A Radio Astronomy Design Project

Level	
High school	

Time Required	Lesson Summary
3.5- 50 min. class periods (175 min.)	During this lesson, students will be introduced to Radio astronomy and the telescopes which are used in the discipline. They will then be challenged to design a dish for a brand-new telescope.

Standards

NGSS

HS-PS4-1 Waves and their Applications in Technologies for Information Transfer. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Vocabulary	Objectives
Parabolic Array Interferometer Focal point	• Students will understand the importance and unique aspect of radio waves. • Students will understand how the Law of Reflection is used in parabolic radio telescopes.

Materials

- Small flashlight with a directed beam (enough for each group)
- Small flat mirrors
- Heavy-duty aluminum foil
- Markers
- protractors

- Student computers

Pre-Requisites
Students should understand the electromagnetic spectrum and radio frequencies.

Safety Considerations
Students should be careful using the flashlights. They should not shine them in anyone's eyes.

Pacing Notes
Day 1 – Radio astronomy video, reading, project introduction Day 2 – Student work Day 3 – Infographic creation Day 4- virtual gallery walk

Before the Lesson
Print enough background information sheets and project sheets for each student to have one. Make an infographic on Canva so you can help students will this task. Get out mirrors and lasers

Assessments	Classroom Instructions
Pre-Activity Assessments	**Introduction**
	As you are taking care of administrative tasks have students respond to this prompt. What is Radio Astronomy?
Activity Embedded Assessments	**Activities**
	1. Discussion After you are finished taking attendance ask for volunteers to

Collect and grade the background information sheet.	share their answers 2. Radio astronomy video Hand out the background information sheet. This page has questions that correspond to both the video and the reading. https://www.ted.com/talks/natasha_hurley_walker_how_radio_telescopes_show_us_unseen_galaxies?language=en (last accessed 9/12/23) 3. Radio astronomy reading Students can either read this individually, in small groups, or you can read it out loud. https://public.nrao.edu/telescopes/radio-telescopes/ (last accessed 9/12/23) 2 and 3 alternatives. If you would prefer to use direct instruction instead of the reading and video you may use the PowerPoint presentation.
Create a rubric and distribute on day one. Walk around and ask the following questions. What are you doing? Why did you make that choice? How are you helping your group? Do you have any questions?	4. Project introduction a. Hand out the project sheet. b. Read through the directions and go over the rubric. c. Demonstrate how to create an infographic It is important that the teacher has made an example of this project for themselves so they can confidently demonstrate how to use the app for the class. The Canva website (www.canva.com) is completely free for educators and students, integrates with classroom software, and will allow multiple students to collaborate on the same project if needed. Adobe Spark works similarly. Demonstrate how the students can choose a template based on how much data they are presenting. The presentation will need a title and the name of the author(s). Images from their research can be copied and pasted into their digital design. Existing images in their template will need adjusting, or deleting. Students should resize the finished project so that it appears attractive and complete. Finally, show students where to add their works cited. Citations do not have to be visible on the main page of the presentation.

Can you explain that to me? Walk from group to group asking the following. Do you have any questions? Do you know how to create an infographic? How are you dividing up the work? Who is in charge of the citation section?	d. Either assign students to groups or allow them to select their own group. The optimal group size is three students. 5. Student research a. Students should look at pictures of Radio Telescopes from across the planet b. They need to select one as the model for their project. 6. Conclusion Day 1 – Telescope selection Each group should identify which Radio telescope they are modeling their project on. Day 2 1. Student inquiry work Students should work in their groups on the project. Day 3 1. Student infographic creation a. Students should work on their presentation. b. When complete have the students add their work to the virtual space you are using for the gallery walk.

Post Activity Assessments	**Closure**
.Grade project according to the rubric.	**Day 4** 1. Virtual Gallery Walk a. Use a common space such as a Google folder to host the gallery walk. b. Disable students' ability to comment on their peer's work. c. Have students vote for the best project. d. If possible award prizes for the best projects before ending this project and moving on to the next thing.

Culturally Inclusive/Responsive Components

Article regarding a telescope built on Native Sacred Ceremonial Grounds https://www.nbcnews.com/news/asian-america/hawaiians-fight-mega-telescope-construction-sacred-ground-n293581 (last accessed 8/12/23)

Educator Resources

National Radio Astronomy Observatory https://public.nrao.edu/
Information about radio waves from NASA
https://www.nasa.gov/directorates/heo/scan/communications/outreach/funfacts/what_are_radio_waves

Acknowledgment

The creation of the lessons in this series was funded by a generous grant from the National Science Foundation (NSF). The lessons were created as part of the SpectrumX project at the National Radio Astronomy Observatory (NRAO).

Below is a list of the lesson titles included in the series. All lessons can be accessed from this web page, https://superknova.org/educational-resources/.

Middle School

Introduction to Satellites
Weather Predicting
Introduction to Radio Wave Communication
The Importance of Radio Astronomy
Cubesat Model Building
Understanding FM Radio
Radio Frequency Technology

Diffraction of Radio Waves

High School

The Uses of Radio Waves and Frequency Allocation
Is Radio Technology Safe?
Who Decides if You Get 5G?
Measuring Sea Surface Temperatures with Satellites
Marine Animal Tracking and Bathymetry
How to Design Your Own Crystal Radio
How Radio Waves Changed the World
Simple Wireless Communication
Seeing and Hearing the Invisible
Local Wireless Radio Frequency Communication
Investigating the Internet Connection
The Geometry of Radio Astronomy

Informal

Modeling Radio Astronomy