ThinkSpace Labs: Teaching Seasons and Moon Phases with WorldWide Telescope

Patricia **Udomprasert,** Harry **Houghton,** Susan **Sunbury,** Erin **Johnson,** Erika **Wright,** Alyssa **Goodman,** Philip **Sadler**
Harvard-Smithsonian Center for Astrophysics

Julia **Plummer,** Abha **Vaishampayan**, Kyungjin **Cho**
Pennsylvania State University

Helen Zhihui **Zhang**
Boston College

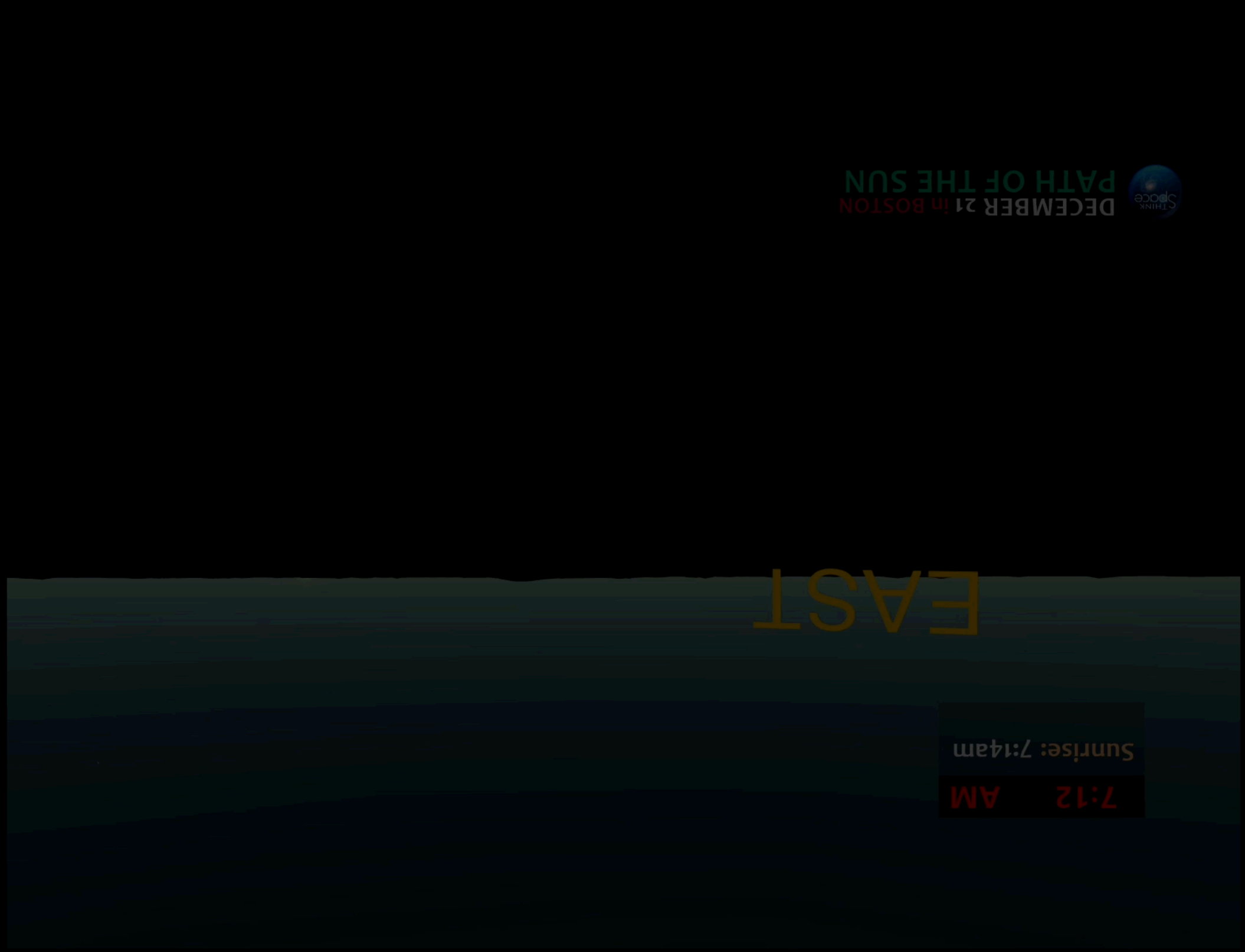
This work has been funded by NSF awards DRL-1503395 & 1502798

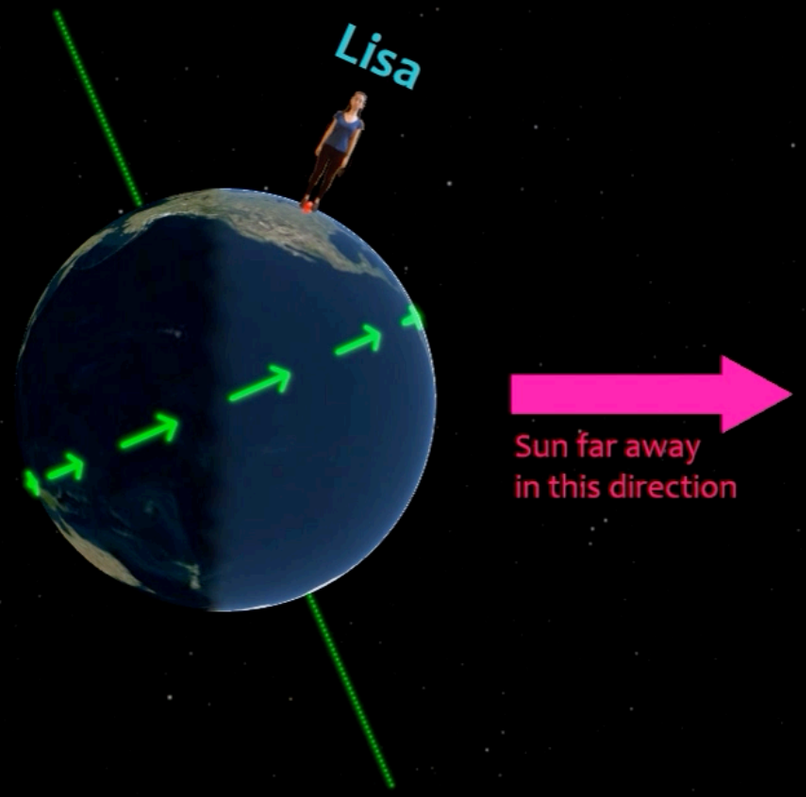
Project OVERVIEW

ThinkSpace labs teach astronomy while supporting spatial thinking skills, like imagining a scene from multiple viewpoints.

DECEMBER 21 in BOSTON

PATH OF THE SUN

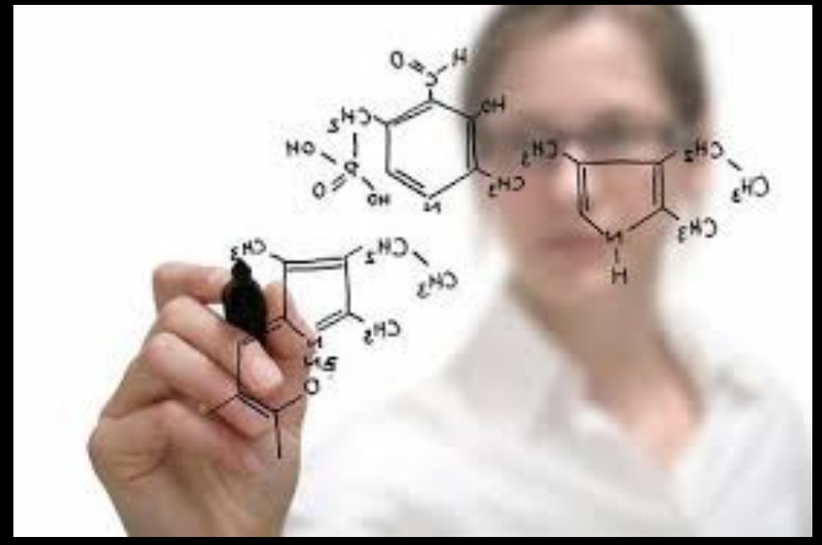




EARTH MODELS

Spatial Thinking and STEM

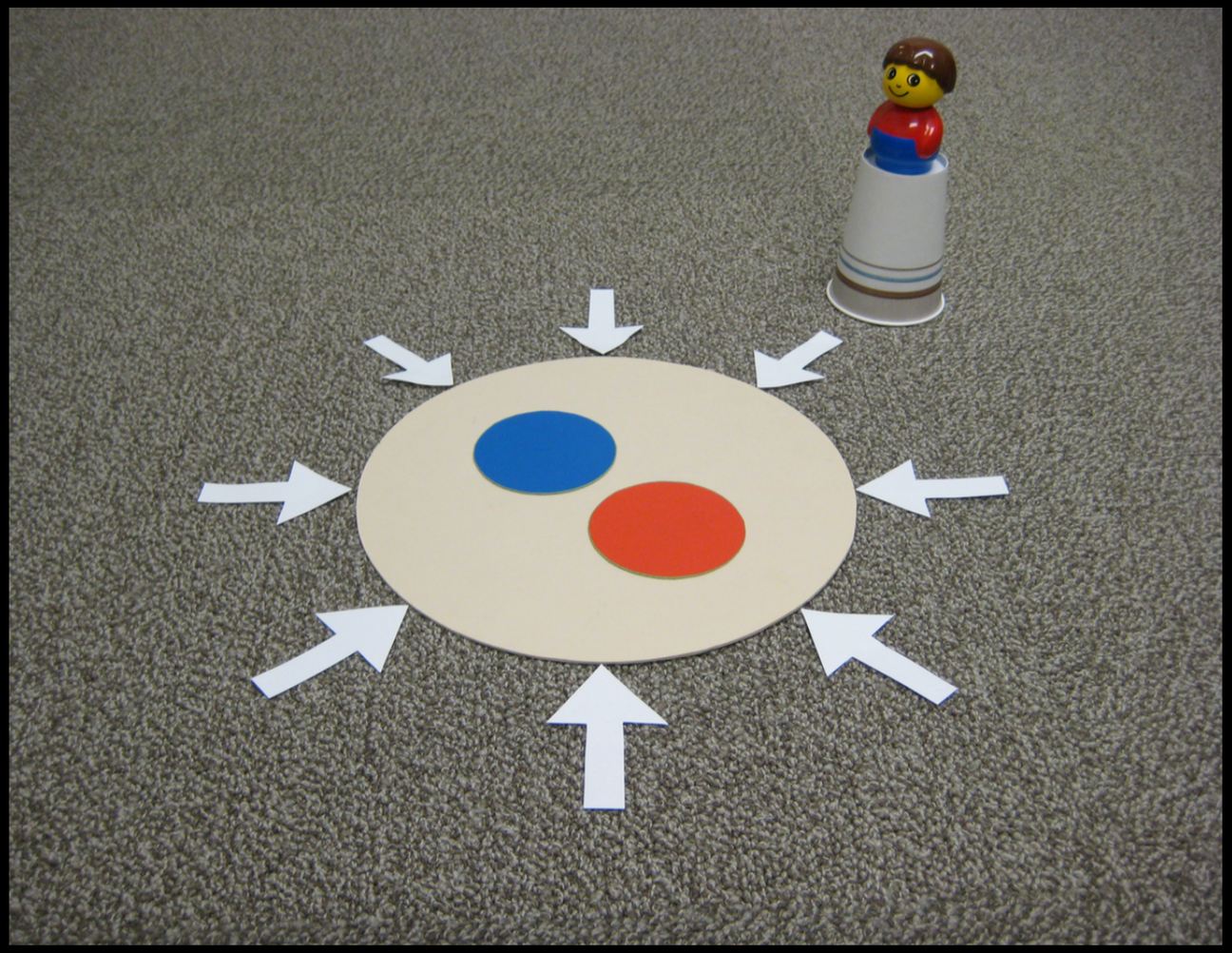
- Spatial skills correlate with performance in science domains, and likelihood to enter a career in STEM (e.g. Hegarty, 2014, Wai et al. 2009, 2010)

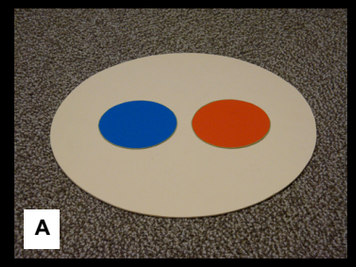


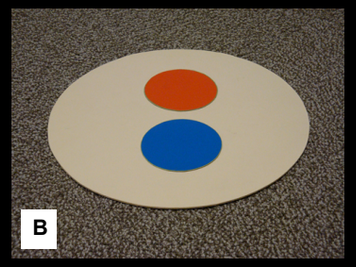
Spatial Thinking and STEM

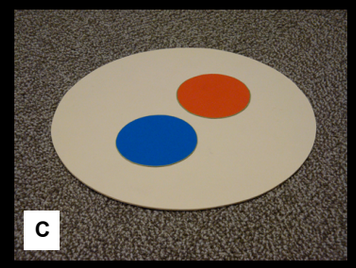
- Spatial skills are malleable and can improve with practice (e.g. Uttal et al., 2013)

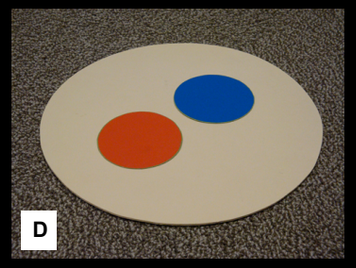
Perspective Taking

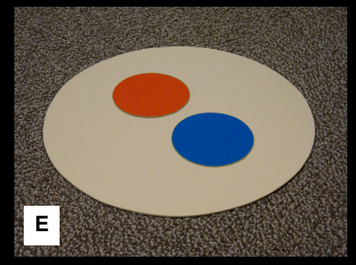


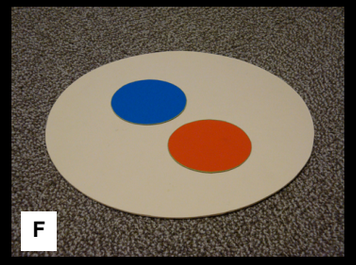


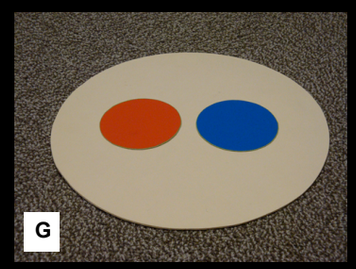


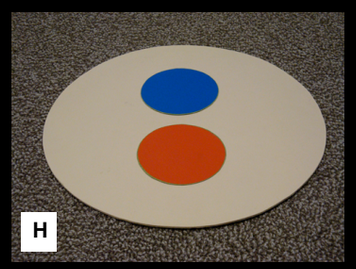












16-item task

Liben, Downs, & Bower, 2015

THINK Space

Distractor-driven multiple choice (DDMC) questions from the Astronomy and Space Science Concept Inventory (Sadler et al, 2009): 10 questions about Seasons on pre/post assessments.

8. The main reason for it being hotter in summer than in winter is:

   a. the Earth's distance from the Sun changes.

✔ b. the Sun is higher in the sky.

   c. the distance between the northern hemisphere and the Sun changes.

   d. ocean currents carry warm water north.

   e. the Sun produces heat and light at a faster rate in the summer.

	Post "typical" Instruction (Sadler et al)	Post ThinkSpace Instruction
a.		8%
b.	9%	55%
c.		33%

Distractor-driven multiple choice (DDMC) questions from the Astronomy and Space Science Concept Inventory (Sadler et al, 2009): 9 questions about Moon Phases & Eclipses on pre/post assessments.

2. One night you looked at the Moon and saw this:

A few days later you looked again and saw this:

Why did the Moon change shape?

A. Clouds covered a different amount of the Moon.
B. The Moon moved out of the Earth's shadow.
C. The Moon moved out of the Sun's shadow.
D. The Moon is black and white and rotates on its axis once a month.
✔ E. We see a different amount of the lit up side of the Moon.

	Post "typical" Instruction (Sadler et al)	Post ThinkSpace Instruction
B	20%	
C	13%	
E	33%	65%

Student Gains: Moon Phases & Seasons Questions

$$\text{Cohen's d Effect Size} = \frac{\text{Average(Posttest Score - Pretest Score)}}{\text{stdev(Pretest Score)}}$$

WWT Moon Phases: Cohen's d=1.2±0.2; N=330

WWT Seasons: Cohen's d=1.5±0.2; N=290

Cohen's d ~ 0.2 → small effect

Cohen's d ~ 0.5 → medium effect

Cohen's d >0.7 → large effect

Student Gains: Spatial Thinking Questions

$$\text{Effect Size} = \frac{\text{Average(Posttest Score - Pretest Score)}}{\text{stdev(Pretest Score)}}$$

Spatial Thinking: Cohen's d=0.3±0.2; N=630

Cohen's d ~ 0.2 → small effect

Significant gain when compared with control groups who did not use WWT ThinkSpace Labs

Download ThinkSpace Curriculum:
wwtambassadors.org

Use WWT:
worldwidetelescope.org

Questions?
email: **pudompra@cfa.harvard.edu**