95% open the textbook



Student Comments: pre-readings

When you did the pre-reading assignments, what MOTIVATED you to do so?

“... if there are questions on the quiz that look unfamiliar or I'm not completely comfortable with it motivates me to go back to the text.”

“To be honest, I did so because it was for marks. After a while, I didn't mind reading it; and the questions on the pre-reading quizzes help me understand some of the concepts [and] I'm better at picking out in the text what's important ...”

“It's for marks and ... it helps me to distinguish what I know and what I have troubles with so I can be all ears in the parts where I am struggling with in class.”



Student motivation for pre-reading

When you did the pre-reading assignments, what MOTIVATED you to do so?

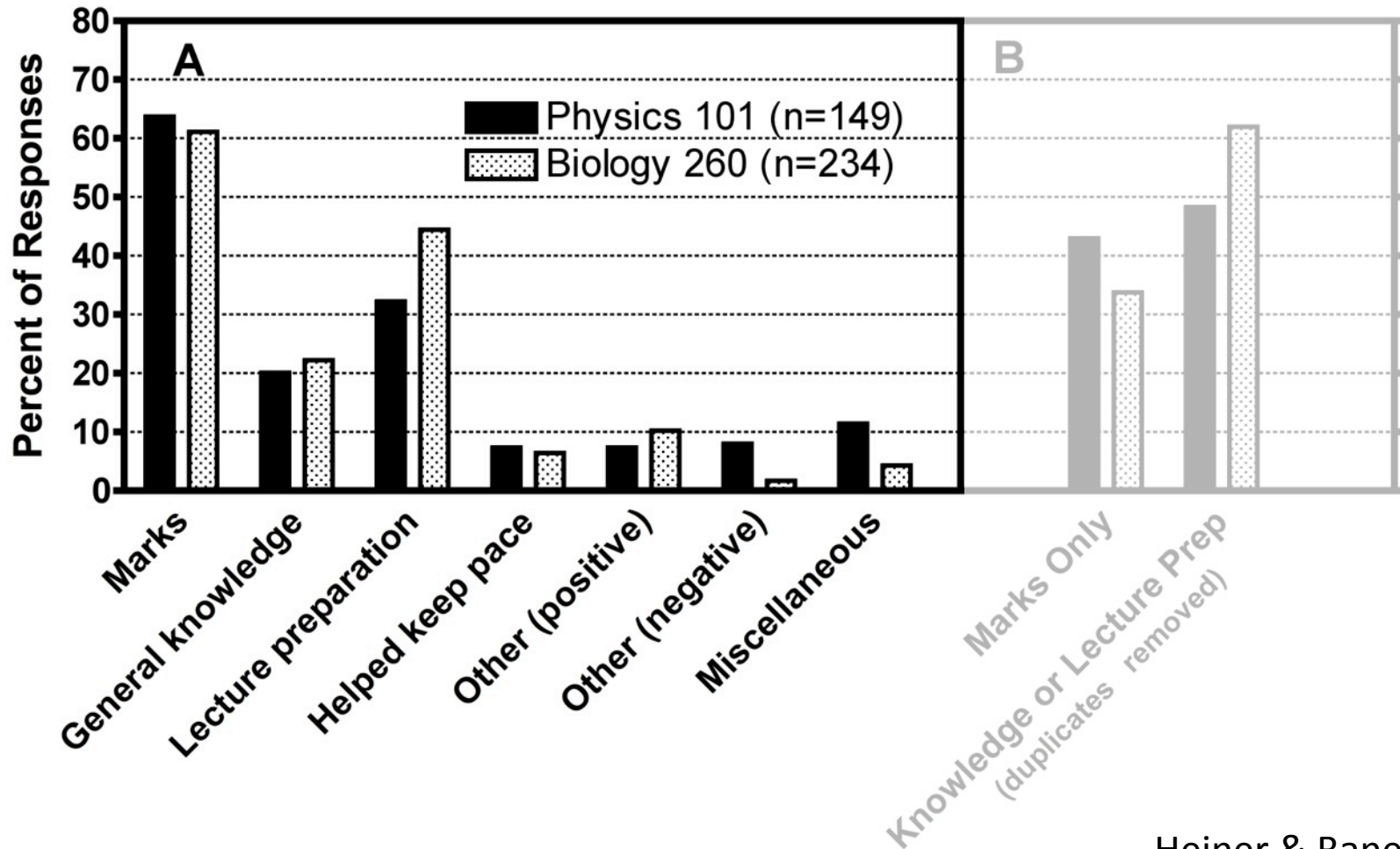
“I learn better in class if I have previous knowledge of the topic. I find that I pay more attention and my brain can make more connections and build on previous knowledge.”

“It's for marks and ... it helps me to distinguish what I know and what I have troubles with so I can be all ears in the parts where I am struggling with in class.”

“...so if I have any questions, they would be knowledgeable and well-founded questions.”

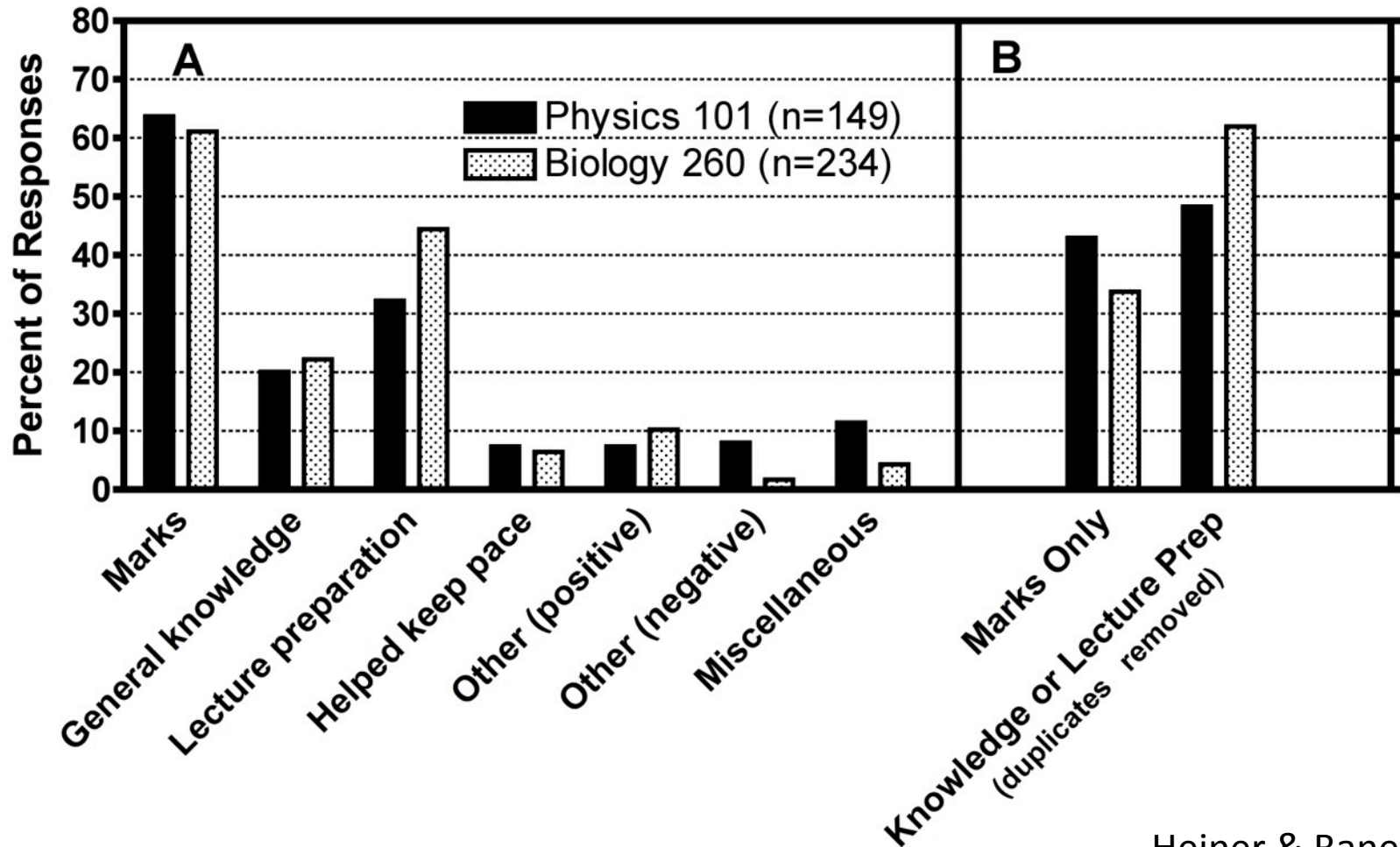
Student motivation for pre-reading

Open ended question: When you did the pre-reading assignments, what **MOTIVATED** you to do so?



Student motivation for pre-reading

Open ended question: When you did the pre-reading assignments, what **MOTIVATED** you to do so?





Best practice tips

HANDS ON PARTS

- 1. Work with a partner and generate a list of what you think are good guiding tips.***
- 2. Work with a partner and generate a list of benefits for the students and for the instructors***
- 3. Have them generate a pre-reading assignment and/or quiz IF audience is of the same field and teach similar level classes.***



Benefits for the Student

- first exposure at their own pace
- explicitly guided reading helps students focus
- come prepared for lecture – critical for peer instruction
- ***many students recognize the benefits***
 - *are able to follow lectures better*
 - *assess their own knowledge*



Benefits for the Instructor

- better use of class time
- reveal possible trouble-spots (similar to JITT)
- adaptable to any textbook
- higher level questions in class
- ***students are reading effectively***

This is a *reading* quiz, not a pop quiz -- the idea is to prepare students and not to surprise them.



Question sophistication

- Students write down questions during class
- 3 courses ~320 students, with and without pre-reading

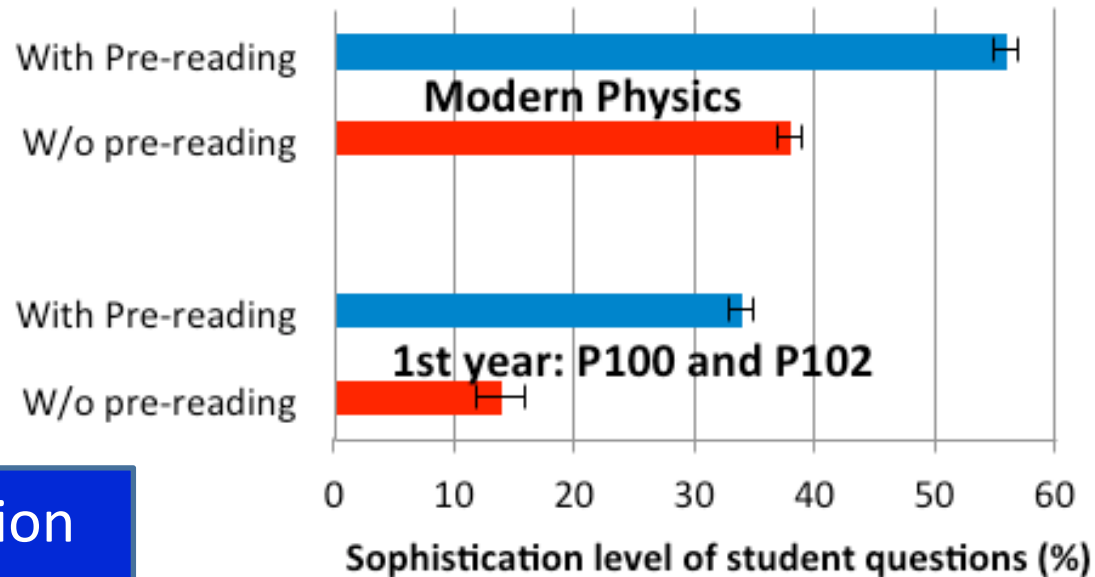
Fraction of questions at high level of sophistication – Marbach (2000)
no pre-reading vs. pre-reading with quiz

2nd year modern physics

38 ⇒ 56

1st year general intro physics

14 ⇒ 34



~ 20% increase in question sophistication



Best practice tips

1. **Focus** on what you plan to discuss in class.
2. **Guided reading** with explicit prompts, e.g., figure numbers or questions to think about while reading.
3. Be realistic: **omit** what is not necessary.
4. Give a reading **quiz for marks** (if possible).
5. The questions should be **easy if they read** and hard if they did not.
6. Refer to things from their pre-reading – but **do not re-teach** them.
7. Be **explicit**: why is this **beneficial** to them and what are the **expectations**.



Summary

- When given targeted pre-readings, students report **reading the textbook**
- Quizzes provide timely feedback & more effective reading
- adaptable to various courses
 - ✓ students are motivated to do the pre-readings as it helps them follow the lecture and learn the material
 - ✓ deeper questions during lecture
 - ✓ helps focus learning
 - ✓ 'levels the playing field'



Conclusions

- ✓ Most students are reading the textbook
- ✓ Students are motivated to do the pre-readings as it helps them follow the lecture and learn the material (*critical for peer instruction*)
- ✓ Students motivation is independent of class standing

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Thank you for your attention!

extra slides

pre-readings take TIME

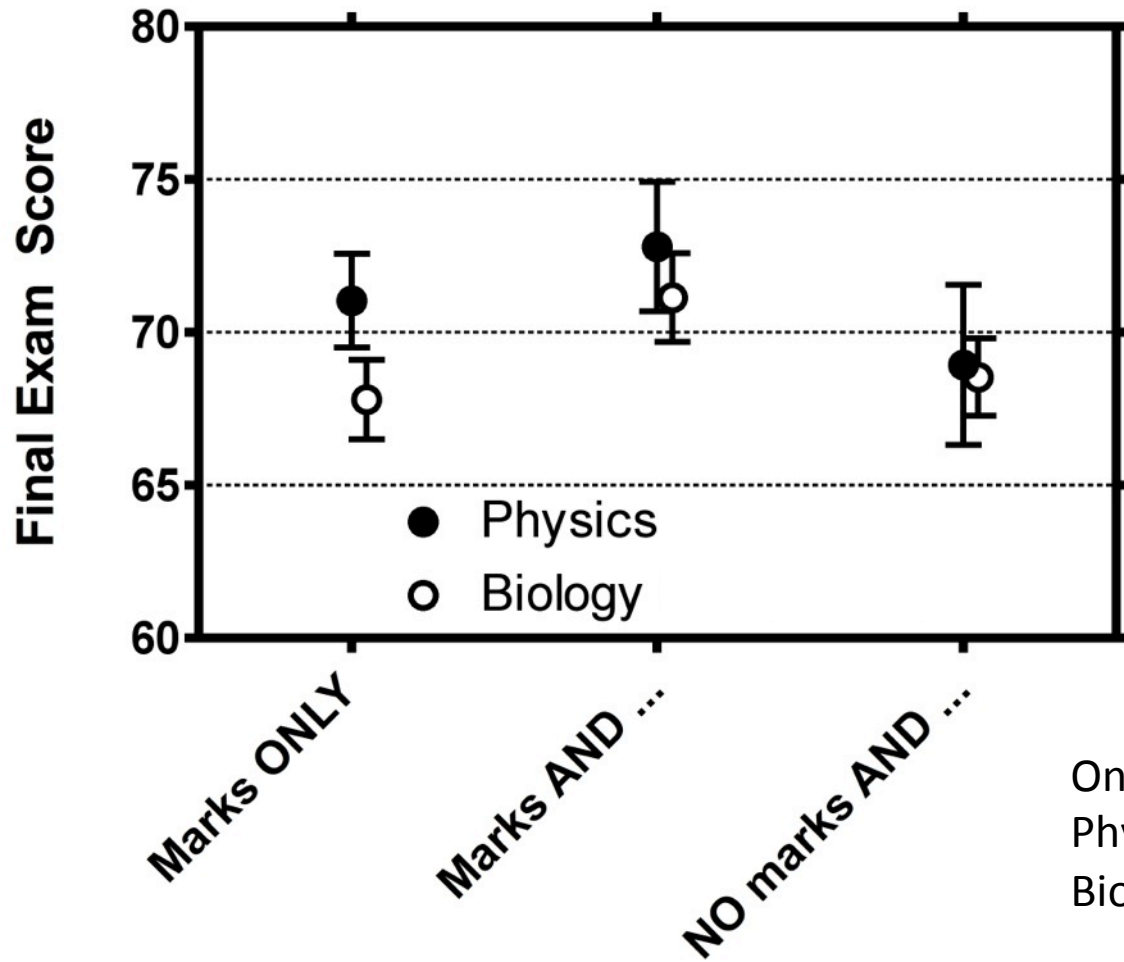
If including a weekly pre-reading assignment, you need to consider the timing

- assignment should take < 1 hour, with the quiz portion taking no more than 10-15 mins (MAX). Typically I've found 5 -7 questions to be a good number
- consider breaking the reading up either once weekly or twice weekly – could post simultaneously and have different closing times.
- should consider how to offset the extra time so that the net time a student spends on one course remains constant
- post quizzes with enough advance notice that the students do not feel under pressure
- For generating a pre-reading assignment and quiz for the FIRST time, figure ~3 hr prep for 3 hr lecture week (instructor time). Front-loaded work, yes, but once established will be easy to re-iterate and expand.



Student standing and motivation

Motivation vs. Final Exam Score



One-way ANOVAs

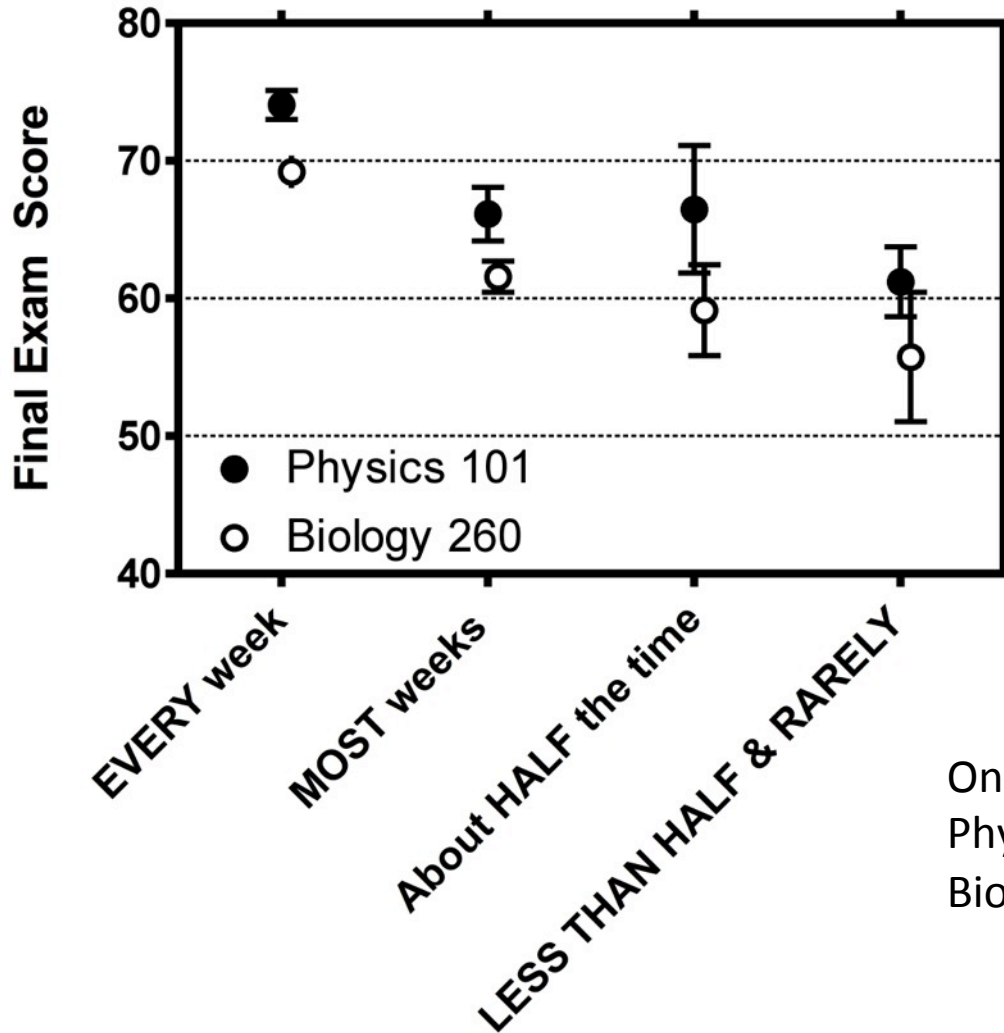
Physics: $F_{2,133}=0.7248$, $p=0.486$

Biology: $F_{2,221}=1.5863$, $p=0.207$



Pre-reading participation and final exam score

Quiz Frequency vs. Final Exam Score



One-way ANOVAs

Physics: $F_{3,206}=7.6266$, $p<0.0001$

Biology: $F_{3,419}=15.8736$, $p<0.0001$