# “Flipping” method of teaching physics and other technical subjects

JOHN GOREE

THE UNIVERSITY OF IOWA

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Polls:

## Polls:

Do you sometimes teach by

- writing on board?
- projector to show slides (powerpoint, etc.)?

## Polls:

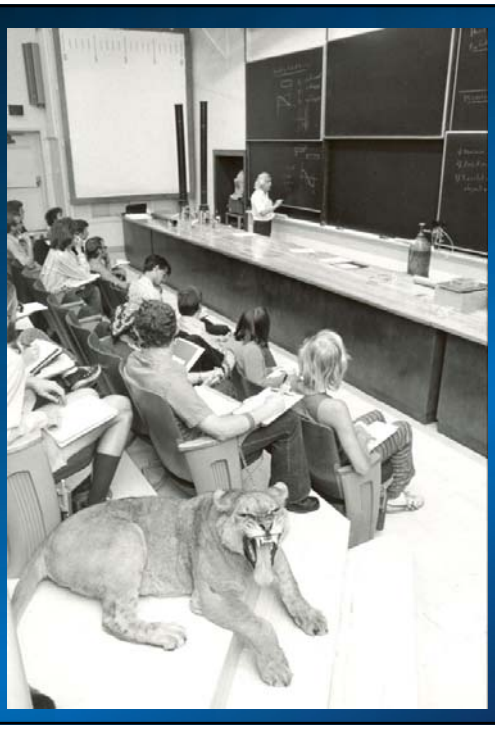
Do you sometimes teach by

- writing on board?
- projector to show slides (powerpoint, etc.)

Do you sometimes feel *there's too much material to cover* to allow:

- enough examples
- enough review
- a lot of discussion

## Traditional lecture



Prof. Ricardo Gomez, Caltech, 1975

## Flipping – what is it?

traditional

Before class

During class

After class

## Flipping – what is it?

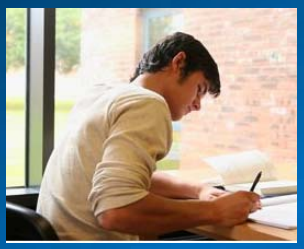
flipped

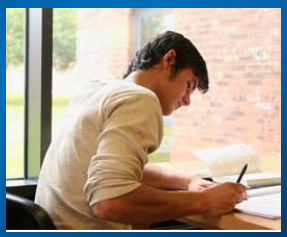
Before class

During class

After class

## Flipping – what is it?





Before class

During class

After class

## Two questions instructors ask about flipping:

What is it?

- short videos replace lectures
- class time used instead for discussion, examples, demonstrations

Doesn't it take a lot of time?

for easy migration, use what's familiar:

- your old slides or handwritten notes
- the same classroom
- hosting on Blackboard (or similar)

it's ok to start with *partial* flipping

## There are many ways to do flipping

I will describe only one approach:

- Not a radical change in teaching

  *so it's sure to work*

- Not an intense time-pressured experience for students

  *so they're happy*

## There are many ways to do flipping

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- Not a radical change in teaching

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The videos themselves help,
but the main impact is from
increased discussion & examples

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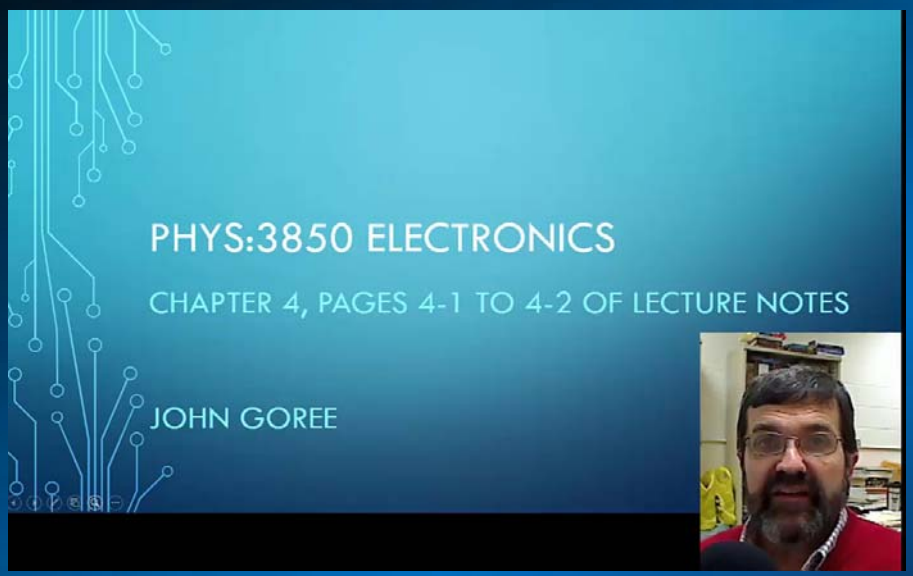
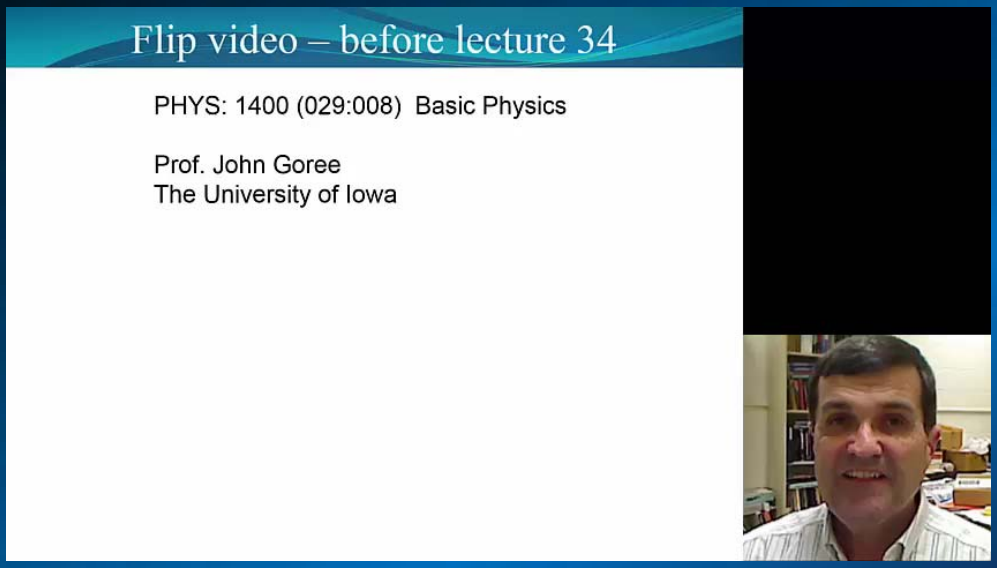
## Example flip videos

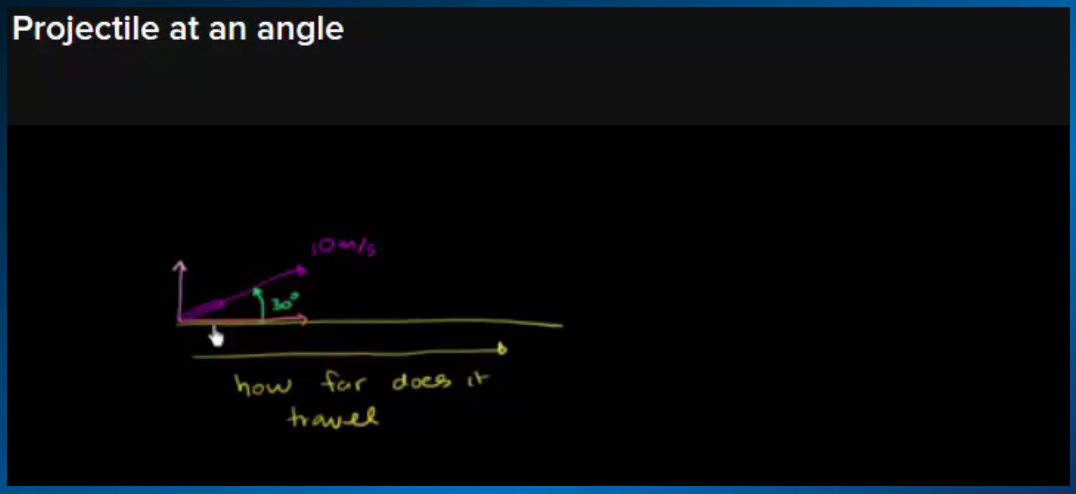
## Approach #1: flip video using pdf handwritten notes



## Approach #2: flip video using powerpoint




## Approach #3: Whiteboard screencast (requires tablet device)




credit: khanacademy.org

Compare to a video capture of a classroom lecture


Prof. Walter Lewin, MIT OpenCourseWare

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## Problems that flipping solves


## What to do during class?


With flipping, you have *more time*. What to do with it?

## What to do during class?

With flipping, you have *more time*. What to do with it?

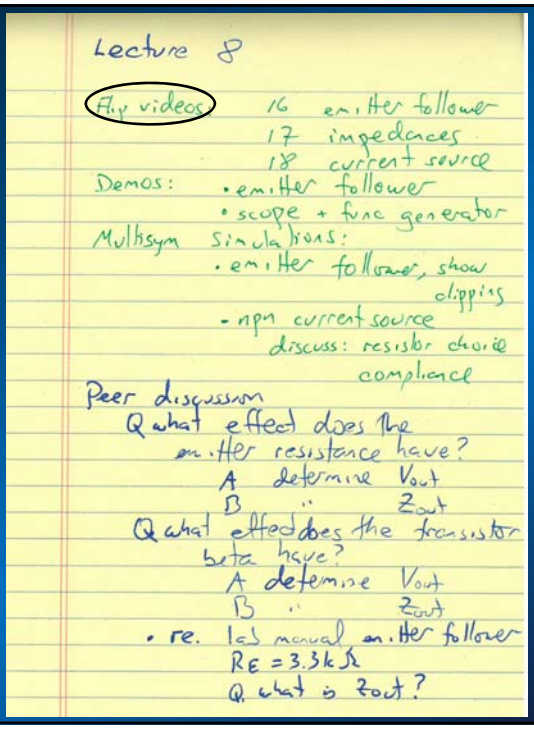
Examples & discussion:

- Problem solving
- Demonstrations or simulations
- Peer instruction

## An activity agenda, instead of lecture notes

Agenda that I followed in a class

(first page)



Lecture 8

Fly videos 16 emitter follower
17 impedances
18 current source

Demos:
- emitter follower
- scope + func generator

Multisym Simulations:
- emitter follower, show clipping
- npn current source
discuss: resistor choice compliance

Peer discussion
Q what effect does the emitter resistance have?
A determine $V_{out}$
B " $Z_{out}$
Q what effect does the transistor beta have?
A determine $V_{out}$
B " $Z_{out}$
- re. lab manual emitter follower
$R_E = 3.3k\Omega$
Q what is $Z_{out}$?

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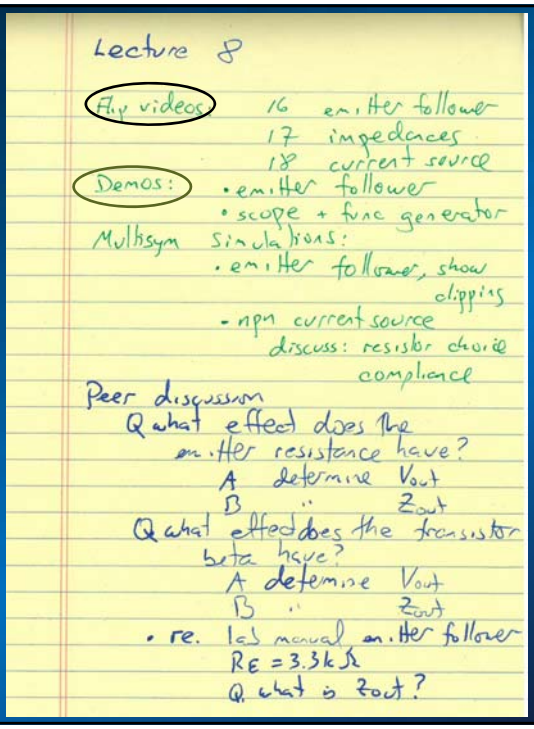
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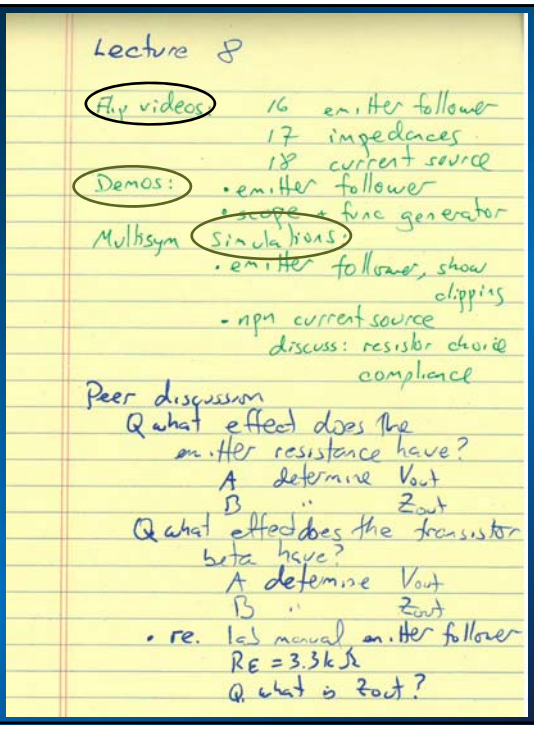
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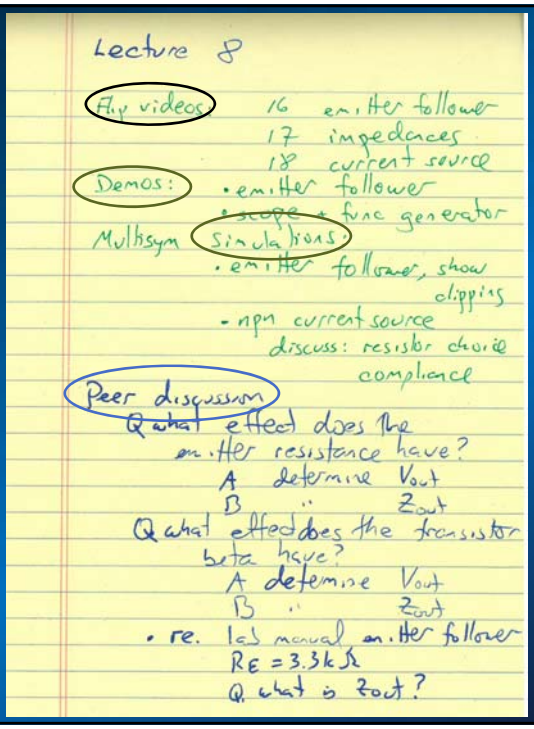
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Another approach: in-class homework

best in a room with large tables

*Mark Andersland*
*Engineering*
*Univ. of Iowa*

# “Flipping” method of teaching physics and other technical subjects

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THE UNIVERSITY OF IOWA

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## Outline

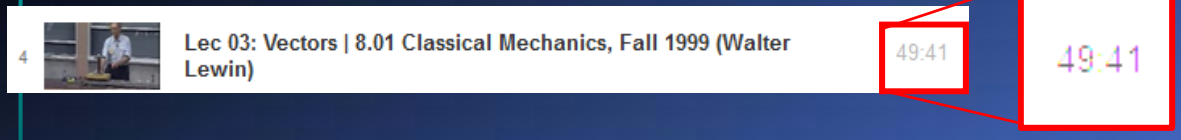
- Flipping - what is it?
- Problems flipping solves
- Good practices
- How to do it:
  - Hosting, equipment and software

## Good Practices

Video length (minutes):

- 4-6 general education
- 5-7 intermediate course
- > 10 never

Not a whole lecture, like this:




Which is more tempting to watch?

## Good Practices

Quizzes, to coerce students to view videos.

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Ways to quiz:

In class:

- Clickers
- Paper

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Quizzes, to coerce students to view videos.

Ways to quiz:

In class:

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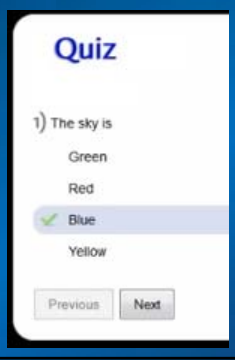
As part of the video:

- Flash or HTML5




## Good Practices

Example paper quiz question
for Electronics (an intermediate course for physics majors)

Which is true for an ideal op-amp:

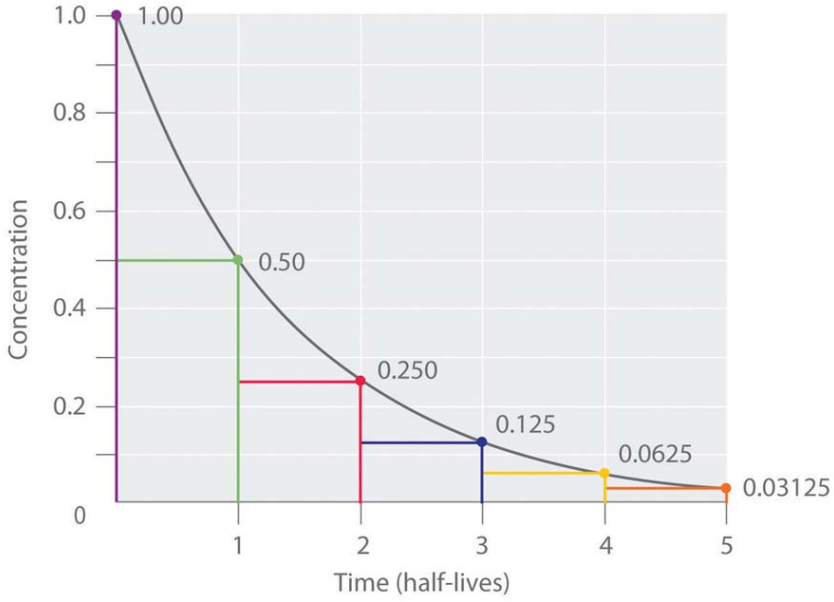
| | Voltages at the two inputs | The output voltage |
|---|---|---|
| (a) | same | responds to the input currents |
| (b) | different | responds to the input currents |
| (c) | same | responds to the input voltages |
| (d) | different | responds to the input voltages |

## Good Practices

Next 5 slides:

clicker quiz slides (Basic Physics -- a general education class)

## Half-life



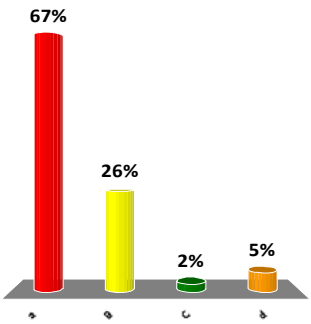
Clicker poll

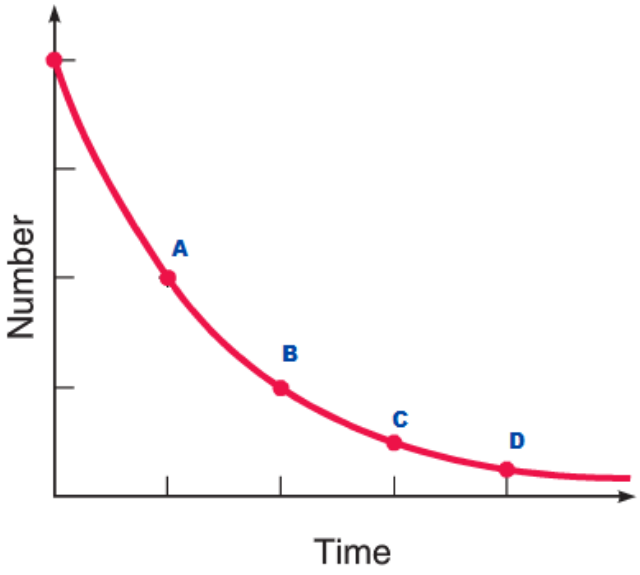
next slide

Clicker **poll**: you ARE allowed to discuss this with neighbor

The number of nuclei in a sample are plotted vs time.

At which data point is the time equal to the half-life?

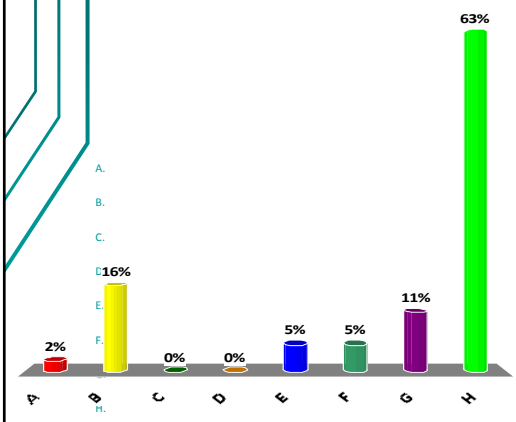


Clicker quiz (flip video)

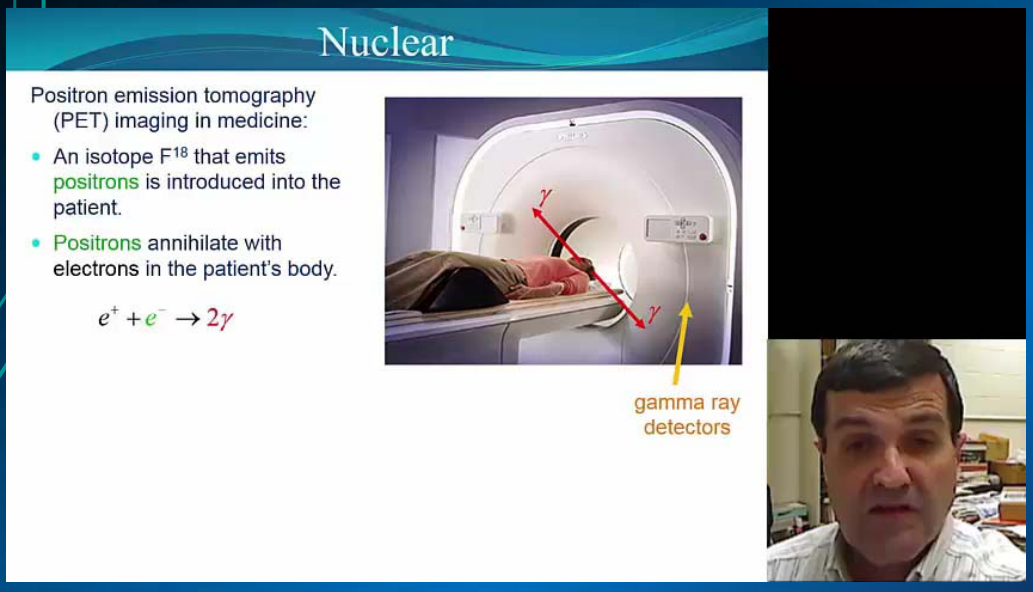
Clicker **quiz**: you **ARE NOT** allowed to discuss this with neighbor

Which is correct regarding radiation PET imaging in medicine?




| | Kinds of radiation detected | How it is produced |
|---|---|---|
| A | Alpha and gamma ray | $p + \bar{p}$ |
| B | Alpha and gamma ray | $e^- + e^+$ |
| C | Alpha ray only | $p + \bar{p}$ |
| D | Alpha ray only | $e^- + e^+$ |
| E | Beta and alpha rays | $p + \bar{p}$ |
| F | Beta and alpha rays | $e^- + e^+$ |
| G | Gamma ray only | $p + \bar{p}$ |
| H | Gamma ray only | $e^- + e^+$ |

Before that quiz, students viewed a video with this:

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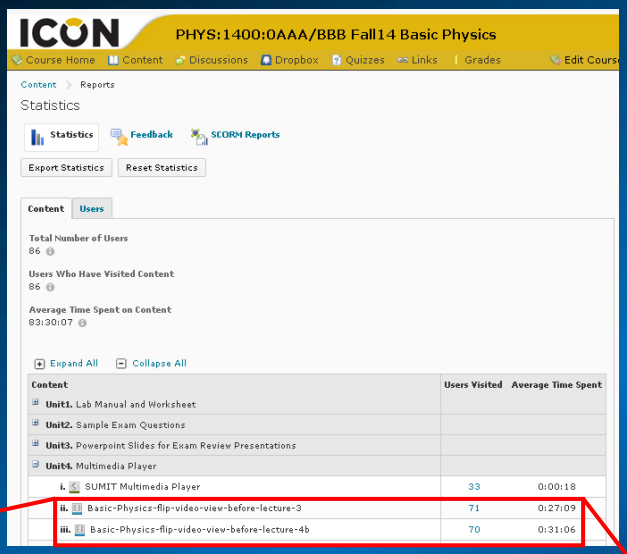
## Good Practices

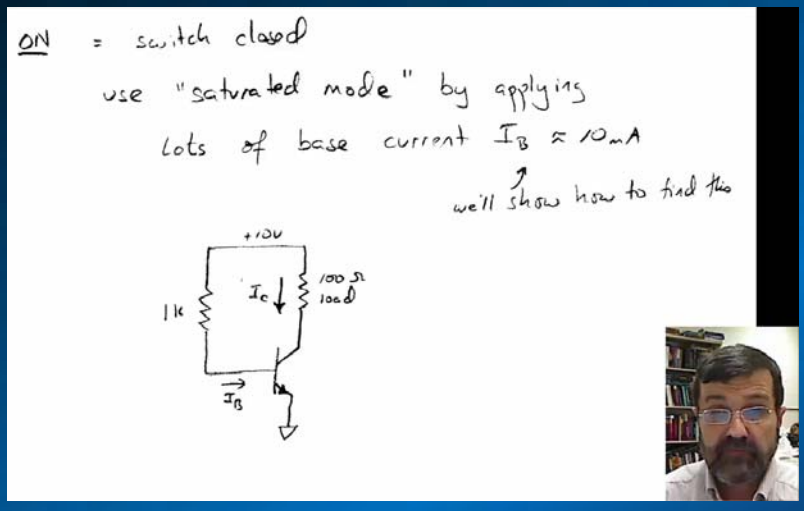
Verify students are viewing videos




ii. Basic-Physics-flip-video-view-before-lecture-3 71 0:27:09
iii. Basic-Physics-flip-video-view-before-lecture-4b 70 0:31:06

## Good Practices

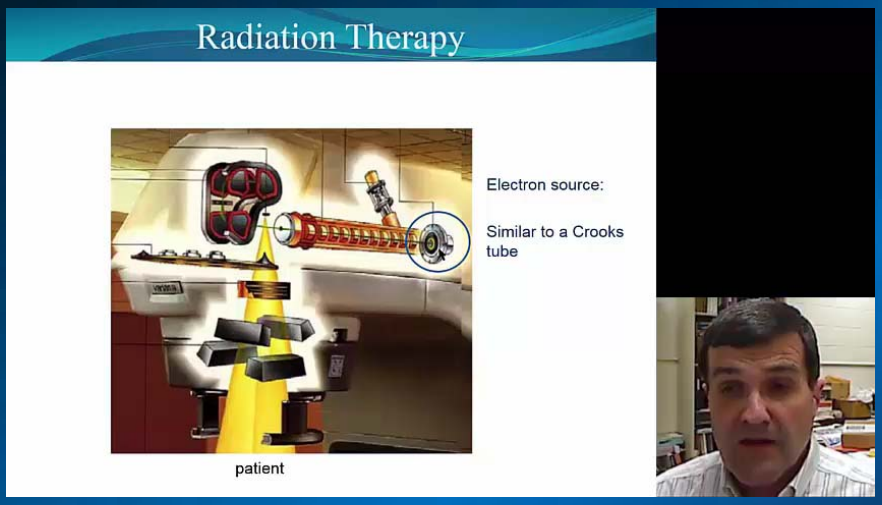
Guiding the eye amongst the clutter




Example: with PDF of handwritten notes

## Good Practices

Guiding the eye amongst the clutter




Example: with powerpoint

## Good Practices

Showing something from a previous page

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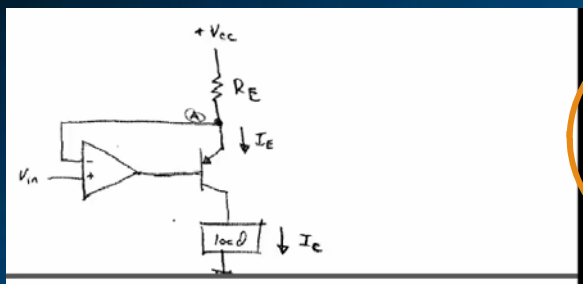
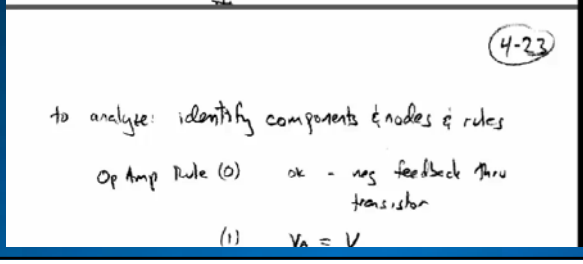
Showing something from a previous page




This space is available!

## Good Practices

Movie players

Tell students: if the video looks bad

- try a different browser


- download video & try a different player.

# "Flipping" method of teaching physics and other technical subjects

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## Outcomes

## Outcomes

Student learning:
improved

Student satisfaction:
improved, or not, depending on:
- what you do in the class
- how much more time you demand

## Student Satisfaction

Basic Physics – partially flipped

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Basic Physics – partially flipped

Four students liked videos

"Love the flip video."

"Flip videos are interesting."

"I liked the flip video because it helped me to connect what we learned in class to real-life applications."

"The flip vids prepare me for class."

## Student Satisfaction

Basic Physics – partially flipped

Four students liked videos

"Love the flip video."

"Flip videos are interesting."

"I liked the flip video because it helped me to connect what we learned in class to real-life applications."

"The flip vids prepare me for class."

Two didn't

"Flip videos could be improved a little bit to make them more beneficial when it comes to class material."

"The flip videos weren't very helpful."

## Student Satisfaction

Electronics – fully flipped

Poll, at midterm, which do students prefer (N = 9):

8 continue with flip videos
0 switch to traditional lectures
1 no preference

Comment re. increased discussion & examples during class:

*"extremely beneficial"*

## Student Learning

Electronics
Midterm exam statistics

Average score increased $p = 0.02$

76% fully flipped 2015 ($N = 9$)
56% traditional 2014 ($N = 21$)

## Student Satisfaction

Not every instructor achieves improved satisfaction:

## Student Satisfaction

Not every instructor achieves improved satisfaction:

Missildine et al., Journal of Nursing Education (2013)
Experiment, comparing:
flipping, classtime used for
- case studies
- simulations of clinical practice

vs traditional lecture.

Results: with flipping,

- Exam scores were *higher* ($p = 0.003$)
- Students were *less satisfied* ($p < 0.001$)
  (They perceived they had to do more work.)

# End

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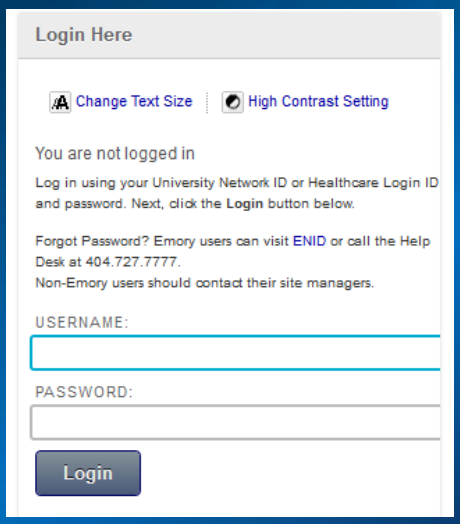
## Outline

- Flipping - what is it?
- Problems flipping solves
- Good practices
- How to do it:
  - Hosting, equipment and software

## Hosting

Blackboard, ICON, or similar

- Password protected
- Track student viewing



## Equipment

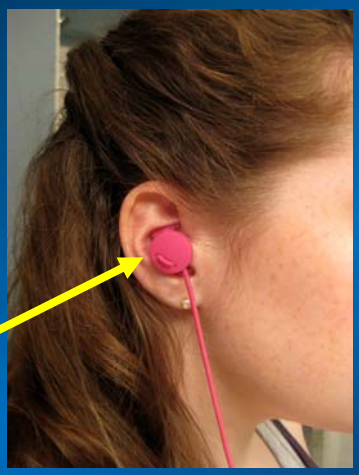
## Equipment

Camera

Microphone

Mic quality is crucial

This is where you are



## Equipment

USB microphone (built-in mic is not recommended)


## Equipment

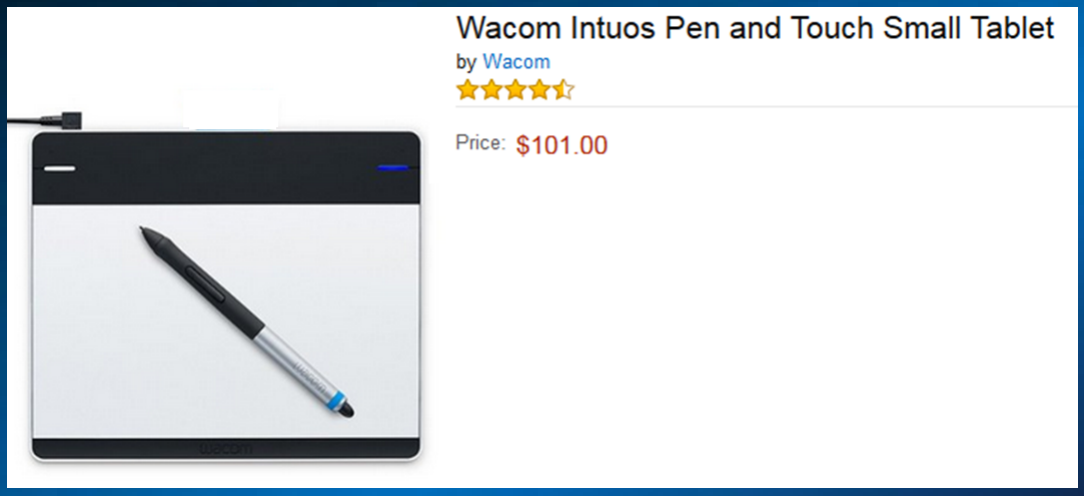
Camera atop computer monitor:

built-in (FREE)

USB (typically $60)

## Equipment

Tablet device - only if you want to "whiteboard"




## Software

Lecture capture:

- Camtasia — $180
- PANOPTO — FREE UI license

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Screen shots & cropping

- Microsoft Paint — FREE

## Software

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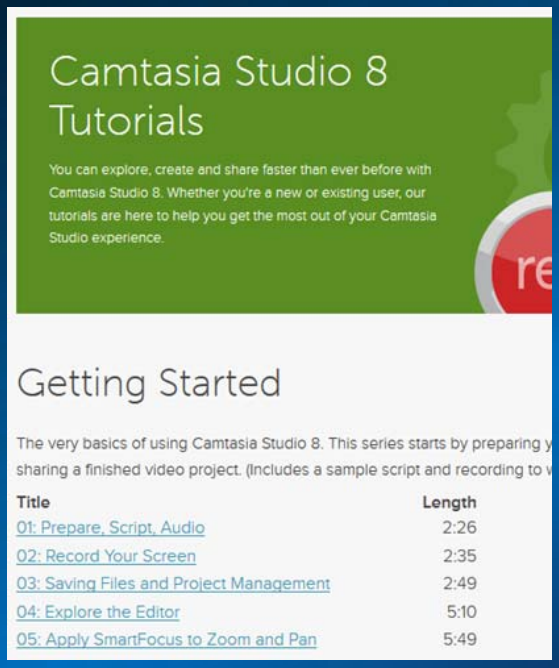
Drawing (for whiteboarding with tablet):

- SmoothDraw — FREE

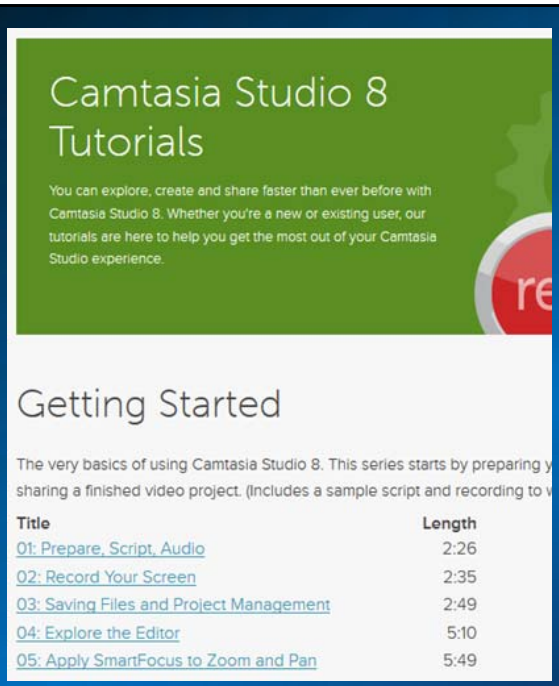
How to learn Camtasia




www.techsmith.com/tutorial-camtasia-8.html

How to learn Camtasia

Demonstration

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## Summary

Outcome
- Improves student learning & satisfaction

What is Flipping?
- Short videos viewed before class.
- Discussion or other activity during class.

How much time does it take?
For easy migration, use what's familiar:

- your old handwritten notes or slides
- the same classroom
- hosting with Blackboard, ICON, or similar

# End