

All I Need to Know about Science Teaching I Learned in Kindergarten.

How sharing science with
kids made me a better
college teacher.

*Brian Jones
Little Shop of Physics
Colorado State University
littleshop.physics.colostate.edu*

From

All I Need to Know I Learned in Kindergarten

by Robert Fulghum

Play fair.

Don't hit people.

Put things back where you found them.

Say you're sorry when you hurt somebody.

Wash your hands before you eat.

Take a nap every afternoon.

**When you go out into the world, watch out for
traffic, hold hands, and stick together.**



My Day Job.

Robert A. Millikan Medal
American Association of Physics Teachers

Excellence in Teaching Award, College Level
Colorado Association of Science Teachers

Best Teacher Award, *CSU Alumni Association*

Provost's Award for Instructional Innovation, *CSU*

Faculty Undergraduate Teaching Award, *College of Natural Sciences*

Professor of the Year, *CSU Panhellenic and Intrafraternity Council*

Outstanding Science Mentor, *Students as Leaders in Science*

Excellence in Teaching Award, *National Society of Leadership & Success*



Sheila Ferguson

Cherie Bornhorst

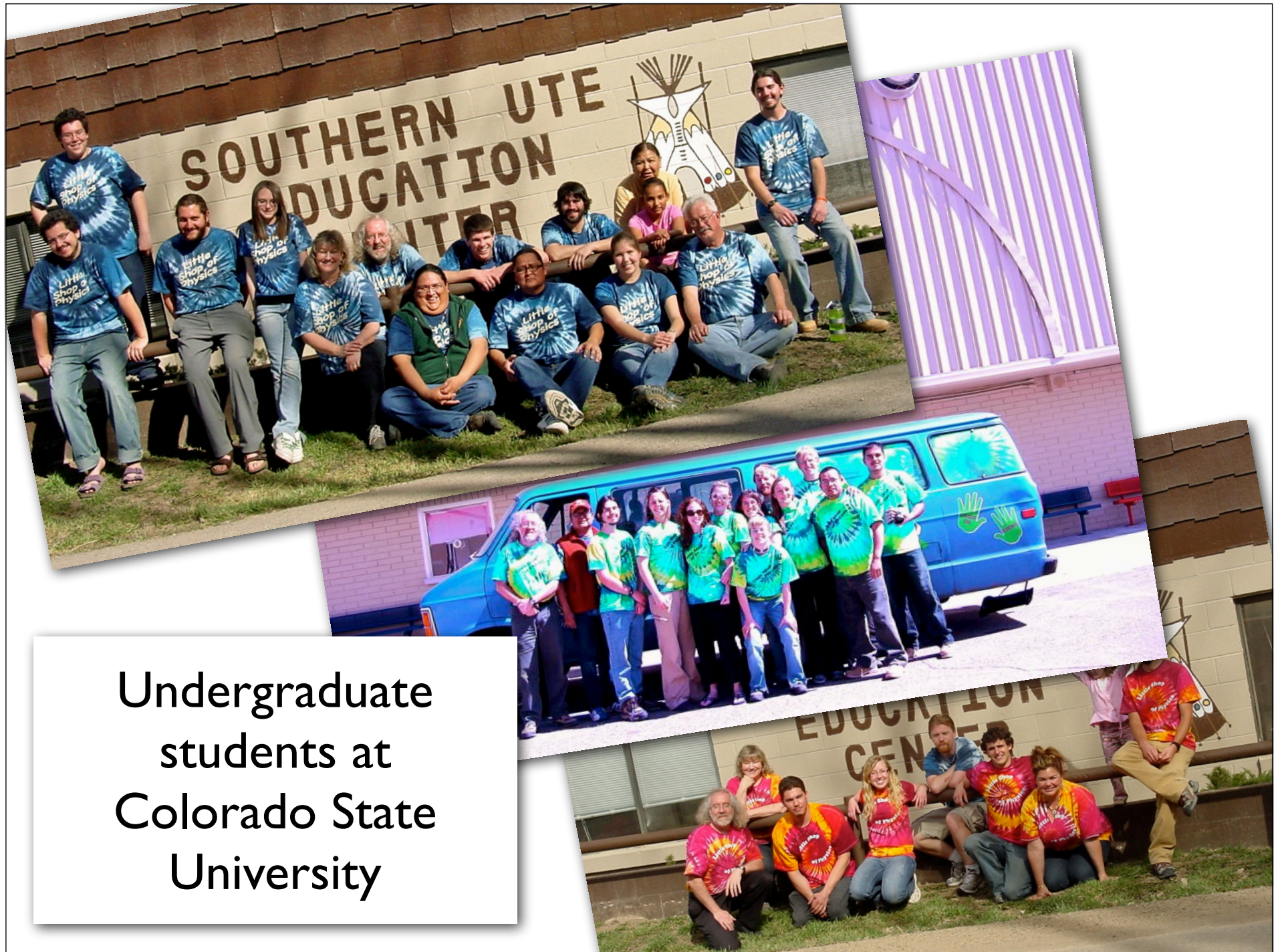
Nisse Lee



CMMAP Graduate Students

Scott Denning
Dave Randall
&
CMMAP Scientists
& Staff





Undergraduate
students at
Colorado State
University

Hands-On Science





Different Facets



School programs



Television program



Teacher workshops



Podcasts



Annual Open House

Normalized learning gain

$$g = \frac{\text{post} - \text{pre}}{100 - \text{pre}}$$



“Conventional” Instruction

A ball is tossed upward; it rises to its highest point, and then falls. At the highest point of its motion, the net force is _____.

- A. Directed upward
- B. Zero
- C. Directed downward

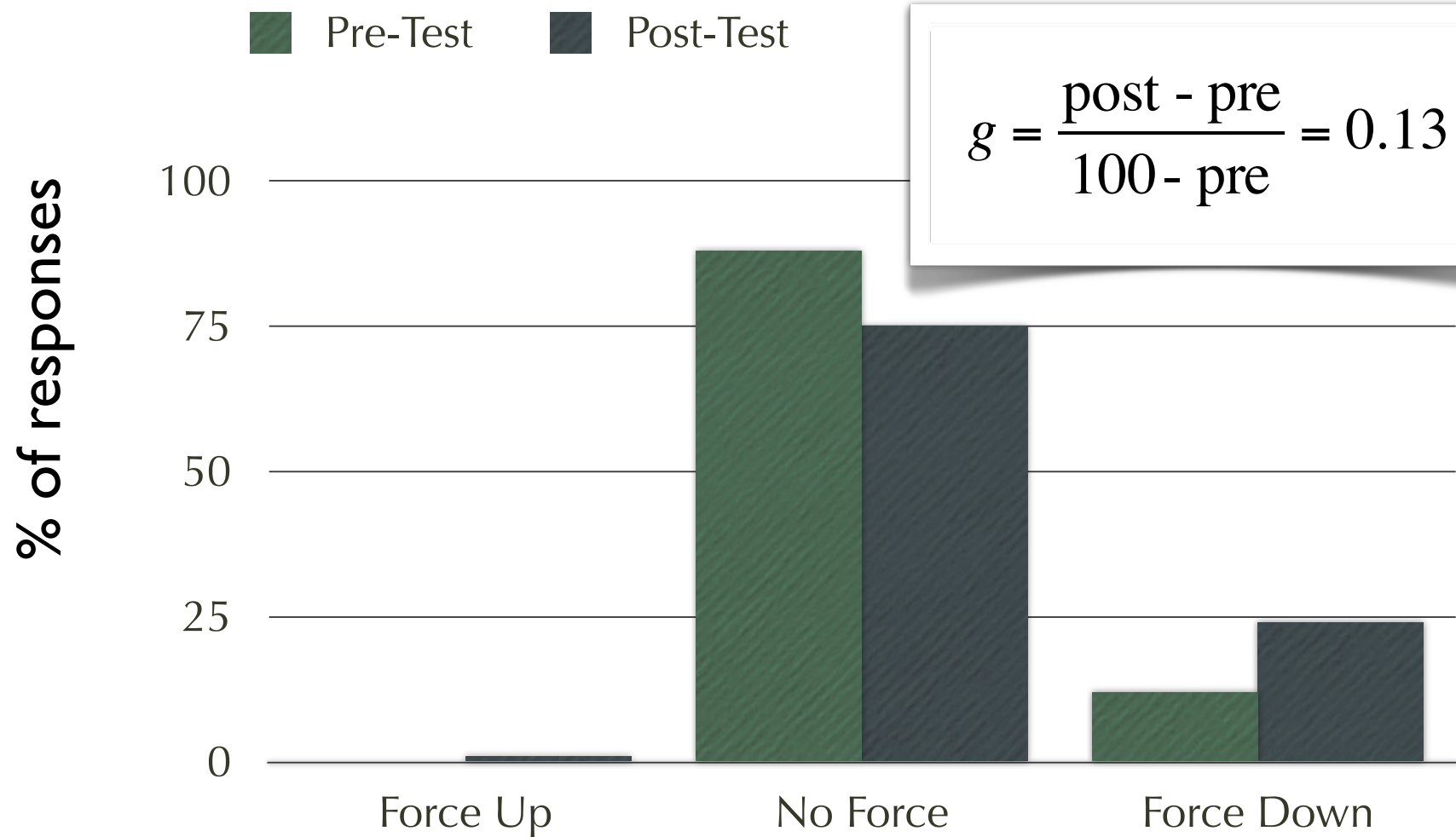
CSU

Physics for
Scientists and
Engineers

*Before and after
6 weeks of
physics instruction*



Tests before and after 6 weeks of instruction



*Data from Colorado State University
1991*

The Way the Wind Blows

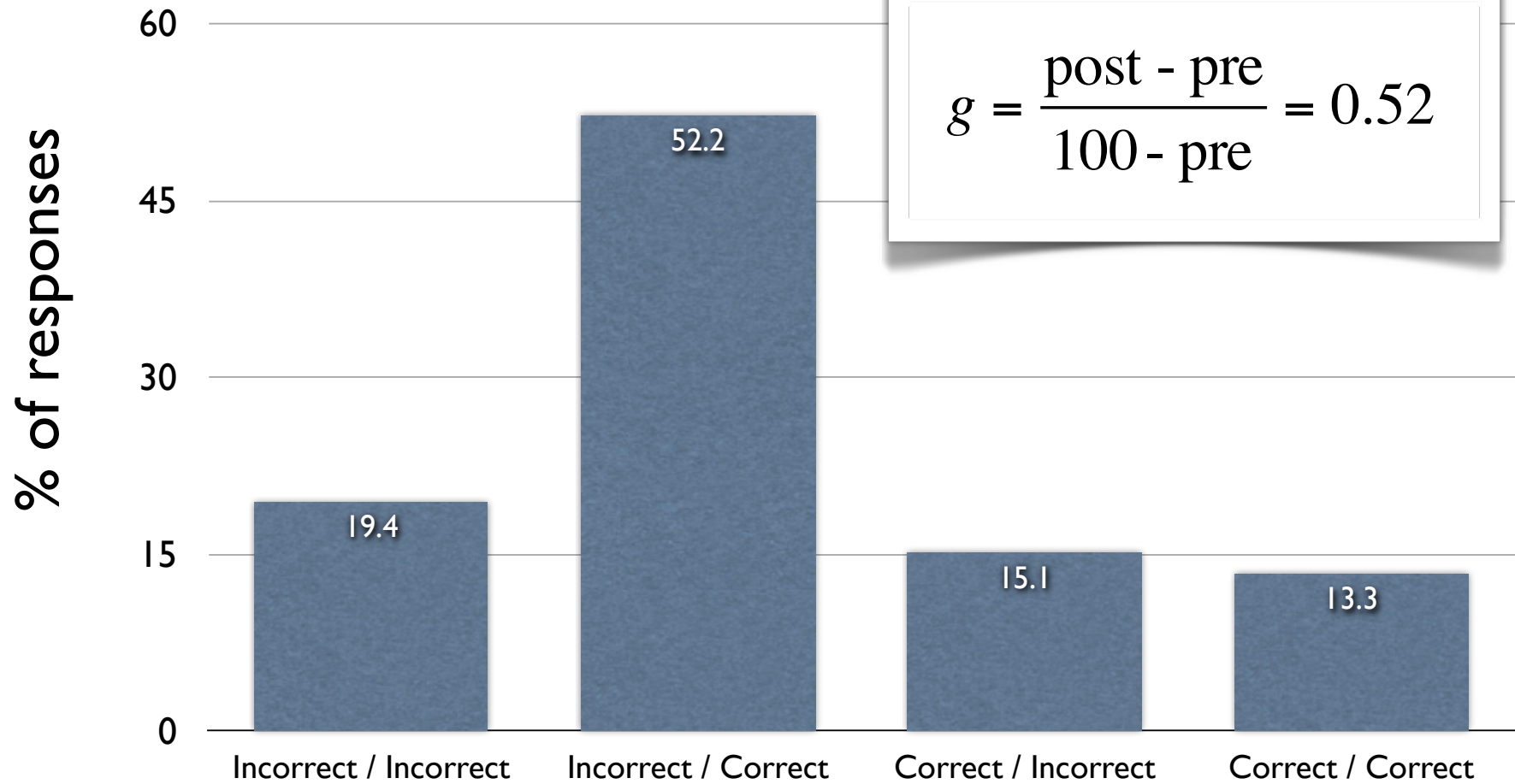
In Colorado, sometimes the wind blows from high elevations and low pressures in the mountains to low elevations and high pressures on the plains.

As the air does this, it:

- A. cools down.
- B. warms up.



Comparing pre-test / post-test data



*Data from Columbia Middle School
17 Feb 2011*

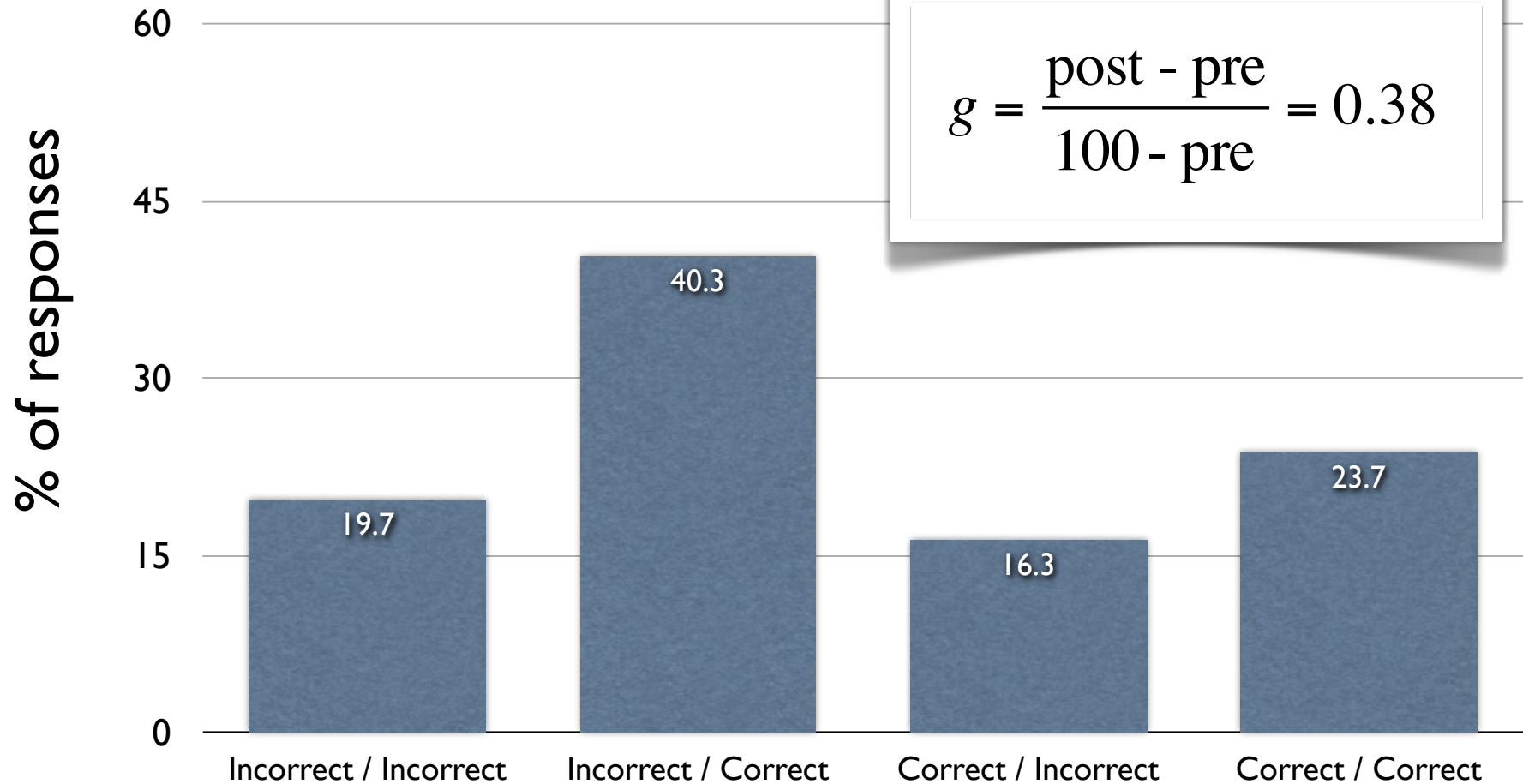
Photon Energy

Which type of light has the highest energy photons?

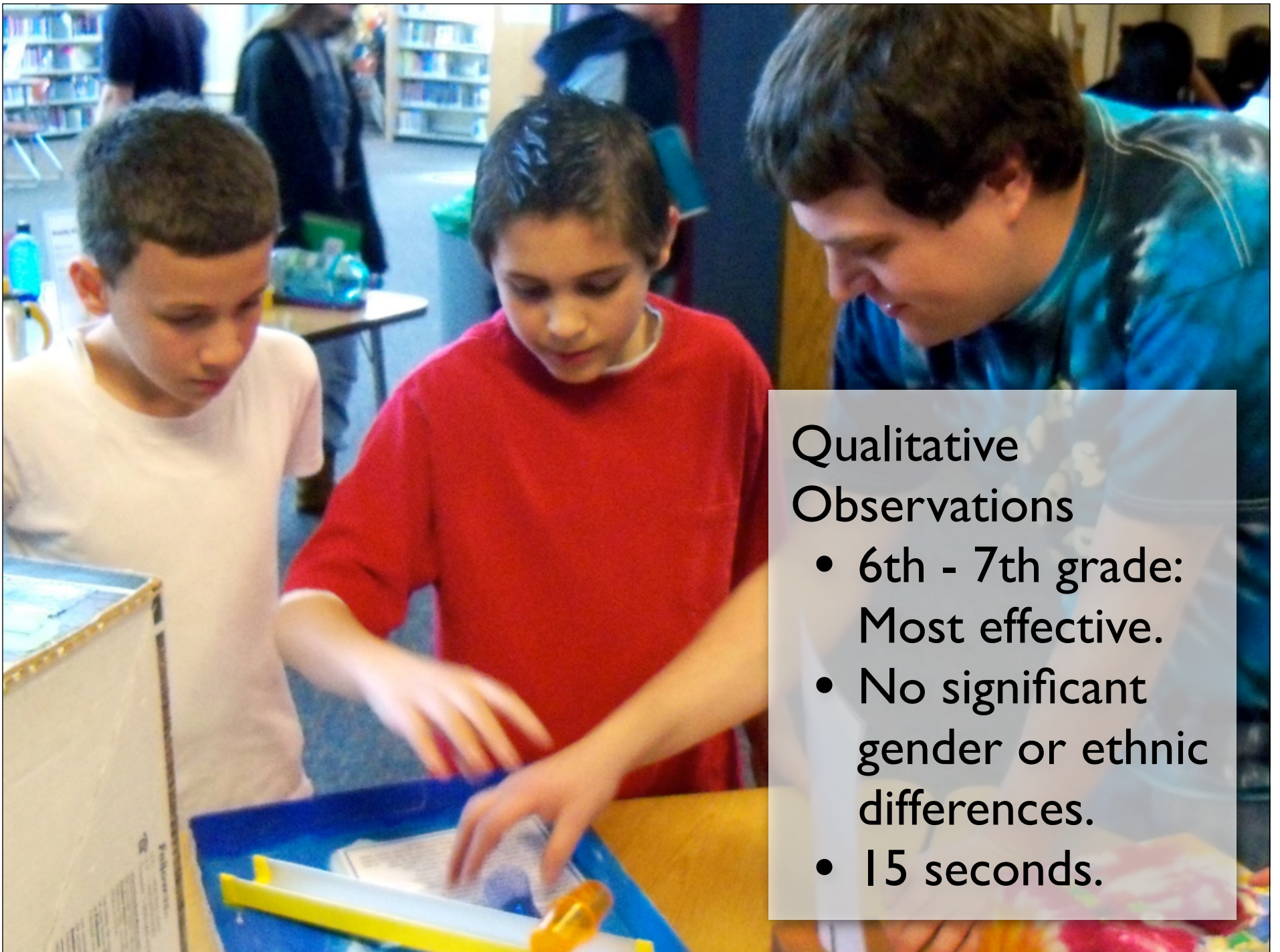
- A. Red light.
- B. Blue light.



Comparing pre-test / post-test data



*Data from Columbia Middle School
17 Feb 2011*



Qualitative Observations

- 6th - 7th grade: Most effective.
- No significant gender or ethnic differences.
- 15 seconds.

Future Directions, with Len & Andrea

- **Attitudes - about the experience**
- **Attitudes - about the scientific enterprise**
- **Role of the “explainers”**



All I Need to Know...

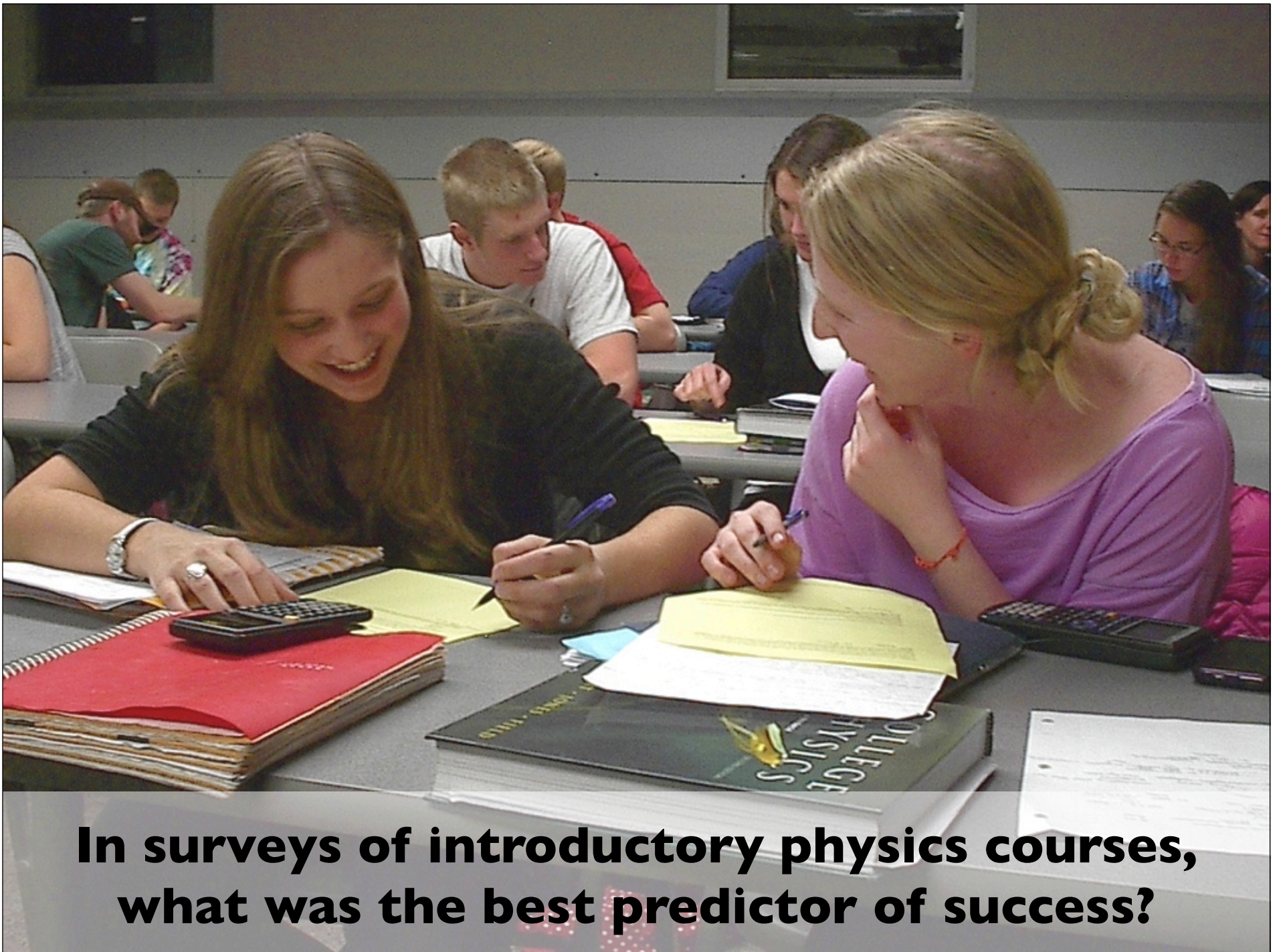


The world is comprehensible, and you can learn about it by exploring.



Science is a social enterprise.





**In surveys of introductory physics courses,
what was the best predictor of success?**

We learn best when we are active.



Melissa Burt at HESTEC



“Be the Parcel”

**You can understand
something better if
you can touch it.**



A photograph of a student on a sliding board. In the background, a red ball is suspended in the air. The scene is outdoors with trees and a clear sky.

A student is going down a sliding board.

If the sliding board makes an angle of 60 degrees with the ground and the coefficient of sliding friction between the student and the sliding board is 0.15 , at what rate will they accelerate?

To make it stick, make it real.

**It's easy to convince
students that you are smart.
It's harder to convince them
that they are smart.**





Our job is to design an environment in which students can learn.



Why does warm air hold more moisture than cold air?



If you want your students to be enthusiastic about learning, you need to be enthusiastic about teaching.



**There are many
different ways to
do something well.**

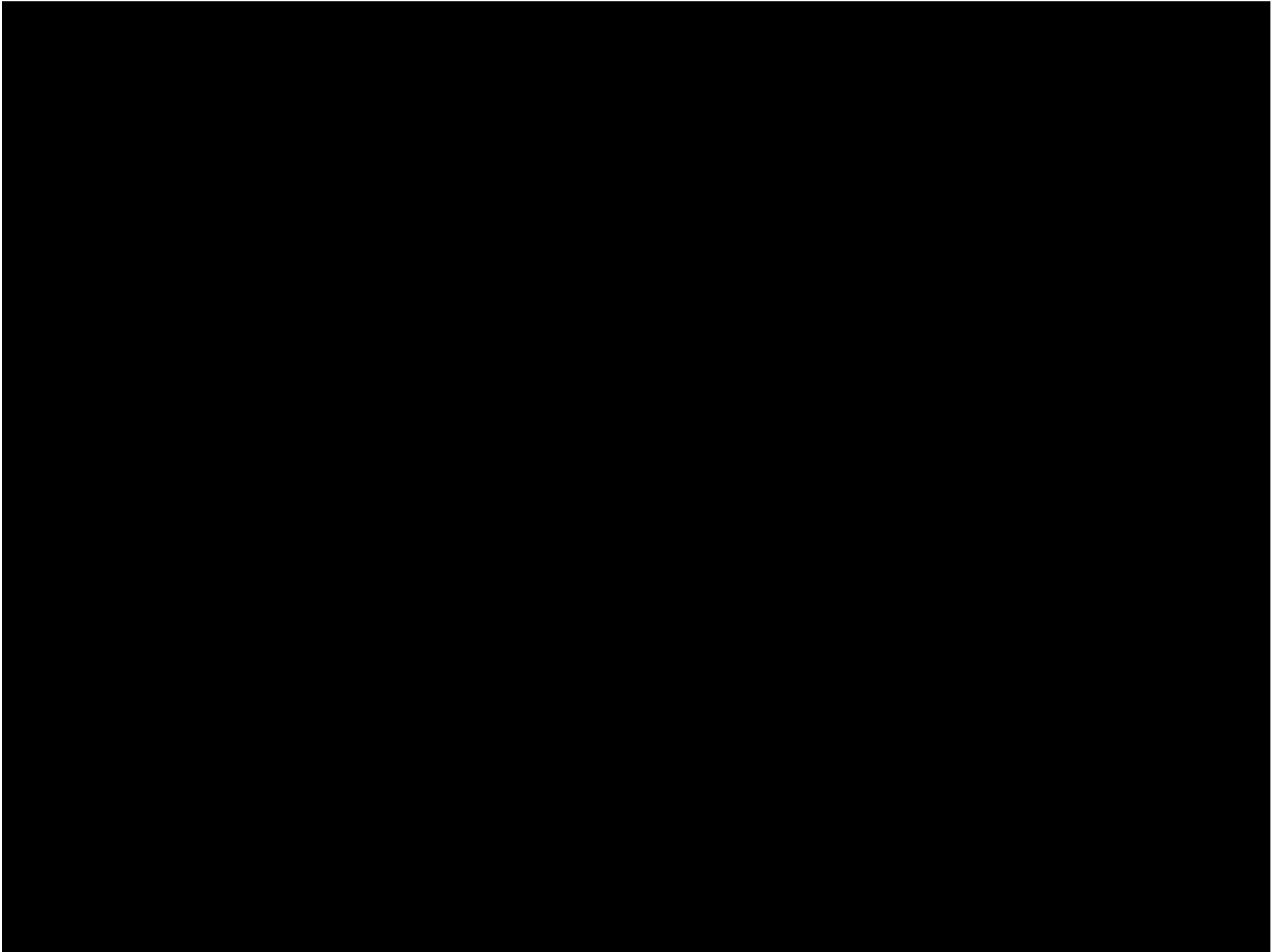


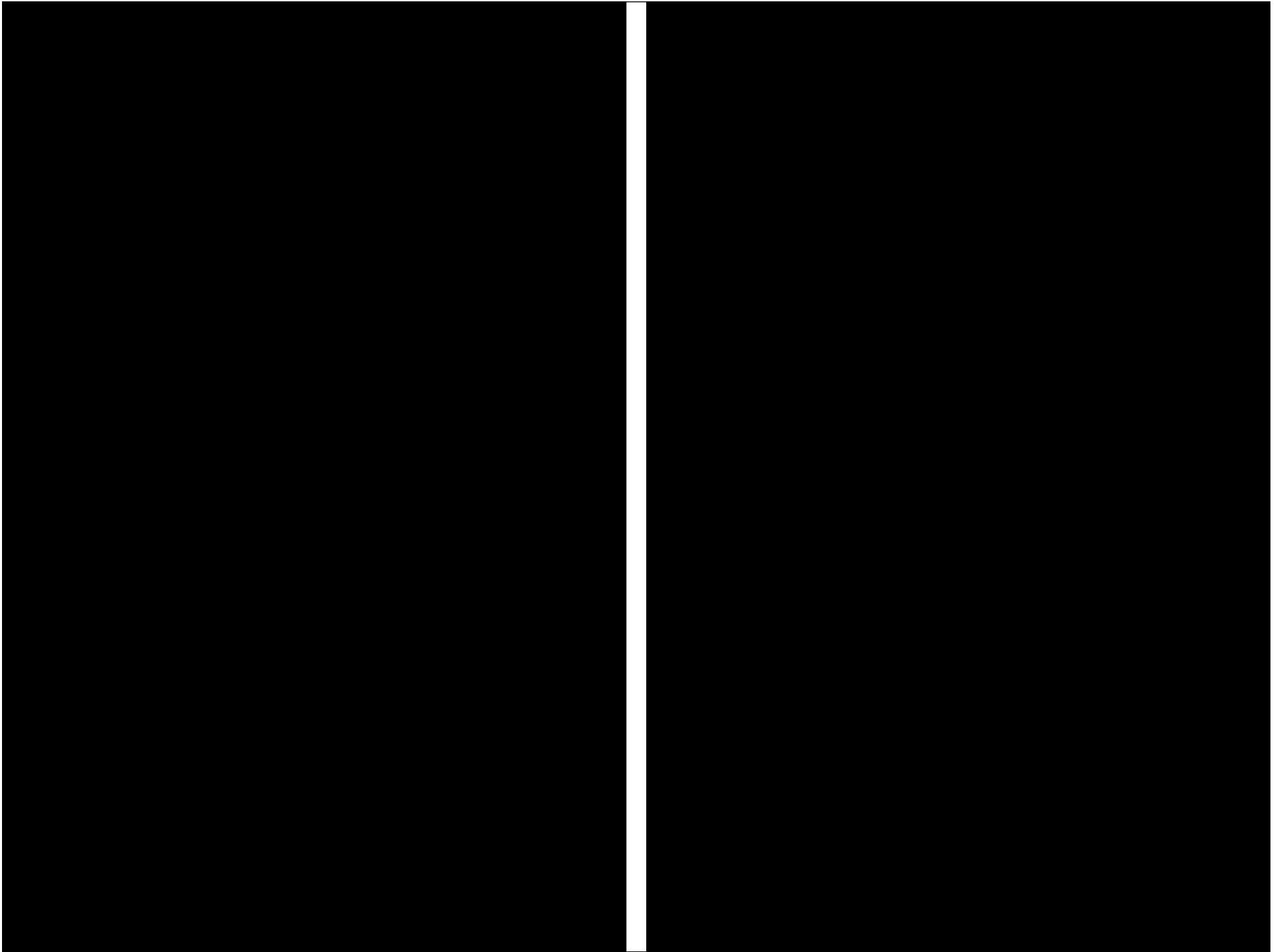
**Some things are worth doing
just because they are cool.**



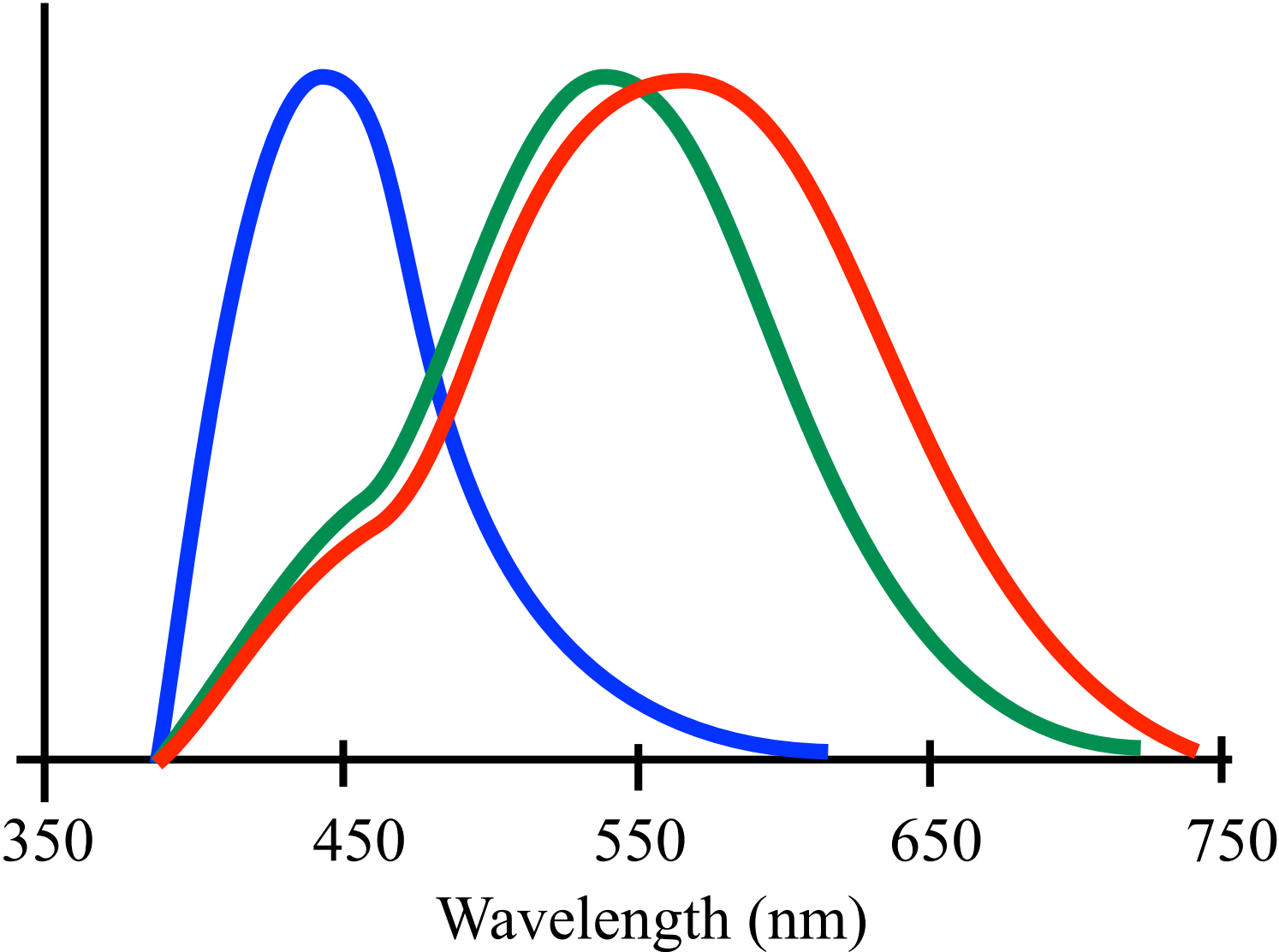


Beyond the Rainbow





Relative
sensitivity



An infrared photograph showing a building with a gabled roof and a weather vane on the left, and a modern multi-story building on the right. The sky is filled with dark, textured clouds. A white rectangular box with a double border is centered in the upper right portion of the image, containing the word "Infrared." in a bold, black, sans-serif font.

Infrared.



Why the sharp edge?

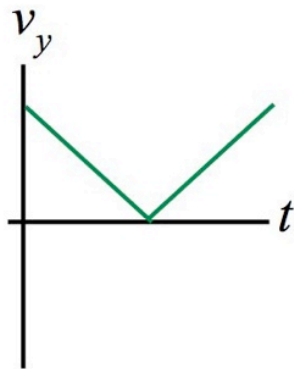
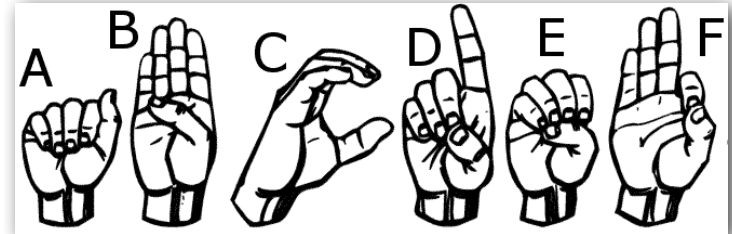
Superpowers.



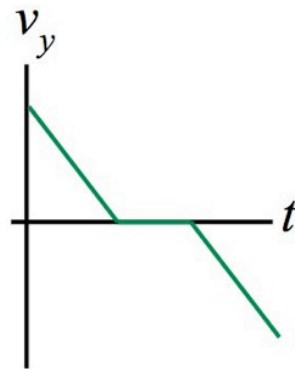


Interactive pedagogy.

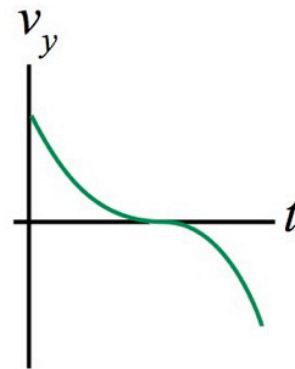
An arrow is launched vertically upwards. It moves straight up to a maximum height, then falls to the ground. The trajectory of the arrow is noted. Which graph best represents the vertical velocity of the arrow as a function of time? Ignore air resistance.



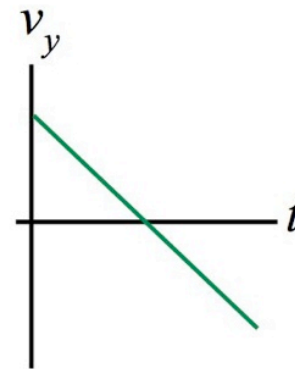
A.



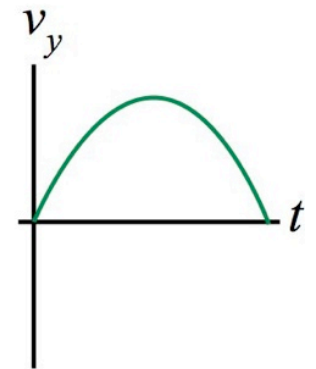
B.



C.



D.



E.

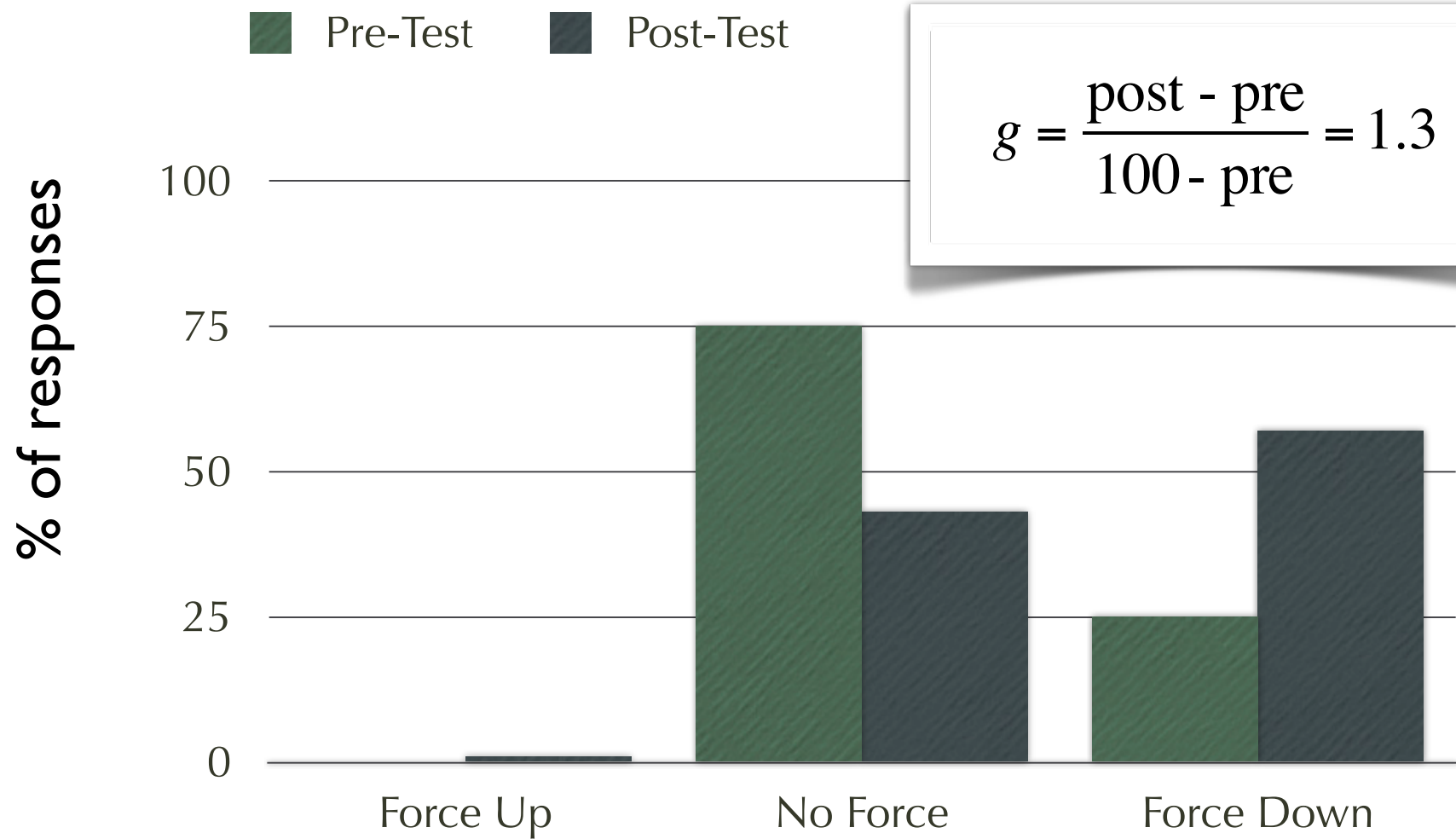
Same question, same timing.

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- B. Zero
- C. Directed downward



Different results.



Typical data from more recent classes.



**It's more
challenging to
talk to a 10
year old about
science than it
is to talk to a
20 year old.**



**Practicing
and refining
our craft.**



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Thanks.





Questions?