

# Hands-On Investigations of Atmospheric Science Concepts in the K-12 Classroom

## Effects: Informal Instruction

### Effectiveness of Informal Instruction

As part of our work with CMMAP, we evaluate the effectiveness of all aspects of our work.

We can show clear evidence of changes in understanding during our formal training sessions with teachers and with students. *More interesting is the informal work that we do.*

*Can we show an impact on learning in a 45 - 60 minute informal education experience with very little structure?*

At a typical Little Shop of Physics school visit, students receive very little direct instruction. Students explore at their own pace with minimal guidance. Students taking part in Little Shop activities come away with an enhanced appreciation for science and the process of science. But do they learn anything?

*The answer is yes. They do. And we have data to show it.*



### Pre-Test / Post-Test Data

Data from 460 students given a test before the Little Shop visit and then after.

Tests for individual students were compared to allow tracking of changes in responses.

If you place your hand into a container full of moist air, water vapor will condense into drops of liquid water on your skin. How does this affect your hand?

- A. This cools your hand down.
- B. This warms your hand up.



Which type of light has the highest energy photons?

- A. Red light
- B. Blue light



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## Effects: Formal Instruction

### Teaching Teachers

We have good data to show increased understanding and confidence among teachers in our one-week summer class. But we also have compelling data to show that we can increase understanding of complex concepts in a shorter evening session.

*All of our workshops showcase effective pedagogy in addition to standards-based content.*

Our data show that instruction is most effective when concepts are presented a few times in a mix of styles including hands-on, open-ended exploration, guided inquiry, discussion and lecture. Our workshops always involve such a mix.

*We provide teachers with knowledge but also with the tools they need to effectively teach their students.*



### Pre-Test / Post-Test Data

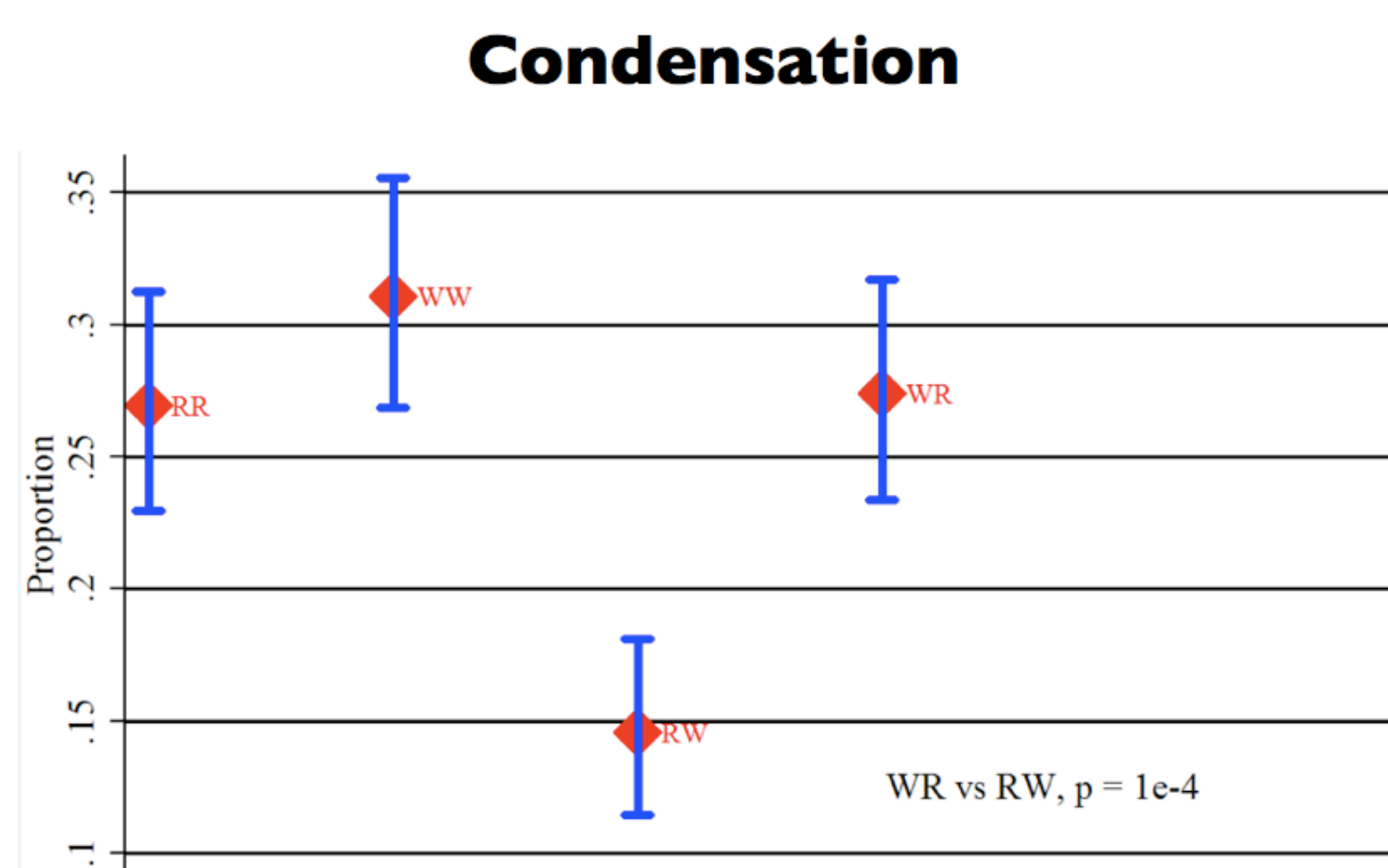
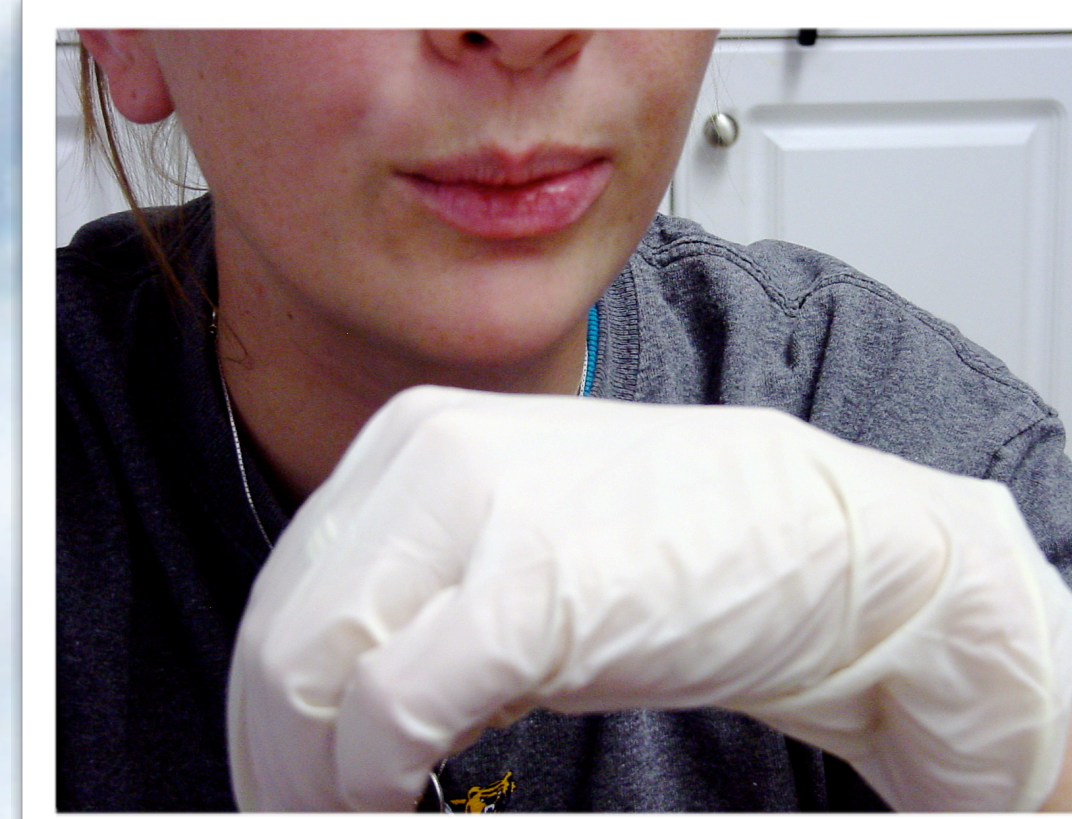
Data from the summer "Weather and Climate for Educators" course held at CMMAP, July 2010.

In addition to tracking changes in responses, we have tracked changes in confidence.

### Consequences of Condensation

On a cool night, dew condenses on the roof of your car. As the water vapor condenses to make the droplets of liquid water that you see as dew,

- A. Heat energy is transferred to the roof of your car, warming it.
- B. Heat energy is transferred from the roof of your car, cooling it.

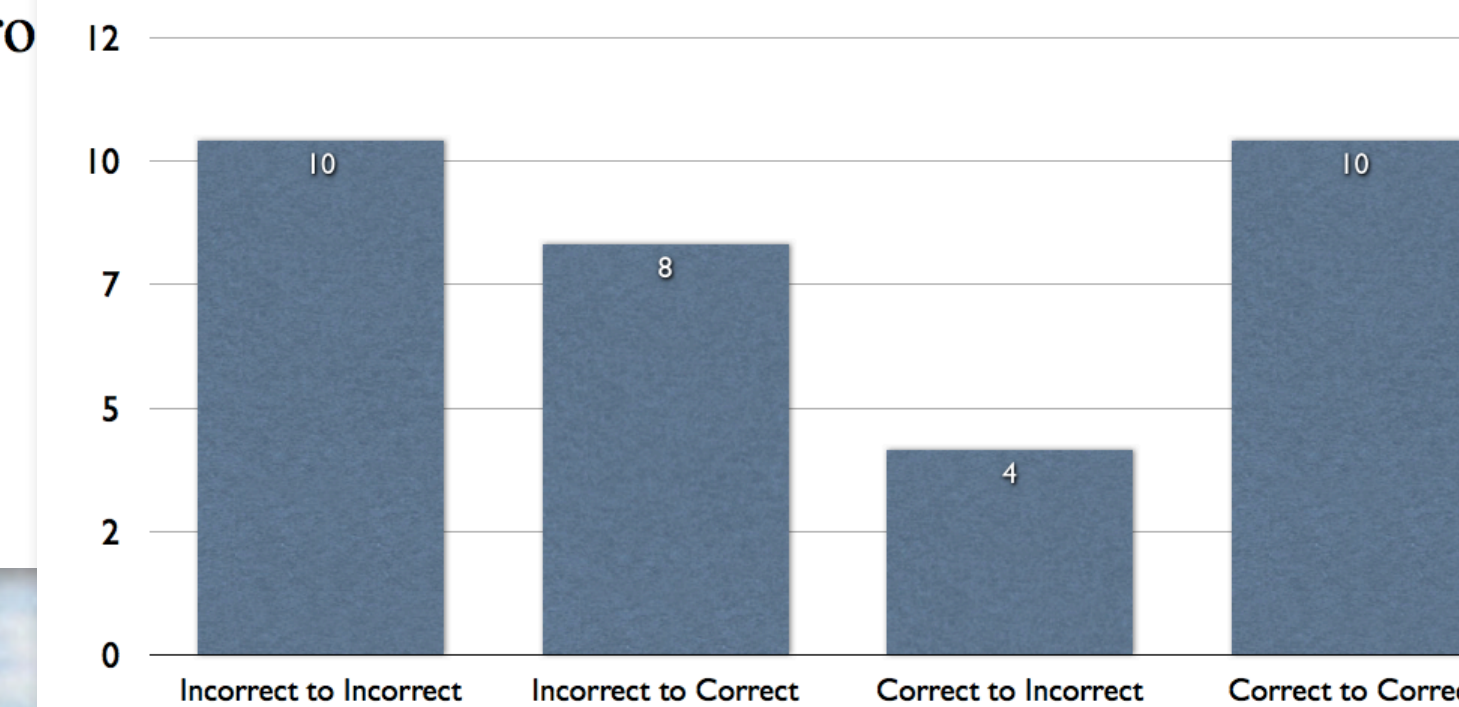


### Measuring Impact

$$\frac{\text{Incorrect} \Rightarrow \text{Correct}}{\text{Initially Incorrect}} = 0.47$$

$$\frac{\text{Incorrect} \Rightarrow \text{Correct}}{\text{Changed Mind}} = 0.63$$

### Consequences of Condensation

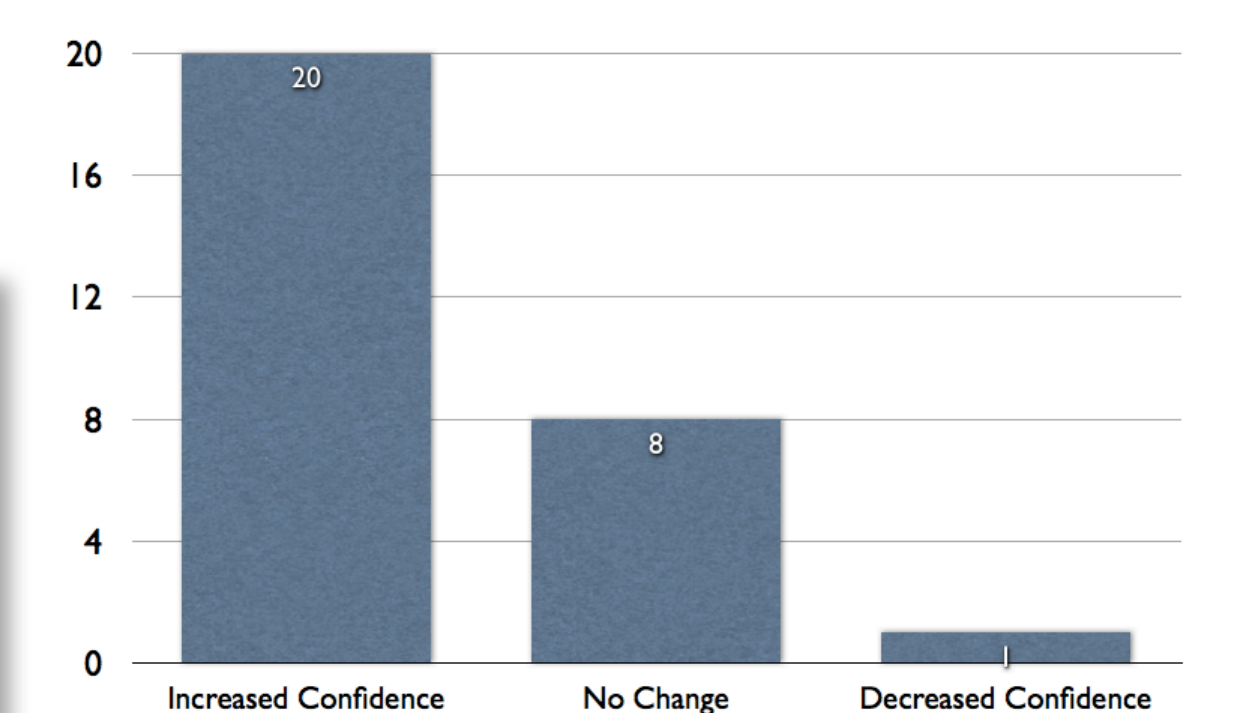


### Measuring Impact

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$$\frac{\text{Incorrect} \Rightarrow \text{Correct}}{\text{Changed Mind}} = 0.67$$

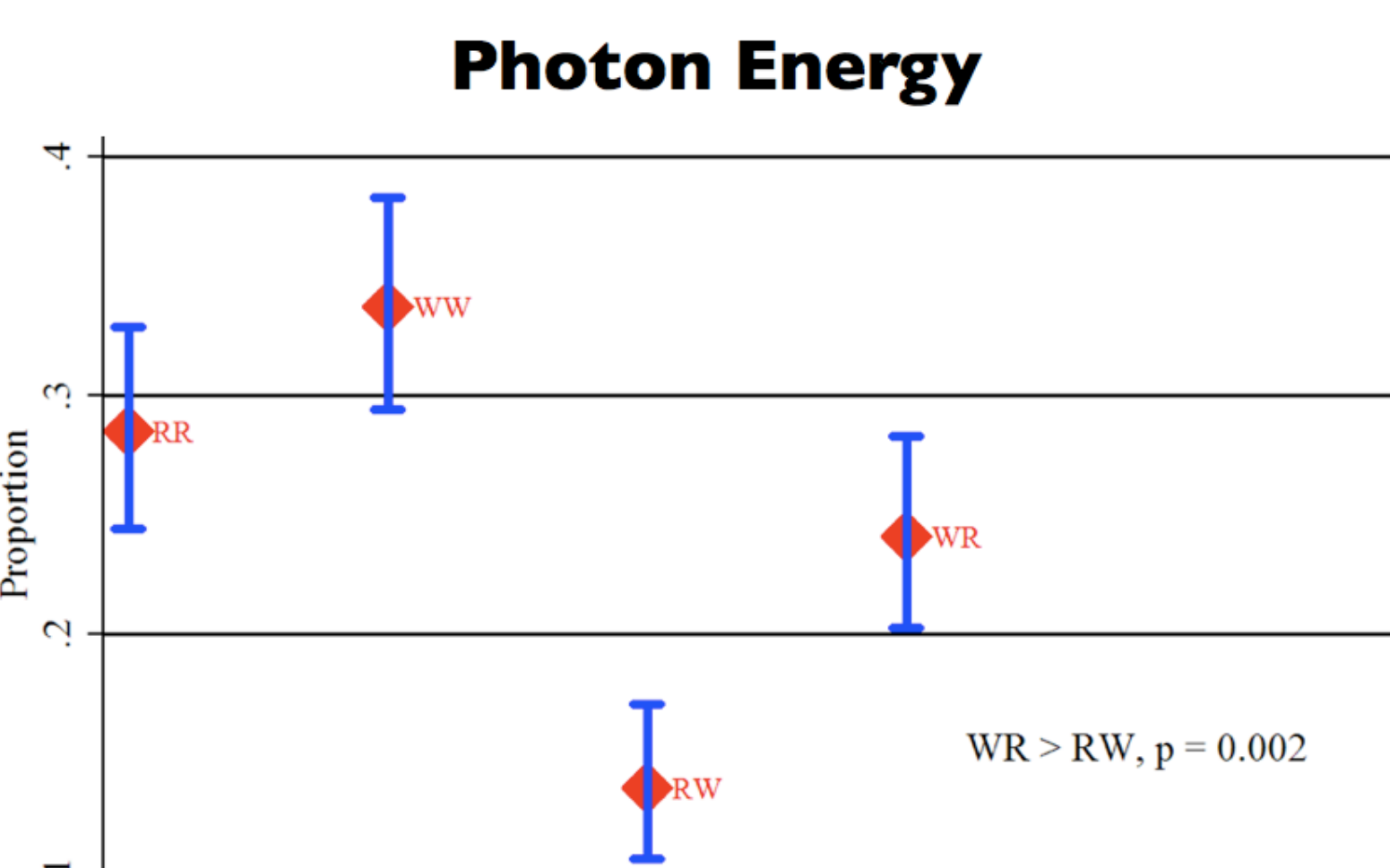
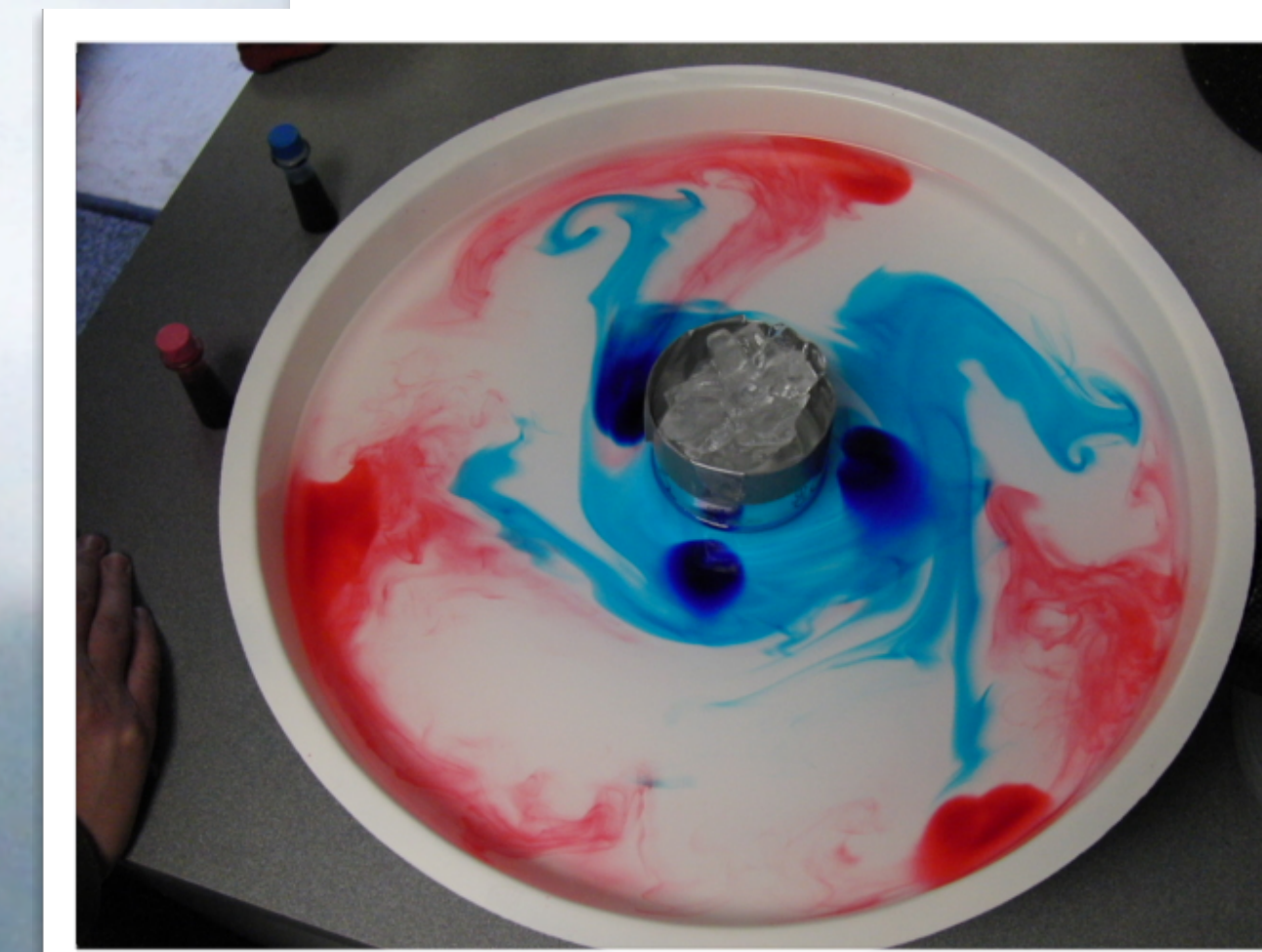
### Changes in Confidence



### Moving Air on the Earth

Surface winds usually blow

- A. from the west in the Northern Hemisphere but from the east in the Southern Hemisphere.
- B. From the north in the winter but from the south and west during the summer.
- C. From the east in the tropics but from west in the middle latitudes of both hemispheres.

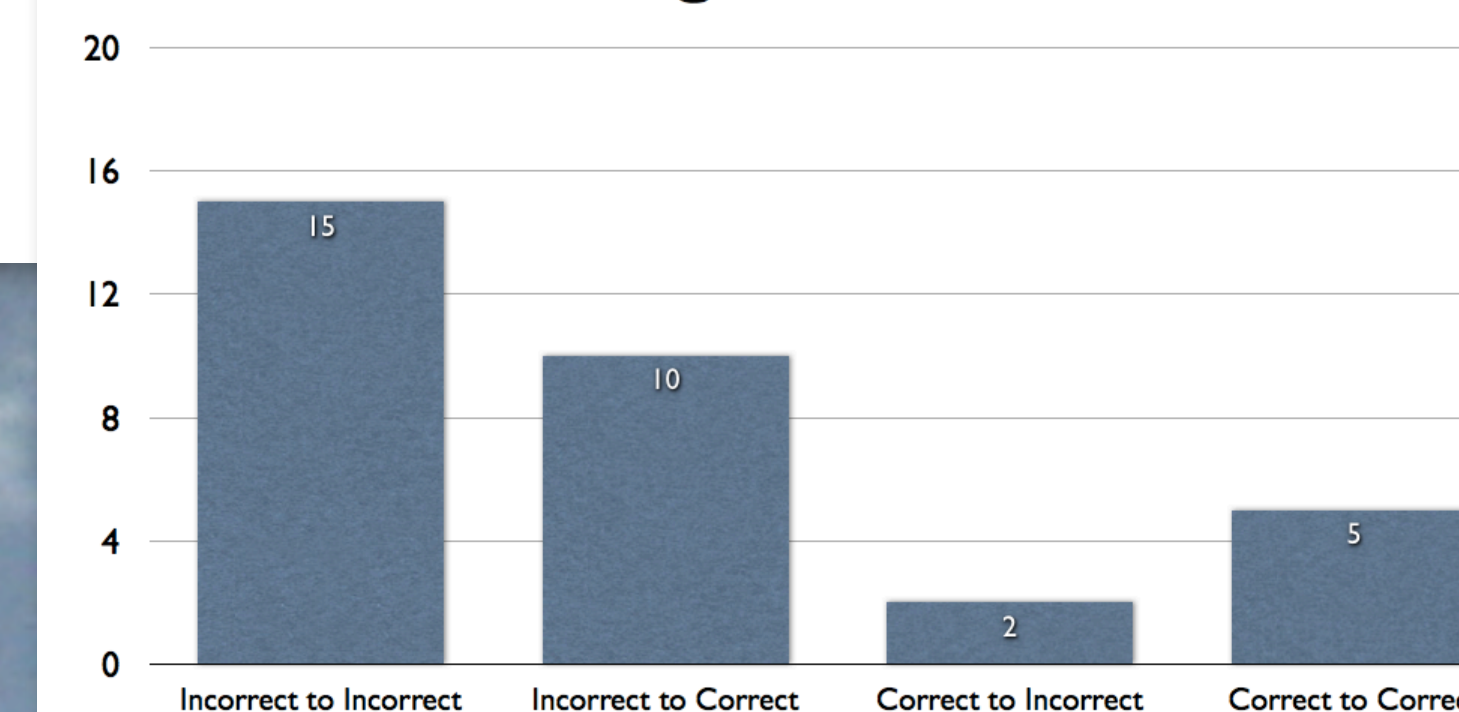


### Measuring Impact

$$\frac{\text{Incorrect} \Rightarrow \text{Correct}}{\text{Initially Incorrect}} = 0.42$$

$$\frac{\text{Incorrect} \Rightarrow \text{Correct}}{\text{Changed Mind}} = 0.63$$

### Moving Air on Earth



### Measuring Impact

$$\frac{\text{Incorrect} \Rightarrow \text{Correct}}{\text{Initially Incorrect}} = 0.40$$

$$\frac{\text{Incorrect} \Rightarrow \text{Correct}}{\text{Changed Mind}} = 0.17$$

### Changes in Confidence

