Preparing Future Faculty: How to Teach a Large Lecture Course

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GSI Teaching & Resource Center
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Large Lecture Classes

- Recently much maligned; said to be “ineffective” (even small lecture classes criticized).
- Strong push to alternatives (e.g., flipped; interactive).
- I disagree; lectures can be highly effective and efficient.
- Older folks learned this way!

Advantages

- Spread knowledge to many.
- The more, the merrier! (Especially if can break up into small discussion sections.)
- The amount of extra time on your part is larger, but not proportionally.
- Possibly expand to a MOOC?

Preparations: Massive!

- Must be VERY well organized by the time the semester begins.
- Textbook, syllabus, goals, GSI and grading teams, rubrics, wait list…; otherwise huge headache.
- Have a chain of command: GSI, Head GSI, Professor (last resort).
- Don’t let the course eat you alive!

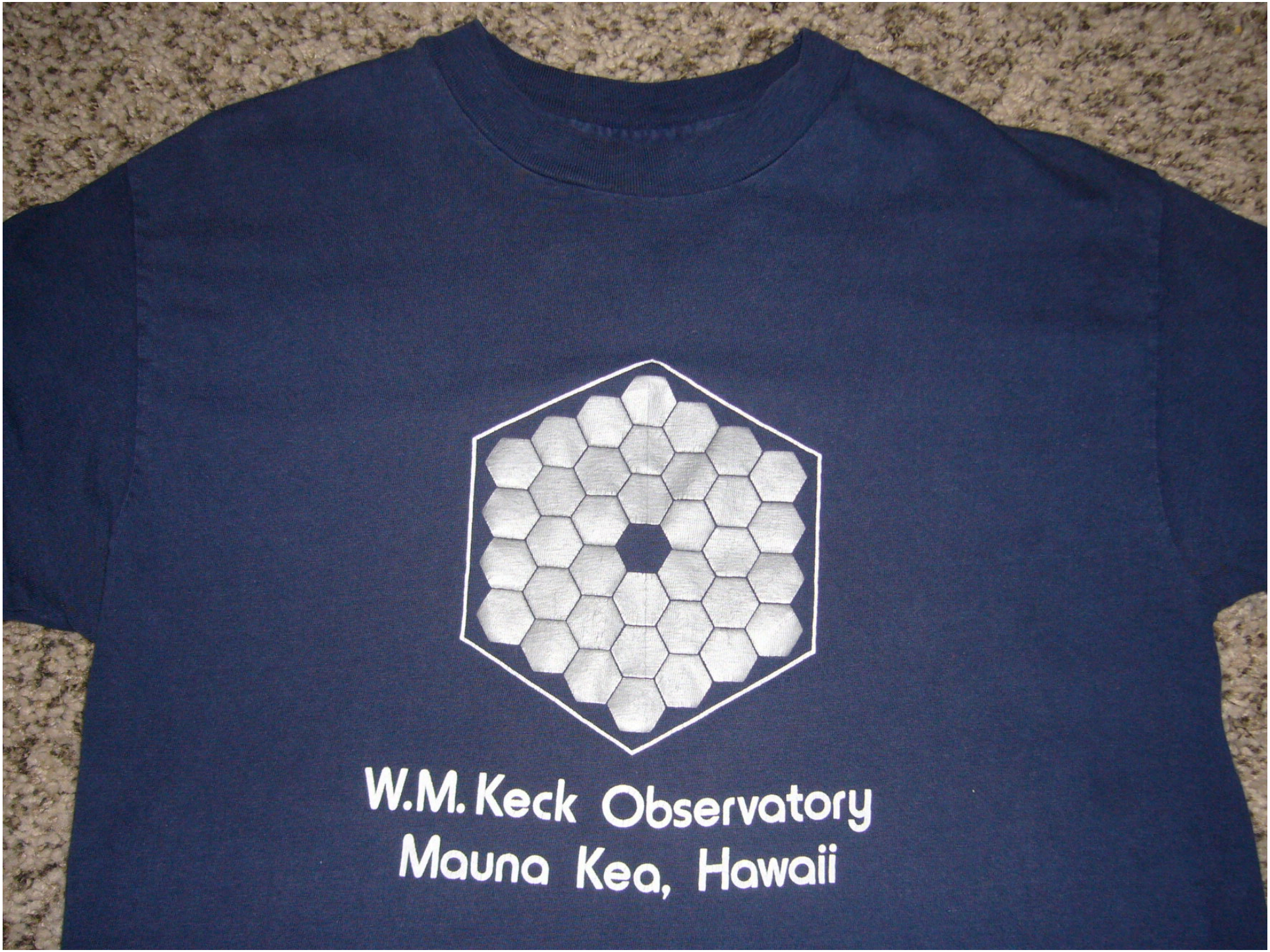
Before Your First Time

- Good to attend some lectures of current professor; talk to him/her.
- Can use their course as a model, but try to give it your own spin.
- If starting from scratch, spend several weeks preparing it.
- The course will evolve as you teach and evaluate it many times.

Excellent lectures!

- **Thoroughly know the material.**
- **Well organized, well prepared, clear, interesting, enthusiastic.**
- **Be entertaining; a *performer*.**
- **Show real *passion* for subject!**
- **Photos, videos, poems, music, jokes, t-shirts, etc. to capture and hold students' attention.**

Purely Akademic, https://www.etsy.com/shop/GaryAllenFreed


W.M. Keck Observatory
Mauna Kea, Hawaii

Music While Entering

- “Here Comes The Sun” (The Beatles)
- “Rocket Man” (Elton John)
- “Walking on the Milky Way” (OMD)
- “Moonlight Sonata” (Beethoven)
- “The Four Seasons” (Vivaldi)
- “The Planets” (Holst)

Joke

- **Q: Have you heard about the restaurant on the Moon?**

Joke

- Q: Have you heard about the restaurant on the Moon?

- A: Great food, but no atmosphere.

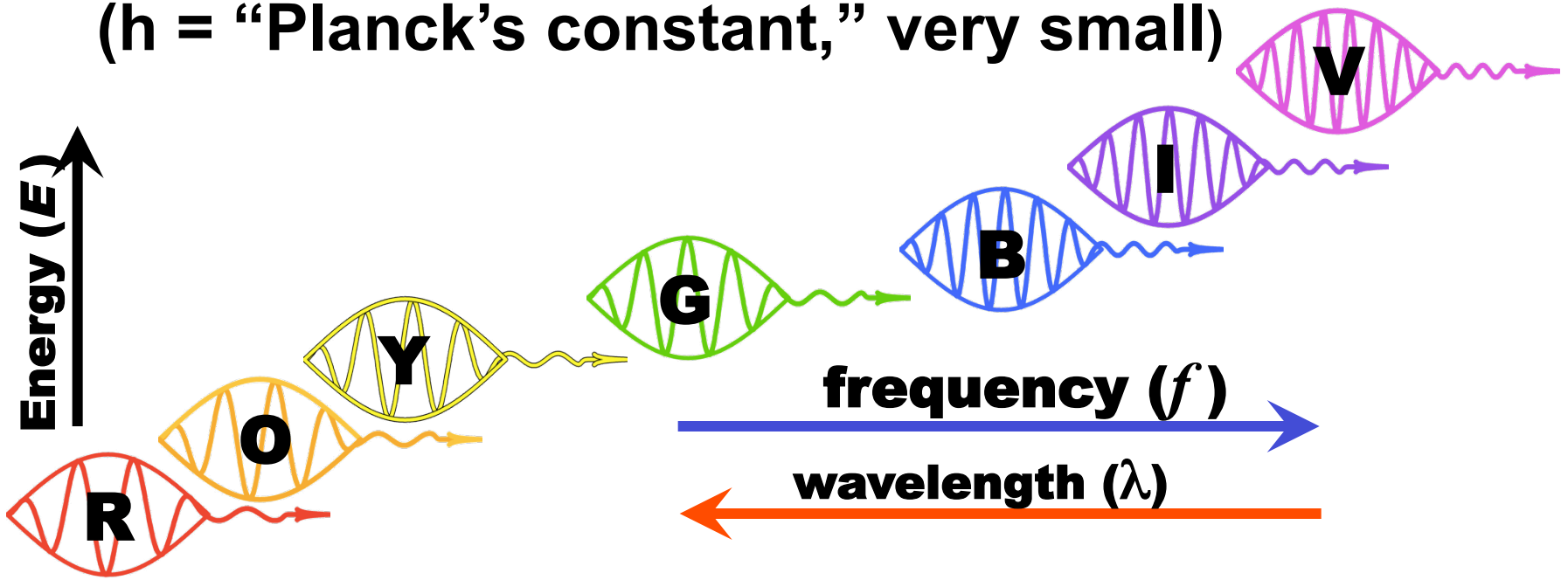

MAY THE
MASS TIMES
ACCELERATION
BE WITH
YOU

Preparing Lectures

- **Takes a full day per lecture, first time. Decreases thereafter.**
- **I *don't* read a scripted lecture.**
- **I use power-point slides: key concepts, diagrams, phrases.**
- **Know what to say; not memory.**
- **Do NOT write full sentences! Students can't listen and read.**

A photon has no mass, but its energy is $E = hf$

(h = "Planck's constant," very small)



Photons of higher energy (E) have higher frequency (f) and shorter wavelength (λ):

$$E = hf = hc/\lambda \qquad \text{(since } c = \lambda f\text{)}$$

Not Scribes!

- **Consider making a Course Reader containing all text/ figure/equation slides you show (*not* most photos).**
- **Then students can really *listen to* and absorb what you say.**
- **They can take marginal notes, but not be scribes.**

Other Lecture Hints

- Include current news and research results, if relevant; highlight your own research.
- Before class: tell them something interesting related to the class (research, fact…)
- Ask for questions! Call on students by name (learn a few).

Incentives

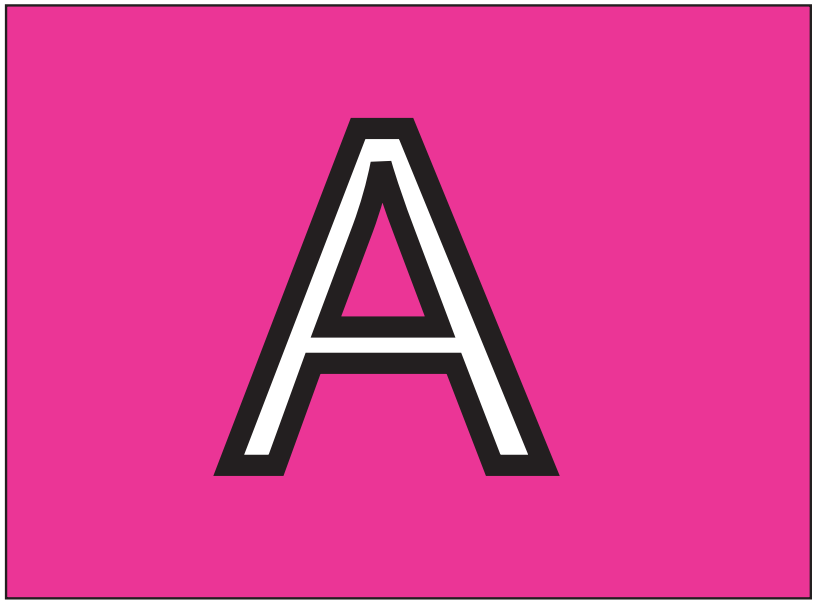
Example: Toss a small piece of candy to a student who correctly answers a question or clarifies a concept for other students.

Engage the students!

- ***Encourage questions. Never use a condescending tone!***
- ***Help them learn through discussions with peers.***
- ***Show demos, and have them participate in demos if possible.***

Peer instruction

- ***Peer Instruction: A User's Manual*, by Eric Mazur (1997, Prentice Hall).**
- **Involve the students; have them teach each other.**
- **"Think, Pair, Share" approach with clickers or colored cards.**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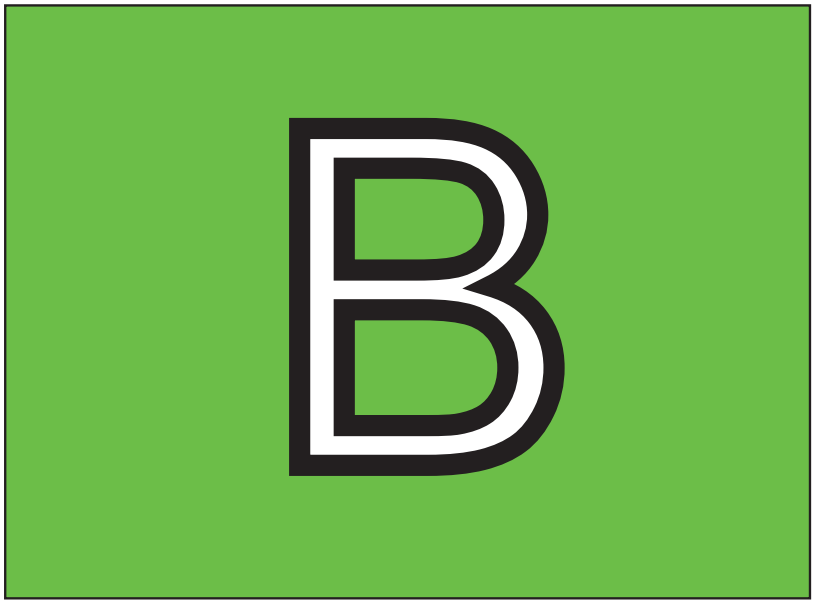
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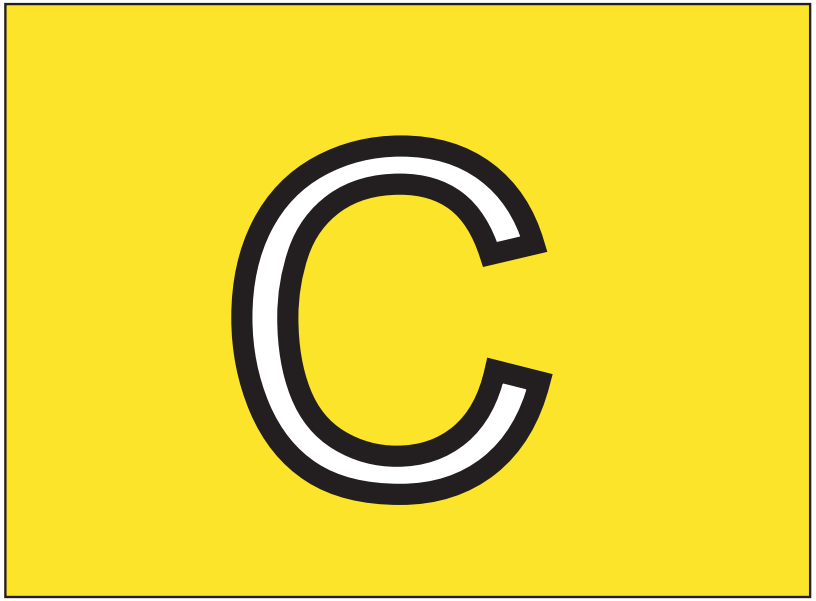
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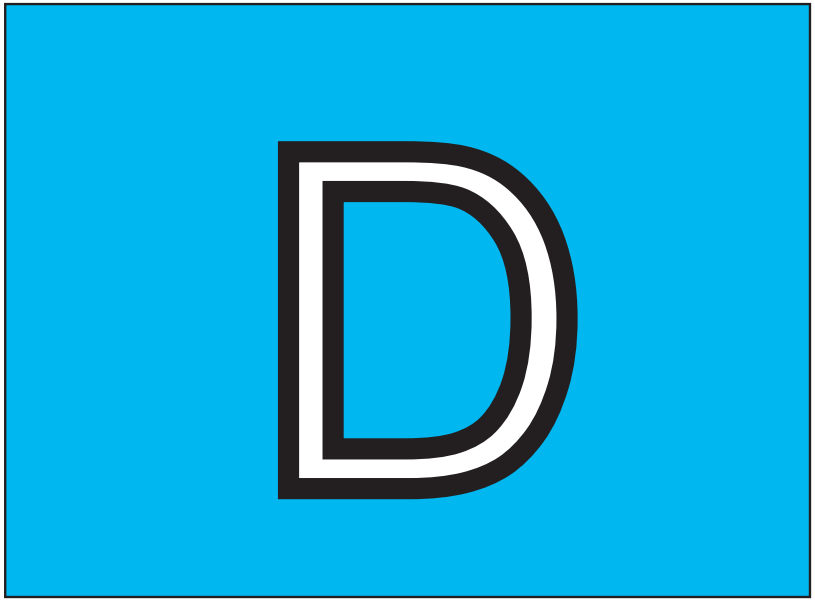
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Why does the Sun shine?

(A) Electric current, like in a light bulb.

(B) Nuclear reactions in the center release energy.

(C) Chemical reactions: the Sun is “burning.”

(D) Slow gravitational contraction releases energy.

Try a question in your own field of study!

NOT Multiple-Choice Q

- Encourage discussion.
- No “right” or “wrong” answer in many cases, but can still engage the students this way; make them think critically.

Example: History

If one particular person hadn't been born, would the world now be very different, or basically the same (i.e., it was "ripe" for this change, and *someone* would have done it soon).

Example: "Discovery" of America.

Demos!

- Show demos, if possible.
- Demos help elucidate concepts; students love.
- Many effective demos do not require fancy equipment.
- Then do Think-Pair-Share

Earth's seasons

Which one of the following correctly describes the primary reason for Earth's seasons?

Choice (A)

Earth's orbit around the Sun is elliptical, and the distance is larger during winter than during summer.

Choice (B)

The tilt of Earth's axis of rotation makes some parts of Earth farther from the Sun than other parts.

Choice (C)

The tilt of Earth's axis of rotation makes the Sun be higher above the horizon and up longer in some parts of Earth than in others.

Choice (D)

The tilt of Earth's axis of rotation physically wobbles back and forth, alternately toward the Sun and away from the Sun.

Earth's gravity

According to Newton's laws, what would happen to the Moon if Earth's gravity were to suddenly vanish?

(A) The Moon would fly away from Earth in a radial direction.

(B) The Moon would fly tangent to its orbit at the moment gravity vanished.

(C) The Moon would spiral away from Earth.

(D) The Moon would disintegrate, since no gravity.

Demo: donut!

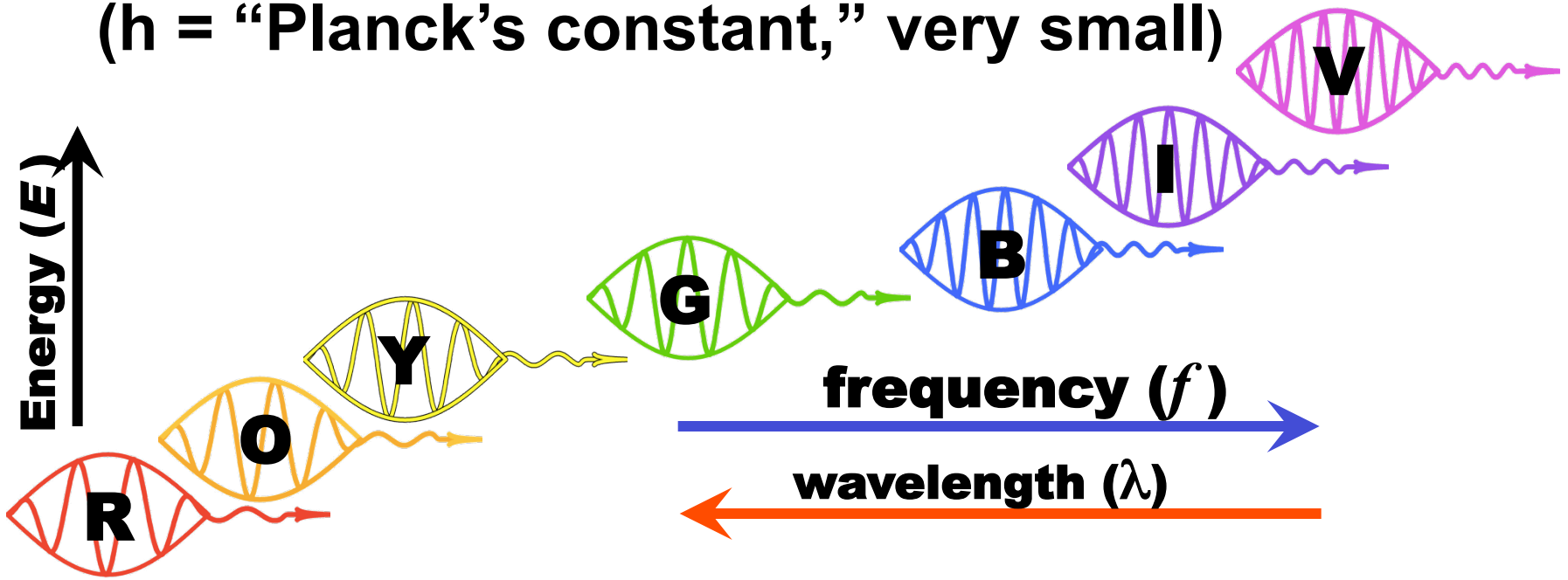
Now reconsider the question and answer it again, with clickers or colored cards.

Get the students involved in demos!

Example: atom absorbs light (photons)

A photon has no mass, but its energy is $E = hf$

(h = "Planck's constant," very small)



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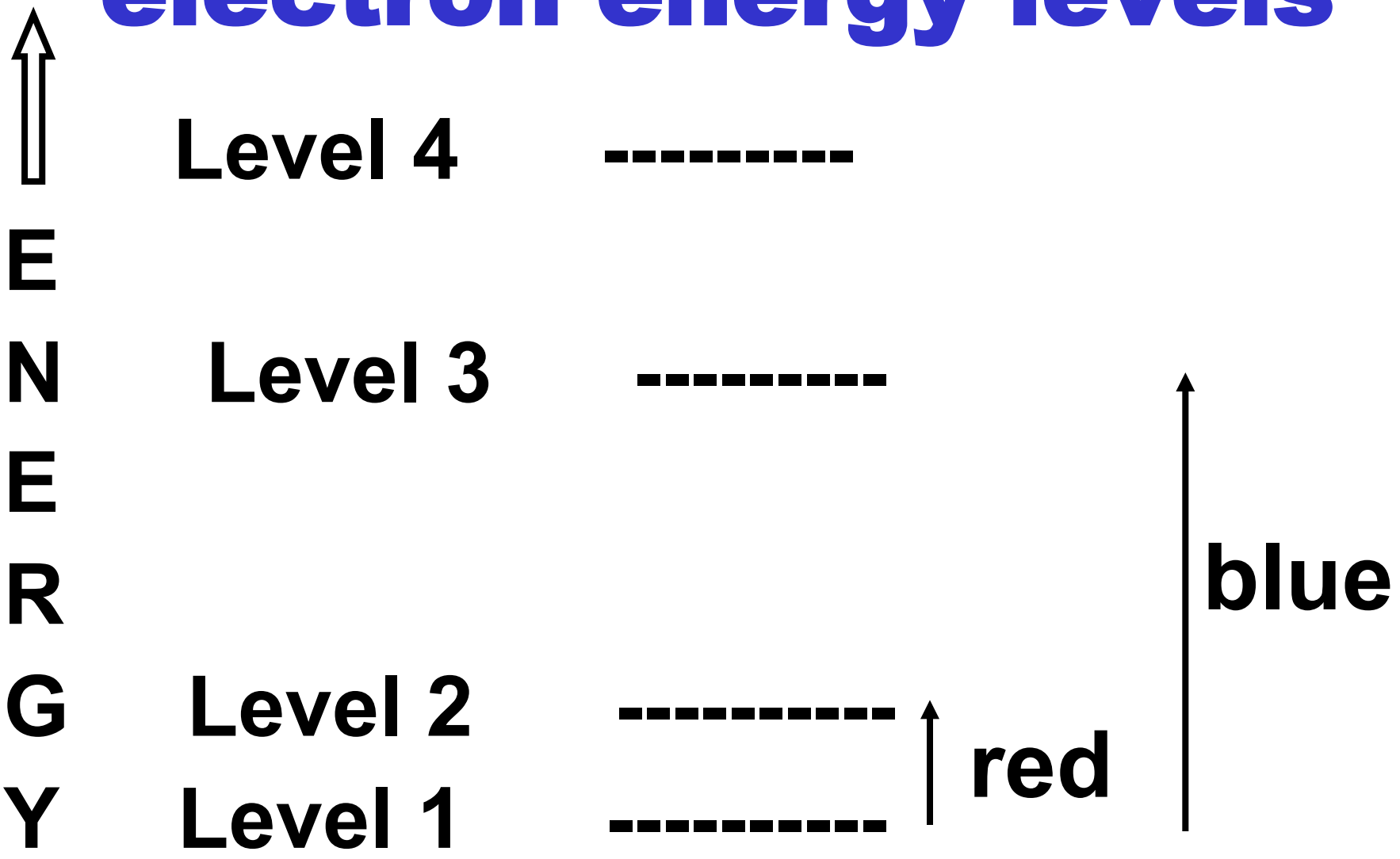
Hypothetical atom: electron energy levels



What color photon does absorption from level 2 to level 3 probably require?

(A) infrared

(B) violet

(C) green

(D) orange

Demo

- Throw balls of different colors at students while jumping from level to level.
- Have the students throw balls at you.

Easiest to do in the sciences

But you can at least do Mazur's "peer instruction" (without demos and models) in the humanities, social sciences, etc.

Optional Extras

- Office hours: Go beyond the class material; probe deeply
- “Bull sessions” (discuss special topics, Q&A, 3 hours)
- Field trips; special contest
- Eat some meals with students
- Hide an “easter egg” in your Course Reader; e.g., dinner

GSI Disc. Sections

- Many additional things to do.
- Expand on topics that were not adequately covered.
- I give considerable latitude to my GSIs, with guidance.
- Involve the students; demos.
- Worksheets, group activities.

Group Activity: Model

Example: If the Sun were the size of a basketball, (1) how big would various planets be? (2) What would be their distances from the Sun? (3) What would be distance of nearest star? (4) How big would Galaxy be?

"Communal" office hours

Example: TALC – The Astronomy Learning Center.

Held a few evenings each week. Small groups of students help themselves; GSI guides them if too far off, offers suggestions.

Summary

- **Enthusiastic, well organized, clear, entertaining, interesting.**
- **Photos, vidoes & animations, poems, music, t-shirts, jokes, personal stories, demos, models, etc., to get attention.**
- **Encourage questions.**
- **Show real *passion* for your subject. *Let it all hang out!***

Good luck and have fun!