TRANSFORMATION OF THE PHYSICS AND ASTRONOMY COURSES

For ICRC2021

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While this is a poster presentation, for the convenience of the online reviewing it's been cast intro series of slides.

THE NEED FOR TRANSFORMATION

- At many places, science courses such as Astronomy & Physics are taught in chalk and blackboard/slides
- Textbook used is typically in $150-$250 range
- This can be deferring factor, or increases total financial burden on a student:
  - In current economic conditions
  - At primarily minorities-oriented schools
- Adoption of new textbook needs also:
  - Class materials, quizzes, exams, homework

- Classes are still in hybrid or similar mode
- Need some support for projects and labs
  - For independent work or collaboration
  - Online collaboration/project tools
- Need some support for projects and labs
  - For independent work or remote collaboration
- **Work conducted under ALG grant**
  - **Adopting free textbook**
  - **Creating class support and other materials**

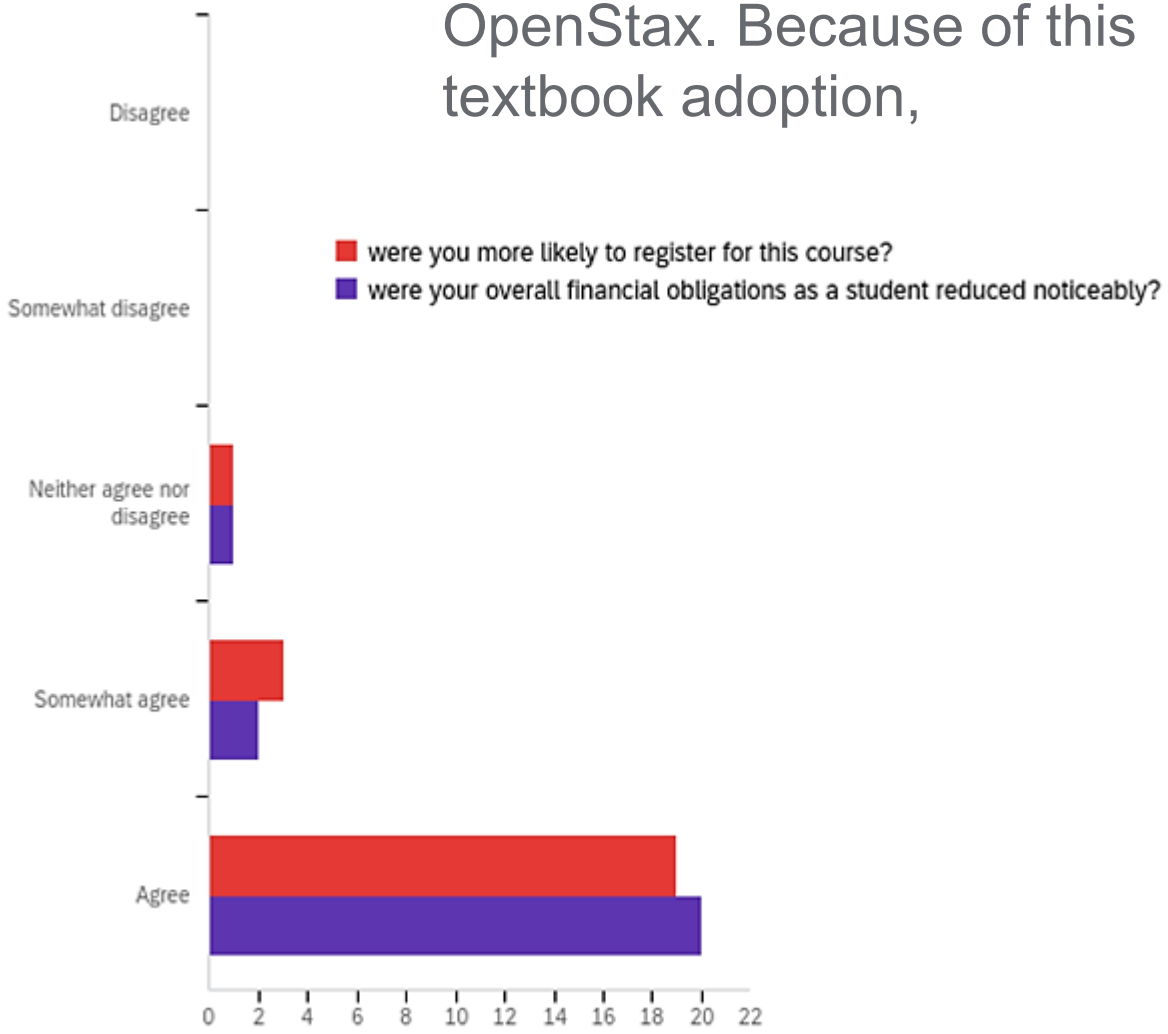
SCIENCE BOOKS FROM OPENSTAX

- https://openstax.org/subjects/science
- Great selection for:
  - Astronomy for non-science majors
  - College physics (Introductory physics with algebra only)
  - University Physics (Introductory course with calculus and modern physics)

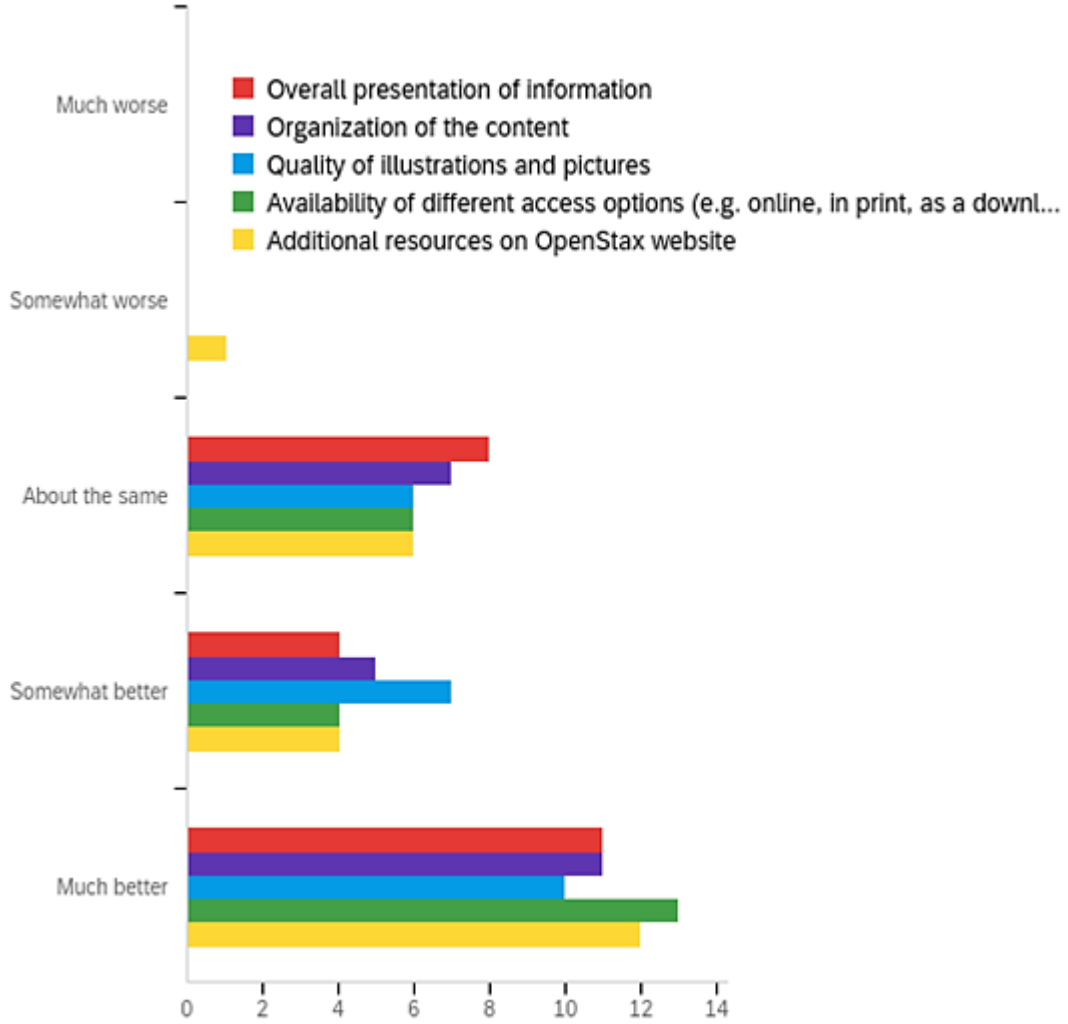
- PROS:
  - Free online/download, affordable printed
  - Collection of OER materials (open educational resources)
  - OpenStax Tutor (beta) for homework and tracked reading assignments
  - Available in many formats

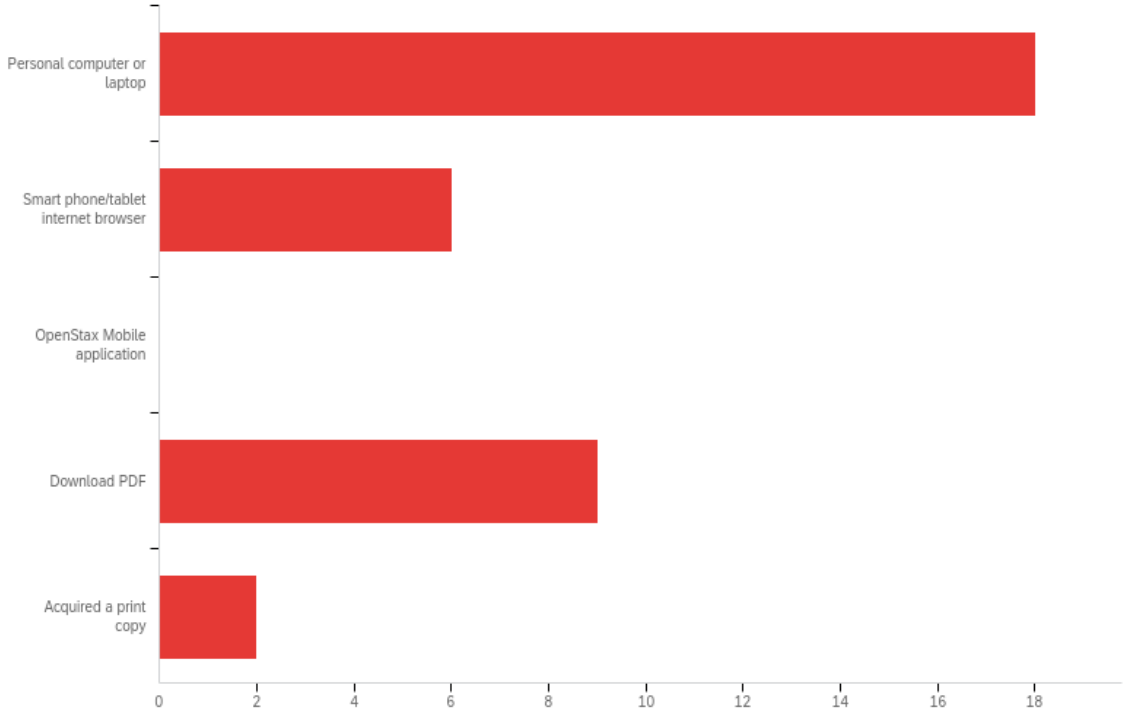
- CONS:
  - Simpler-looking design
  - No or limited collection of test questions and other materials
  - Offered slides are just figures from the textbook – need to adopt to course
  - Subject's order may be very different from the textbook used previously, may need to adjust
    - Quizzes and exams
    - Labs and their order

The textbook for this course is free and available through OpenStax. Because of this textbook adoption,



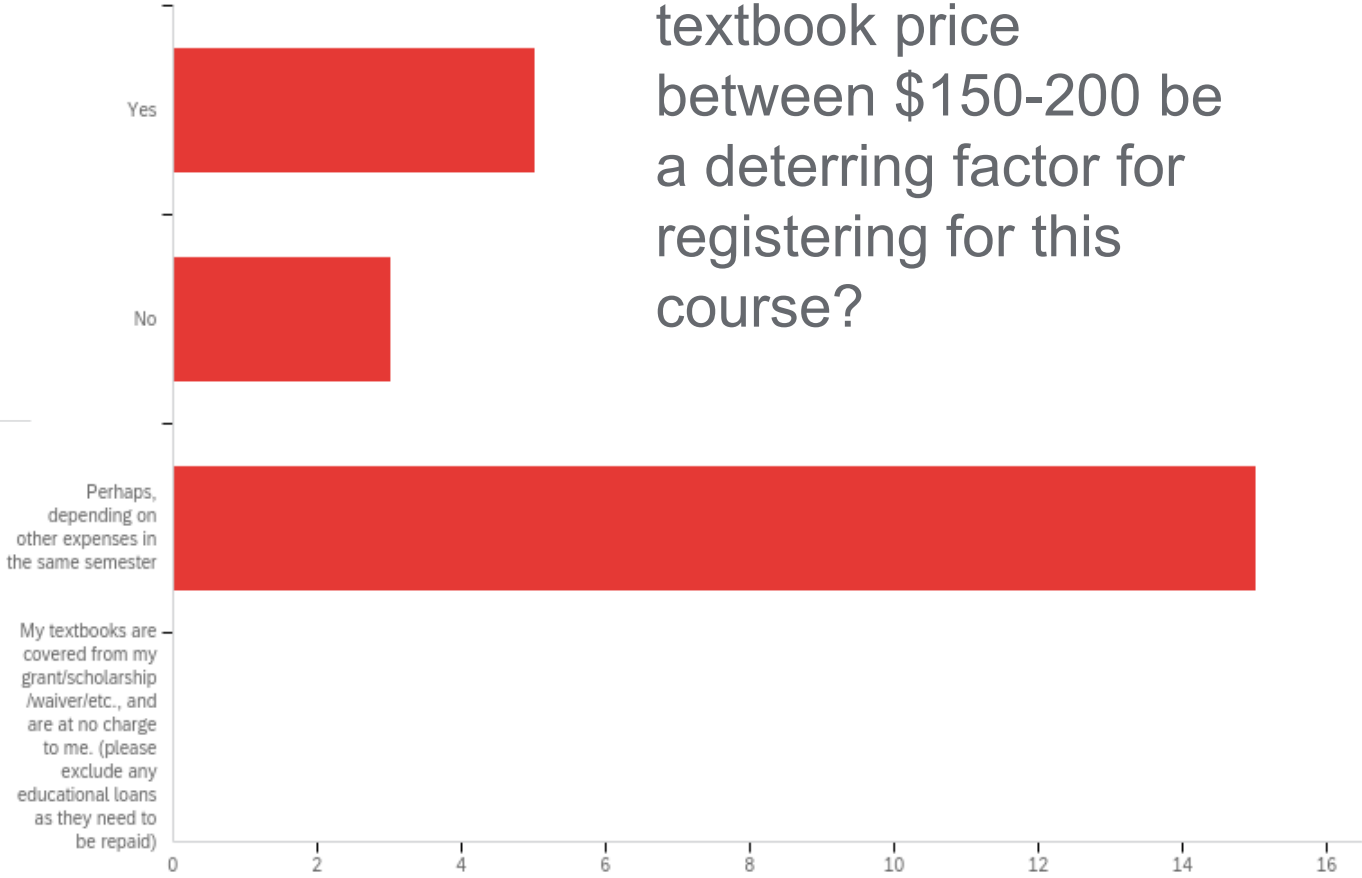
Comparing this book to traditional science books in previous courses, select the rating that best applies to your experience.





How did you access the course textbook? (Click all that apply)

Would the average textbook price between $150-200 be a deterring factor for registering for this course?



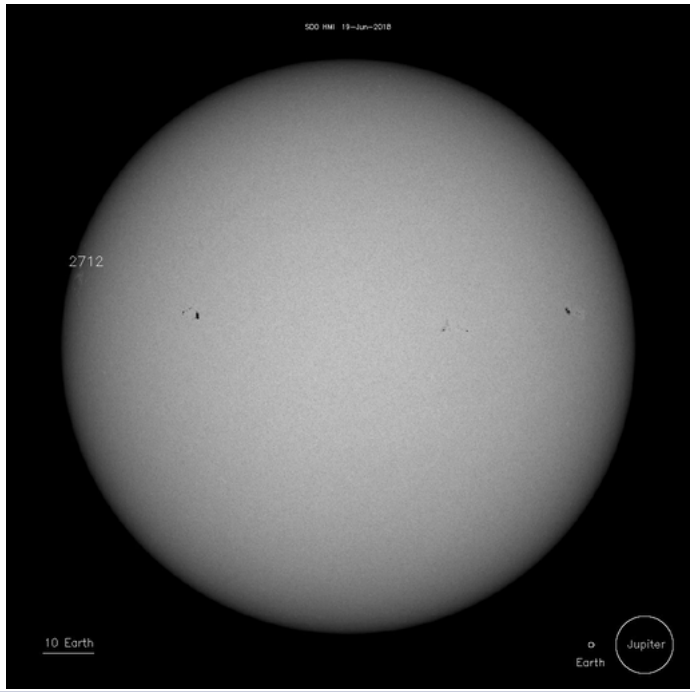
SOLAR ROTATION TOOL - FOR INTRODUCTORY ASTRONOMY OR GENERAL SCIENCE COURSE

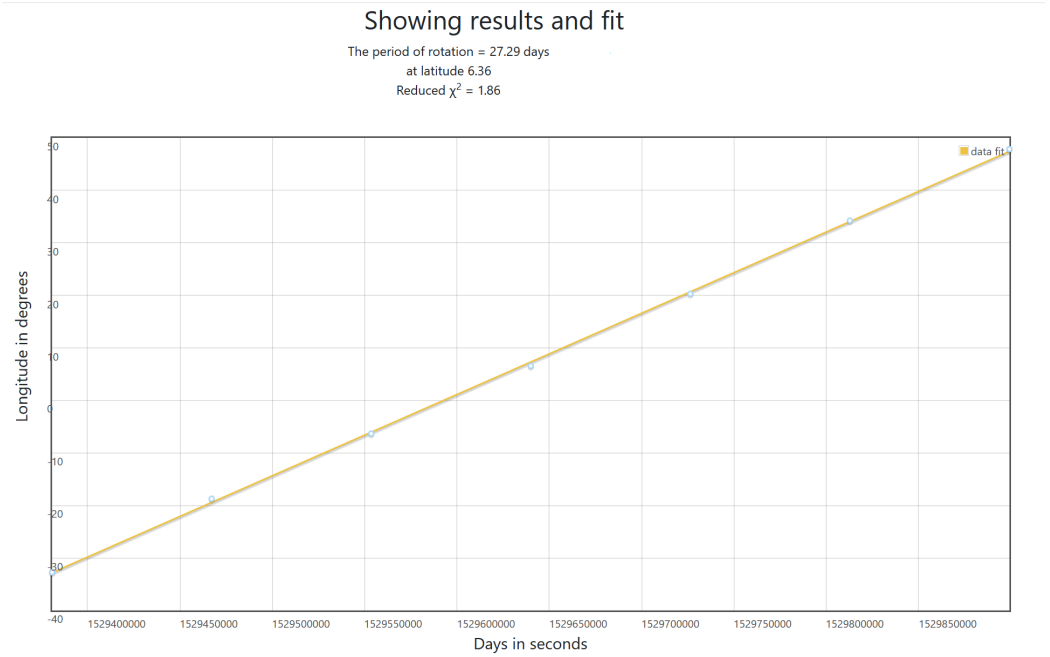
- Students search and download satellite images from a site like https://sohowww.nascom.nasa.gov/data/synoptic/sunspots_earth/

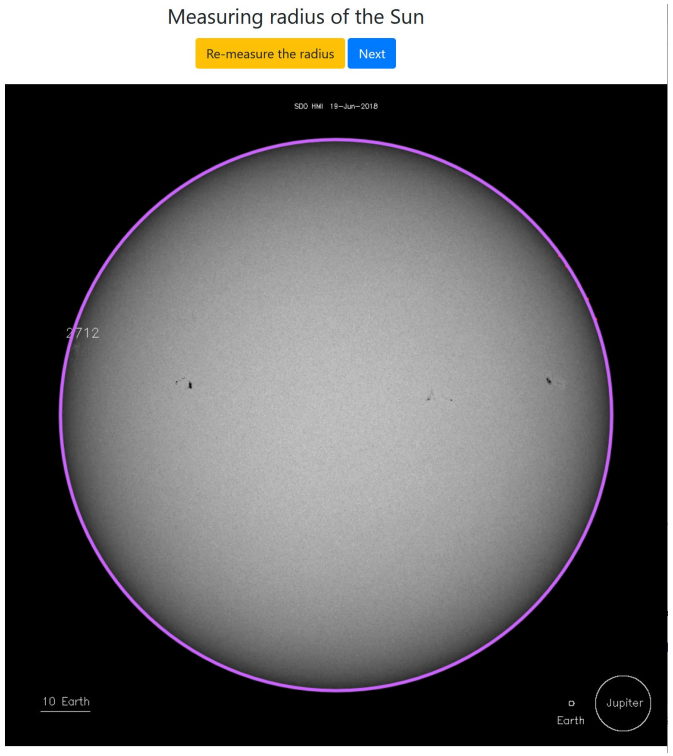
- Use the tool to measure
  - Rotation period
  - Sunspot latitude

- Open Educational Resource
  - Creative Commons **Attribution License** (CC BY)

https://github.com/aiakovlev/ASTR-1010-1020







ONLINE REPORTING TOOL FOR ASTRONOMY

- For introductory astronomy courses or similar
- Allows to enter the report in browser
- No need for any Office software or additional libraries
- Convert to pdf, submit resulting file
- ***Works on mobile devices***

  - Open Educational Resource
    - Creative Commons **Attribution License** (CC BY)

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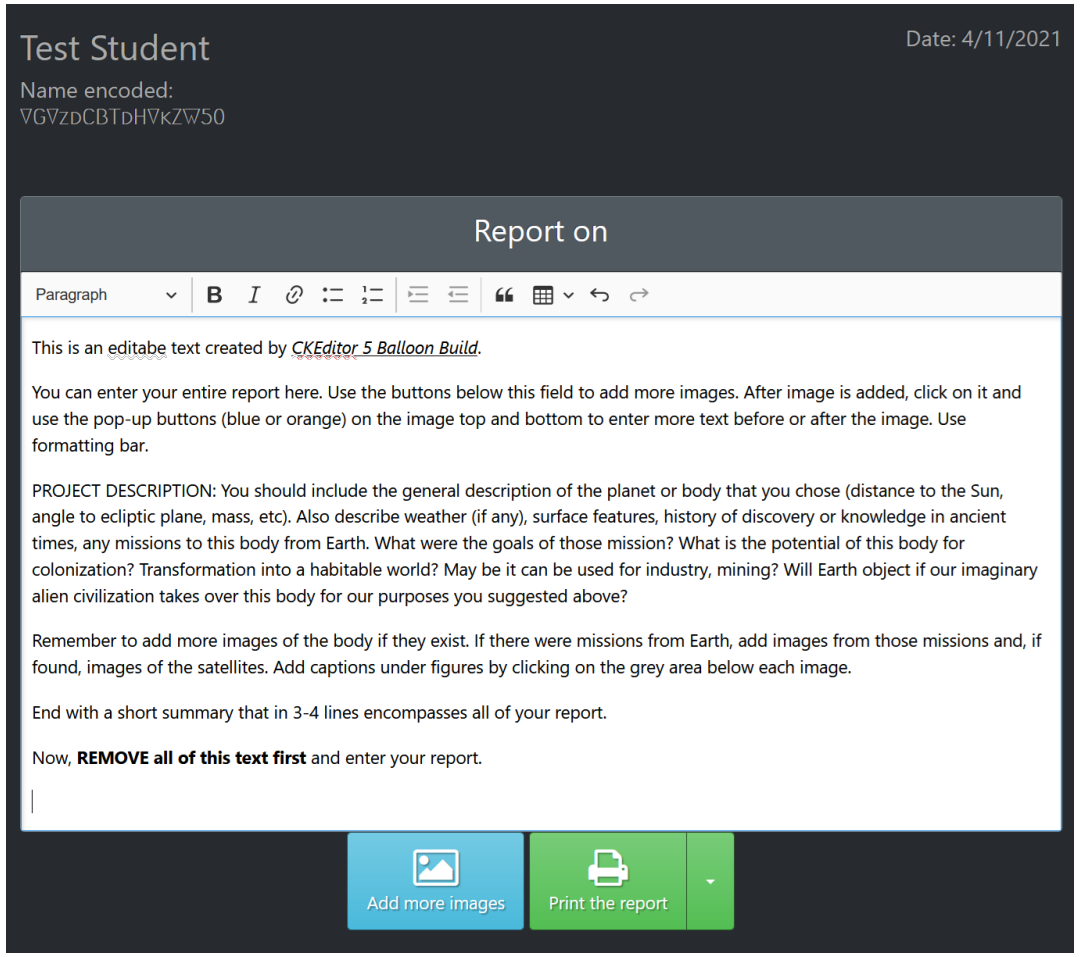
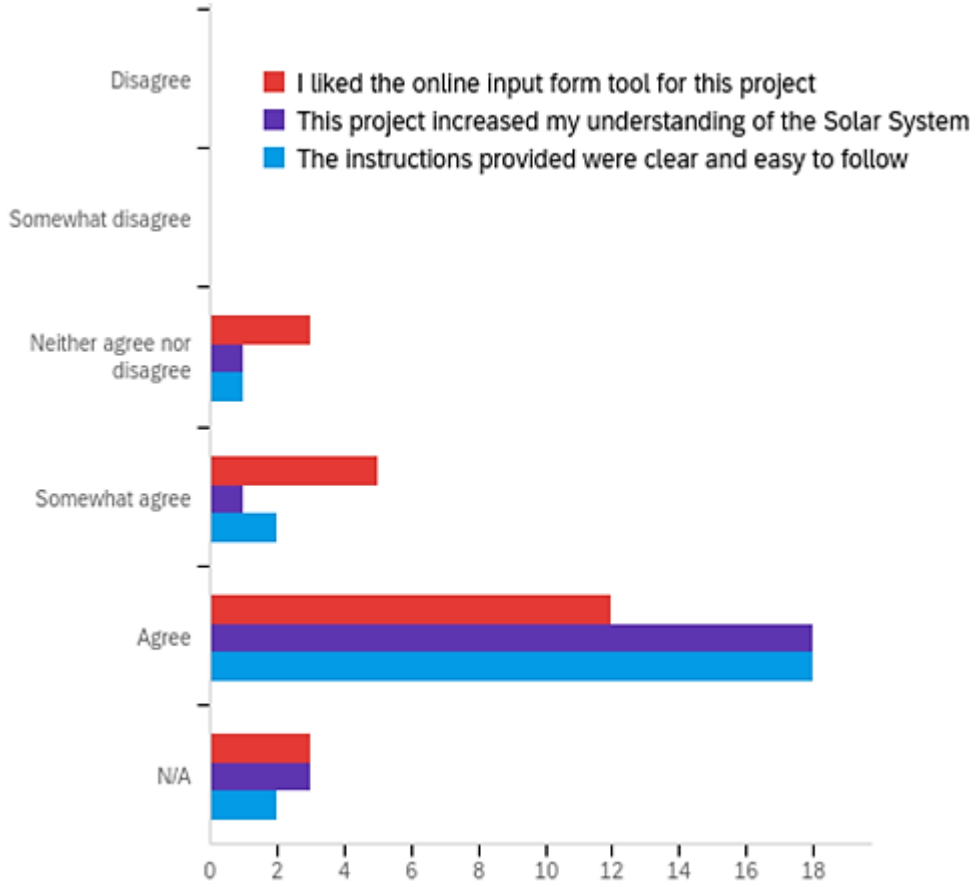
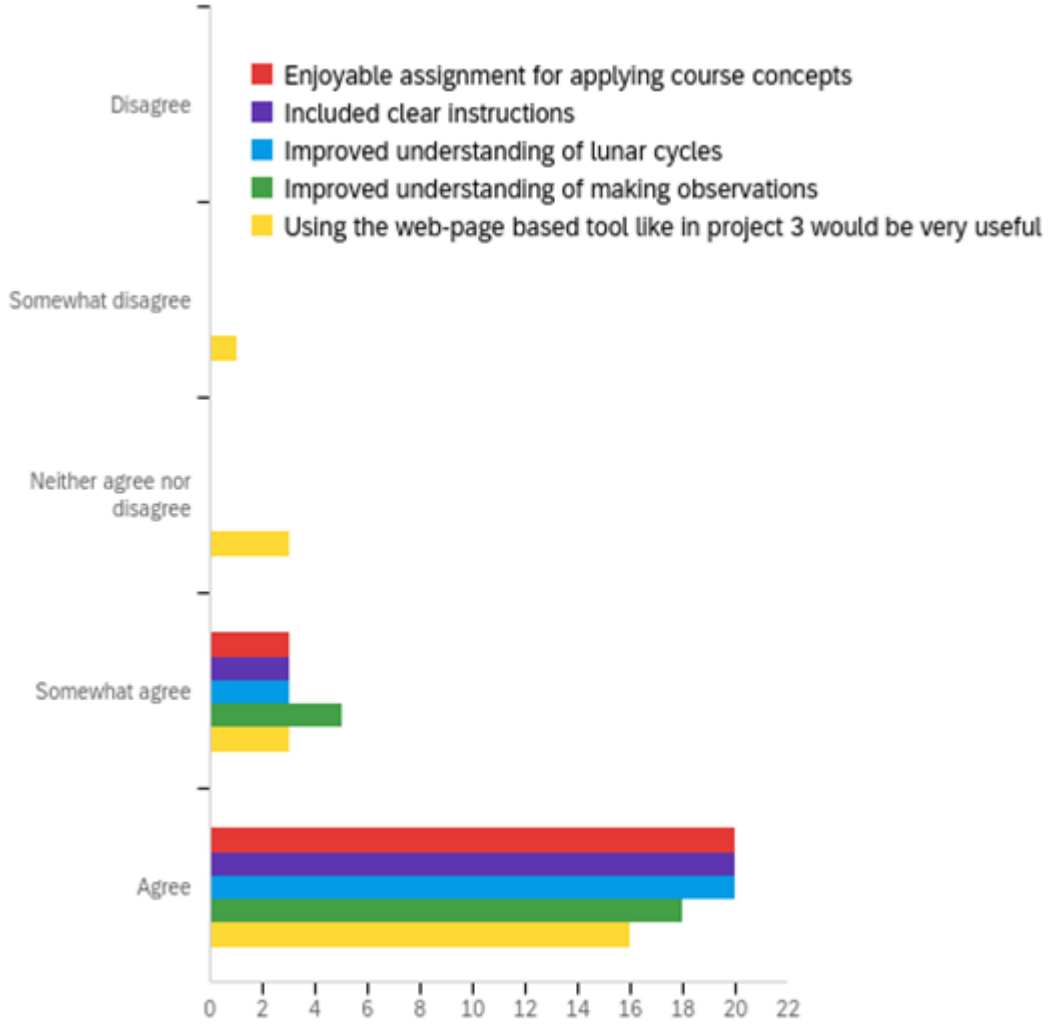


About a planet (N/A if word processing program was used instead)

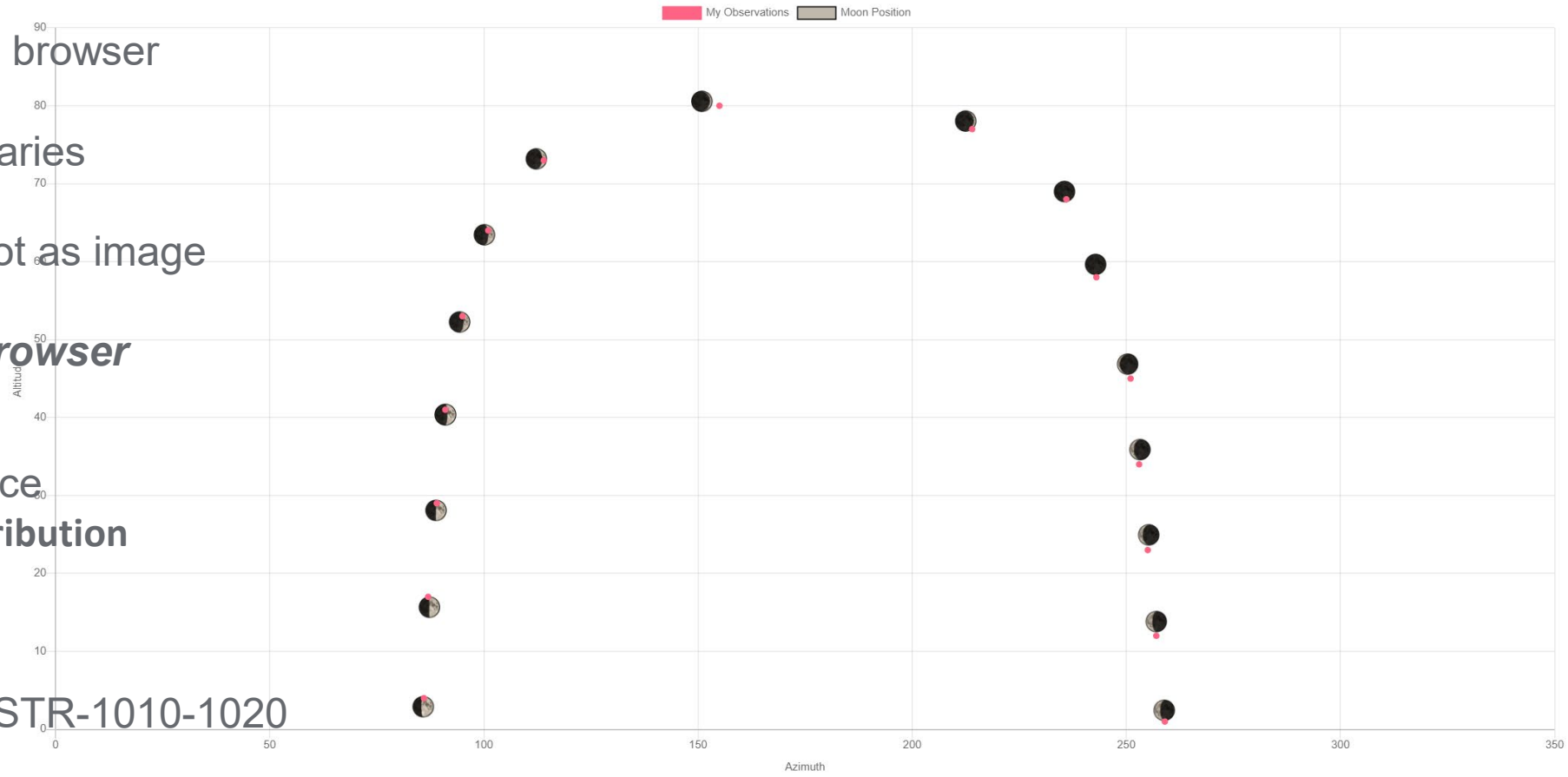


Observing the Moon



MOON OBSERVATION DATA LOGGER TOOL

- For introductory astronomy courses or similar
- Allows to enter the data in browser
- No need for additional libraries
- Allows to download the plot as image
- ***Keeps entered data in browser***
- Open Educational Resource
  - Creative Commons **Attribution License** (CC BY)



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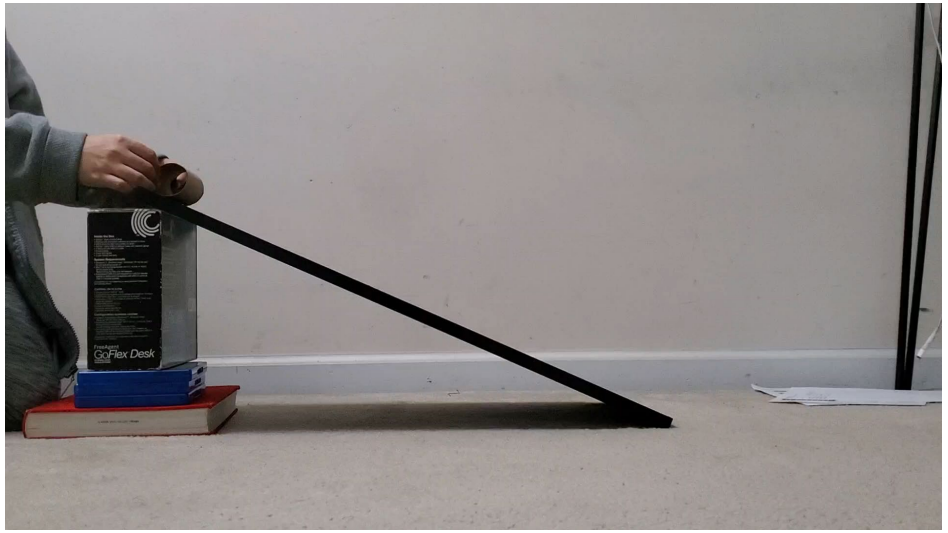
ADJUSTMENT OF PHYSICS LABS – ROLLING MOTION

- Direct instruction over the online conference software on procedures and data analysis steps or video with the instructions
- Laboratory manuals and supporting materials posted on class site, including several videos provided by an instructor
- Student options are
  - create your own video and analyze
  - use instructor provided video for the data analysis
- Tracker software (https://www.physlets.org/tracker/) can be used for labs in the Introductory Physics I and Principles of Physics I Laboratories for mechanics experiments.
- Analysis can be done at home for hybrid teaching mode (e.g. 50/50 at lab and online/at home)

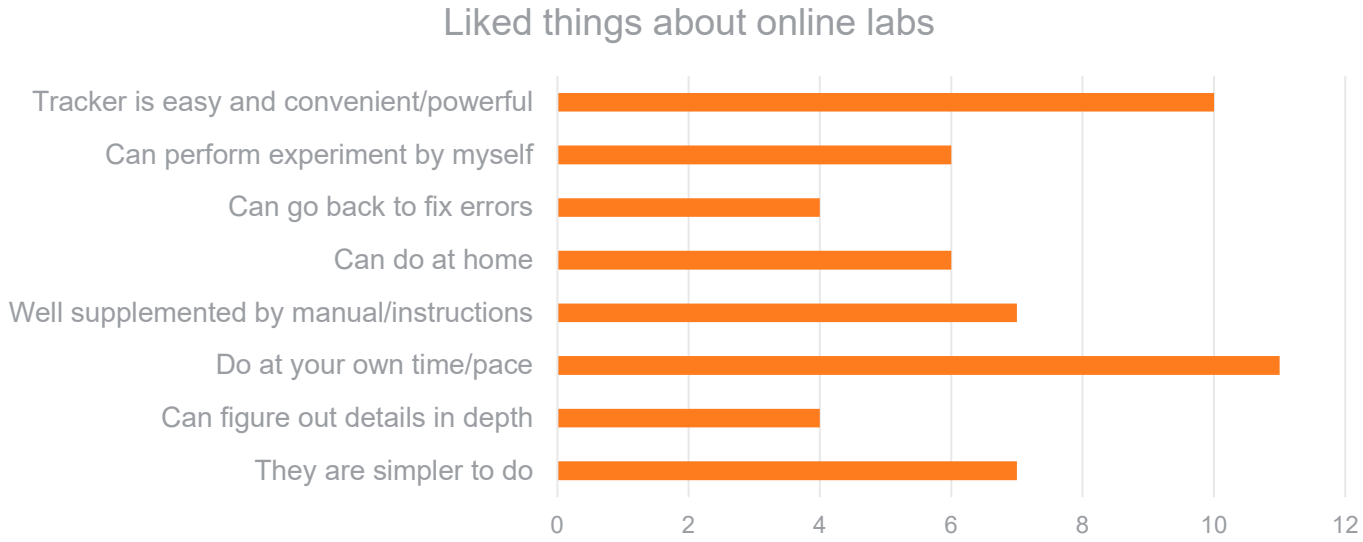
A video of rolling hollow cylinder produced by a student

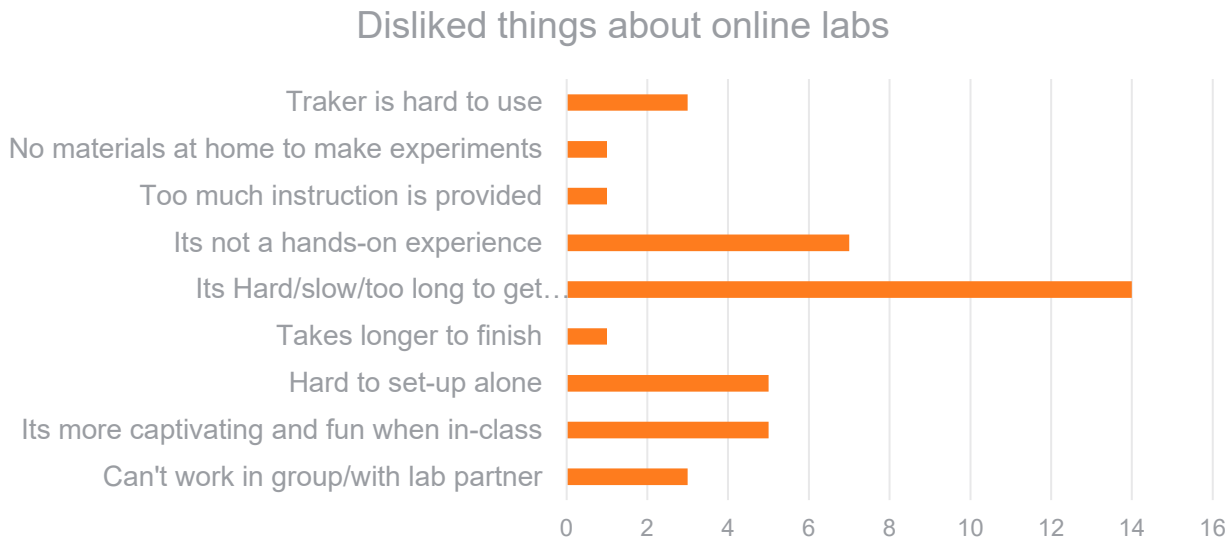


Summary		
	a^{exp} (m/s^2)	a^{th} (m/s^2)
Solid Sphere	1.659	1.918
Hollow Sphere	1.247	1.611
Solid Cylinder	1.628	1.790
Hollow Cylinder	1.087	1.342

SURVEY RESULTS ABOUT THE ONLINE LAB AND USE OF TRACKER

- Most students likes using Tracker, doing things at home and their own time and pace
- Most disliked thing was that its harder or much slower than during the class to get the support or question answered by the instructor





CONCLUSION

- The experience of the first semester has shown that
  - Students say that the free textbook is overall better in their opinion than other textbooks from their experience as a student
    - Other courses to be moved to a free textbook
  - Overall financial burden is reduced while textbook cost may not have been a strong deferring factor
  - Online reporting tools are generally liked (with very few students reporting technical difficulties – if they missed introduction to tool in class)
  - Online lab experiments are much preferred, and we will continue expanding this idea with a goal to introduce up to 50% of all lab experiments as ‘online’