Lesson Plan
Wanda Diaz-Merced Hearing Stars

In this lesson plan students will learn about Stellar seismology, a technique that was developed by the astronomy Wanda Diaz-Merced.

Wanda Diaz-Merced is a blind astrophysicist that has developed a method of studying stars using sounds. After becoming blind during her studies, Diaz-Merced could develop a software that was able to take data from telescopes, which was traditionally made in visual graphs, and turn it into sounds. This software is called xSonify, and she has used to study many types of astronomical phenomena in her career. She mainly works in gamma ray bursts, and highly energetic events. Through listening to the stars, Diaz-Merced could determine that Gamma Ray bursts last long enough to hold resonance wavers. She has also worked in educational programs for the visually impaired. She works at the South African...
Observatory teaching visually impaired students radio astronomy in parallel with her research and advocacy.

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<tr>
<th>Instructions</th>
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<tbody>
<tr>
<td><strong>Engage: 15 Minutes</strong></td>
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<tr>
<td>Video on guessing sounds</td>
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<tr>
<td><strong>What is the teacher doing?</strong></td>
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<tr>
<td>Introducing the concept of the video and settling the students down so that they focus on the task at hand. This portion of the lesson plan will be graded on completion, not accuracy.</td>
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<tr>
<td><strong>What are the students doing?</strong></td>
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<tr>
<td>Writing down their answers the sounds as they appear, giving their best guess. Give the students to thing about each sound as they come up.</td>
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<tr>
<td>Explain after going over the answers how it is very difficult to learn things just from sounds. Start to inquire as to why Students think someone would ever try to learn about something purely from sounds. Flow into the next section</td>
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| **Explore: 15 Minutes** |
| Listen to Wanda Diaz-Merced’s Ted Talk |
| **What is the teacher doing?** |
| Playing Diaz-Merced’s talk and making sure the students are paying attention. Give them time to answer some discussion questions. |
| **What are the students doing?** |
| Learning about Wanda Diaz-Merced and taking notes on the discussion sheet about her work. |

| **Explain: 30 Minutes** |
| Read articles on xSonify and Gamma Ray Bursts. |
| **What is the teacher doing?** |
| Explain that Wanda Diaz-Merced’s Main work is dealing with Gamma Ray Bursts and how they work. Handing out the article and asking questions as they come up from the students. Making sure they are staying focused. If you are choosing to let the student work in groups, facilitate the separation off the groups and make sure everyone is staying on task. Make sure each group gets to BOTH articles and answer all the questions. |
| **What are the students doing?** |
| The students will be reading an article about the development of the xSonify software which Wanda Diaz-Merced used to analyze data from Gamma Ray Bursts. Then they will read an article about what a Gamma Ray Burst is, to better understand Diaz-Merced’s application of the software. |

| **Elaborate: 5 Minutes** |
Discuss the articles

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<th>What are the students doing?</th>
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<tr>
<td>Asking the students what they learned in the articles, going over the last few discussion questions</td>
<td>Discussing what they have learned in the class thus far about sonification and Wanda Diaz-Merced. Asking any further questions. Sharing what they found interesting or strange.</td>
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</table>

Evaluate:
The teacher can evaluate the students based on the completion of the discussion sheet, and the accuracy and depth of their answers.

**Required/Recommended Reading and Resources**

- Video to Guess Sounds: [https://www.youtube.com/watch?v=lZsssS_1_2Y](https://www.youtube.com/watch?v=lZsssS_1_2Y)
- Video on Stellar Sounds: [https://www.youtube.com/watch?v=IzeJq3CbiZM](https://www.youtube.com/watch?v=IzeJq3CbiZM)
- Article on Gamma Ray Bursts:
  - Christopher Crockett, *what are Gamma Ray Bursts?* Earthsky.org, October 14, 2013
- Article on xSonify:
- Wanda Diaz-Merced’s ted talk:
  - [https://www.youtube.com/watch?v=wbtLTCA1Qd4](https://www.youtube.com/watch?v=wbtLTCA1Qd4)

**Discussion Questions**
Discussion Questions can be found as a Handout with a corresponding Answer Key in the Supplemental Materials to this lesson plan.

1. What are the sounds in the video? (In order!)
2. Was Diaz-Merced always blind? How old was she when she went blind?
3. Why does Wanda Diaz-Merced emphasize that the assistive technology she uses is free?
4. What does the pitch of the sound indicate about the object being observed?
5. What us the difference between audification and sonification?
6. What is a Coronal Mass Ejection?
7. When scientists were trying to find when they discover GRBs (Gamma Ray Bursts)?
8. What is a hypernova and how does it relate to GRBs?
9. Name and explain the 2 different projects the xSonify software was used on.
10. What is the approximation method used to formulate the data into sound?

**Further Reading and Additional Resources**
### Extensions

Related AIP Teacher’s Guides on Women and Minorities in the Physical Sciences:
- Teaching Guide title

### Common Core Standards


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<th>Reading: Literature</th>
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<tr>
<td>CCSS.ELA-LITERACY.RL.11-12.6</td>
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<th>Reading: Informational Text</th>
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<tr>
<td>CCSS.ELA-LITERACY.RI.9-10.3</td>
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<tr>
<td>CCSS.ELA-LITERACY.RI.9-10.4</td>
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<tr>
<td>CCSS.ELA-LITERACY.RI.9-10.6</td>
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<td>CCSS.ELA-LITERACY.RI.9-10.7</td>
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<tr>
<td>CCSS.ELA-LITERACY.SL.9-10.3</td>
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<td>CCSS.ELA-LITERACY.L.9-10.6</td>
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and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

### History/Social Studies

| CCSS.ELA-LITERACY.RH.9-10.9 | Compare and contrast treatments of the same topic in several primary and secondary sources. |
| CCSS.ELA-LITERACY.RH.9-10.2 | Determine the central ideas or information of a primary or secondary source; provide an accurate summary of how key events or ideas develop over the course of the text. |

### Science & Technical Subjects

| CCSS.ELA-LITERACY.RST.9-10.1 | Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. |
| CCSS.ELA-LITERACY.RST.9-10.2 | Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. |
| CCSS.ELA-LITERACY.RST.9-10.4 | Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics. |
| CCSS.ELA-LITERACY.RST.9-10.6 | Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. |
| CCSS.ELA-LITERACY.RST.9-10.7 | Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. |

### Subject Writing

| CCSS.ELA-LITERACY.WHST. | |

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### Next Generation Science Standards


| Dimension One: Practices | |
| Dimension Two: Crosscutting Concepts | |
| Dimension Three: Disciplinary Core Ideas | Core Idea |

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Prepared by the Center for the History of Physics at AIP