



# COSMOS

## astronomy projects

Designing with elements of authentic inquiry and the seven principles

or

keeping students in their zone of proximal development using facilitated scaffolding: an epistemologically metacognitive jigsaw

Patrik Jonsson & Scott Seagroves

# Outline

- COSMOS projects
  - ~2 weeks
  - 1:~3 advisor:students
  - focused research in astronomy or vision science
- Expose students to authentic scientific inquiry
- Encourage their future participation in science
  
- 2 projects: Variable Stars and Galaxies
- Compare/contrast design elements

# Lessons

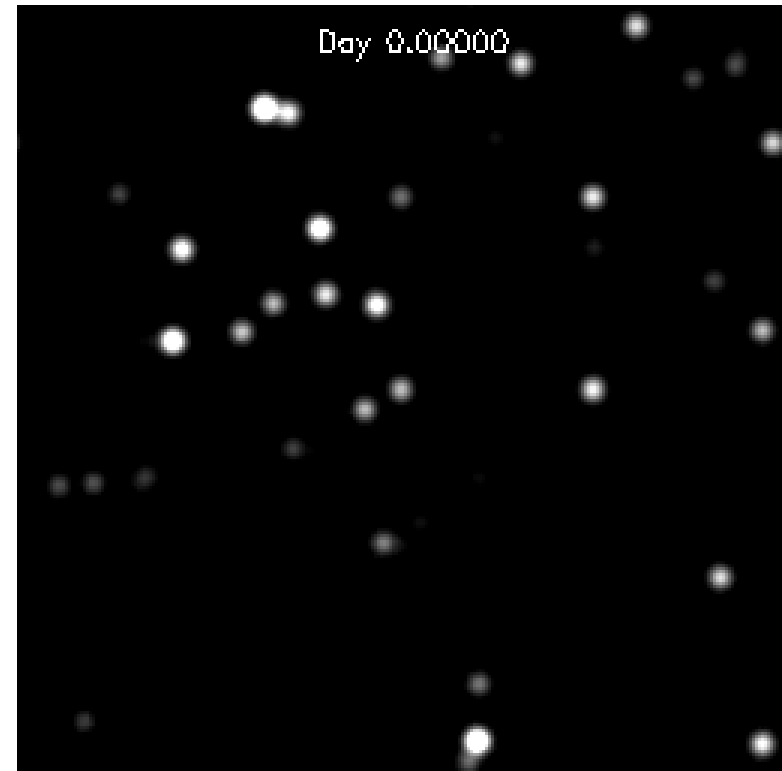
- Designs don't have to look like the “Light & Shadow” inquiry of the PDW
- The seven principles are not goals in and of themselves but can inform design
- You don't have to do all inquiry all the time

# Variable Stars

- Focused investigation where students are challenged to answer a given question
- Students observe the light of a varying star and must find a model which fits their data
- Hands-on experiment helps students find the right type of model
- Original design pre-dates PDW but was redesigned during PDW 2.

# Starter

- Simulated movie
- Why do the stars vary?  
A planet blocks the light?



# Tabletop eclipse experiment

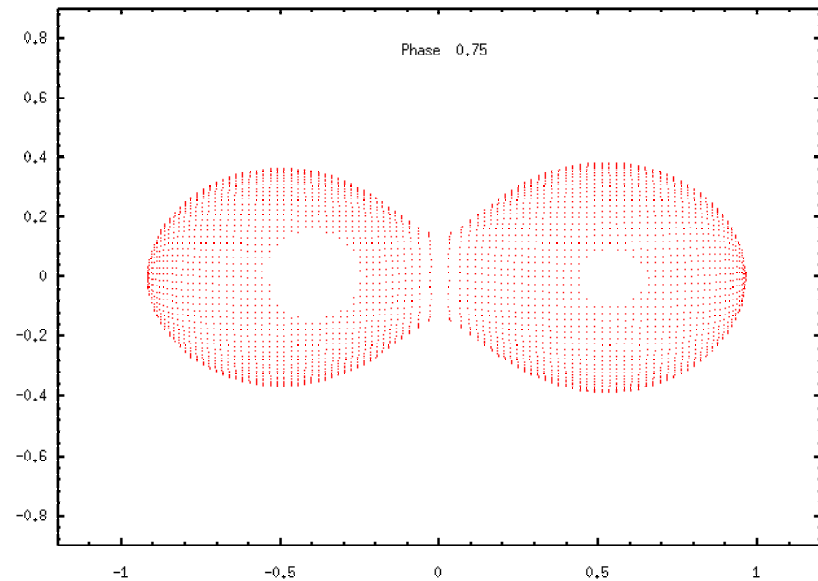


- Most open-ended part, but still with a well-defined goal:  
They figured it out: 2 stars, not a star and a planet!

# Computer simulations

- Match model and observations
- Computer equivalent of eclipse lab
- Get an image of the system

The two stars actually touch!

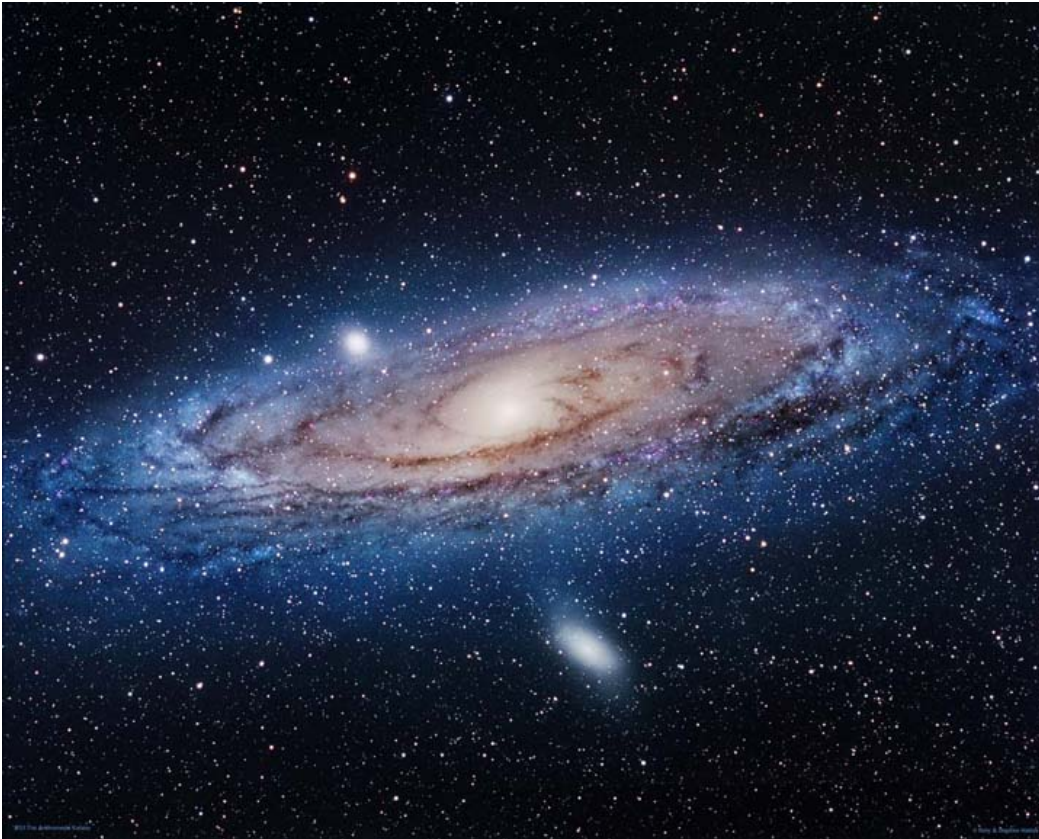


# Galaxies

- Less linear than VS project
- Students observe galaxies and ask questions about their properties
- Heavily facilitated explorations answer their questions



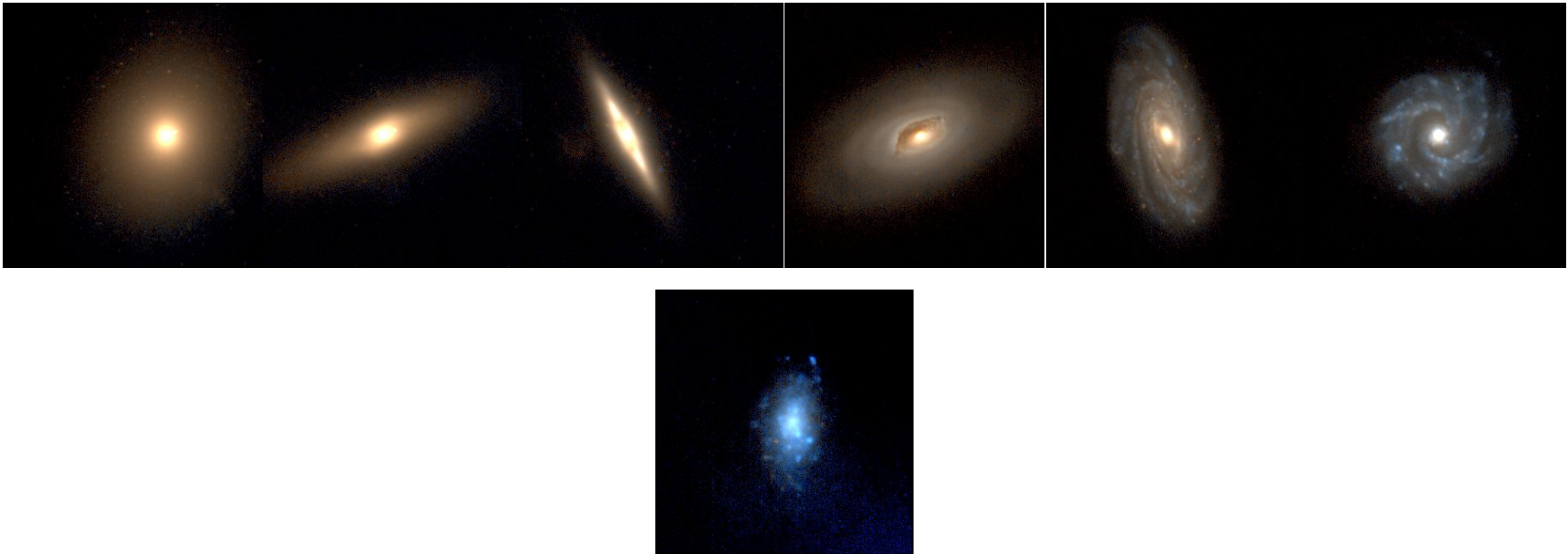
# Starters



- Packet of pretty galaxy images
- Students note whatever interests them and ask questions

# Investigation & thinking tools: Galaxy classification activity

Students' classification scheme for isolated galaxies



# Investigation & thinking tools

- Students read textbooks and web pages for basic facts about galaxy components and terminologies
- Red/blue box demo and mini-lecture on stellar lifecycles to help with color questions
- Hubble classifications to affirm their own system and to bring questions about interactions to the fore
- Always pausing for synthesis/mini-lecturing, dialogue, and re-questioning

# Goals

- **Common: Teach authentic inquiry skills:**
  - Gal: Generating questions
  - VS: Designing experiments, making observations
  - VS: Comparing models to data
  - Gal: Studying others' research
  - Both: utilizing evidence
  - Both: Making generalizations, communication
  - Both: Promoting and modeling metacognitive strategies
- **Common: Promote student ownership**

# Goals

- From the design standpoint, the choice of content is a vehicle for the process goals
  - VS: simple system allows students to make progress from observation to inference easily
  - Gal: rich content allows diversity of questions and investigations
- From learner's perspective, the activity is about the content

Common

Variable Stars

Galaxies

