

## Lesson Plan Conflict on High



*Kitt Peak National Observatory  
Image Credit: Victoria DiTomasso*

**Grade Level(s): 9+**

**Subject(s): Astronomy, Contemporary**

**In-Class Time: 70-120 Minutes**

**Prep Time: 15-20 Minutes**

“Explore” section can be assigned as homework to limit in-class time.

### Materials

- Copies of the Supplemental Materials:
  - KPNO Tohono O’odham Webpage
  - Excerpt from “Somewhere Touching Earth to Sky”
  - Discussion Questions
- Internet access for student research, either at school or at home
- (Optional) PowerPoint and projection capabilities

### Objective

In this lesson, students will learn about the conflicts that can arise between the astronomical and local communities over the construction of telescopes. They will read two sources about the conflict and resolution between Native Americans and astronomers over the construction of telescopes on Kitt Peak in Arizona. They will analyze the bias in these two sources. Then they will research and present the various aspects of the conflict between native Hawaiians and astronomers over the construction of the Thirty Meter Telescope on the peak of Mauna Kea on the island of Hawaii. They will debate about the possible solutions to the unresolved conflict at Mauna Kea.

## Introduction

Astronomy is built around melding theory and observations of space. There is a constant push and pull between the theory that has been developed and the observations that can be obtained using contemporary technology. Over time, astronomers advance the quality and resolution of their observations by building bigger telescopes in darker places with less atmospheric interference. Space telescopes are ideal because the light does not have to travel through Earth's atmosphere and is therefore far less distorted. Space telescopes, however, are extremely expensive and complicated to construct. The alternative is building telescopes on Earth, referred to as ground-based telescopes. These telescopes can be made larger, but their placement is key to their success. For over a hundred years, astronomers have been seeking out the highest, darkest, least atmospherically turbulent places on Earth at which to construct these large telescopes. Conflict often arises over the construction of telescopes because these areas tend to be prime areas for religious worship and belief.

This lesson plan focuses on two such conflicts: one at Kitt Peak outside of Tucson, Arizona, the other at Mauna Kea on the island of Hawaii. Students will read two sources about the conflict and resolution between the astronomical community and the Apache over use of land at Kitt Peak. These sources present two different points of view regarding the resolution: one from the Kitt Peak National Observatory (KPNO) website, that presents the outcome as fair to both parties; the other, from the senior thesis of an Urban Studies student, suggests that the final agreement favors that astronomers and belittles the beliefs and requests of the Apache people. Through the analysis of these two documents, students will be introduced to this conflict and think critically about each source's biases.

After an introduction to the Kitt Peak conflict and an exercise in bias identification, students will investigate the ongoing conflict at Mauna Kea, Hawaii. Astronomers set their sights on Mauna Kea for telescope construction in the 1950s. There are currently 13 working telescopes near the summit of the mountain. The current controversy centers on the construction of the Thirty Meter Telescope (TMT). The construction of this telescope has been repeatedly halted by lawsuits and protests from native Hawaiians. One motivation for their dissent is that Mauna Kea holds religious significance to the native people and is used as a burial ground. Further construction on the mountain will continue to disrupt this sacred site. Additionally, some Hawaiians see it as continued oppression. They do not think that the way the United States acquired Hawaii was legitimate and they want Hawaiians to have more control over their land, if not complete autonomy. There are also ecological concerns over how the construction and use of these telescopes is affecting the natural resources of the island.

The counterarguments to the Hawaiian dissent rest in the scientific value of the TMT. It would be the largest telescope on Earth and allow astronomers to observe astronomical objects that were previously beyond their reach. The location at Mauna Kea is ideal because of its high altitude, dark skies and minimal air turbulence. Astronomers have also made concessions about the new telescope, changing its planned location so that it would be less visible from the island, pledging to donate money to STEM education on the island and pay a greater lease for the land than was accounted for in previous telescope agreements. Students will do their own research into all these aspects of the conflict at Mauna Kea. After presenting their findings to the class, the students will debate the issue, discussing possible outcomes and what they think are possible solutions. Optionally, they could then write up a proposal arguing for their preferred solution.

**Instructions**

**Engage: 20-25 Minutes**

In this section, students will learn about the historical conflict between Native Americans and the astronomical community over the construction of telescopes at Kitt Peak in Arizona. They will be prompted to consider the fairness of the outcome of this conflict.

**What is the teacher doing?**

Give the students a brief introduction to what observatories are and what they are used for. Briefly tell them about Kitt Peak National Observatory, where it is and why it was formed.

Give out copies of the KPNO's webpage about the Tohono O'odham, copies of Excerpt from "Somewhere Touching Earth to Sky," and copies of the Discussion Questions (all found in the Supplemental Materials). Students will read the two documents and complete the handout.

Conduct a class discussion about the two documents that the students read. Talk about their answers to the Discussion Questions. Answer any questions that the students may have about the basis of the conflict between astronomers and the Tohono O'odham.

**What are the students doing?**

Listen as the teacher introduces them to observatories and KPNO in particular.

Receive copies of the KPNO's webpage about the Tohono O'odham and copies of Excerpt from "Somewhere Touching Earth to Sky." Read both of these documents and complete the Discussion Questions handout.

Participating in the discussion about astronomer/Tohono O'odham relations surrounding KPNO.

**Explore: 5-45 Minutes**

In groups, students will research the various aspects of the ongoing conflict on the Island of Hawaii between the native Hawaiian and astronomical communities over the construction of the Thirty Meter Telescope. They will prepare a short presentation on their issue to present to the class. **This section could be assigned as homework, depending on class time and student resources inside and outside of the classroom.** If research and presentations are assigned as homework, students should be given a few minutes in class to plan with their group members.

**What is the teacher doing?**

Divide the class into six groups. Assign each group one of the following aspects of the conflict in Hawaii over the use of Mauna Kea by the astronomical community.

1. History of the United States acquisition of Hawaii
2. Native Hawaiian beliefs surrounding the mountain
3. History of agreements over astronomical use of the mountain
4. Astronomical value of the location

**What are the students doing?**

Using a computer with internet access, research, in groups, their assigned issue.

<p>5. Ecological, economic and scientific impacts of currently operating telescopes at Mauna Kea</p> <p>6. Current proposal for construction</p> <p>See the Required/Recommended Readings for a few suggested sources to start off student research. As this is an ongoing conflict, encourage students to pay attention to when their sources were published and to seek out recent sources.</p>	
<p>Prompt the students, in their groups, to create a presentation of their aspect of the conflict at Mauna Kea. They should make an accompanying PowerPoint if possible.</p>	<p>Create a presentation, with PowerPoint if possible, about their assigned aspect of the conflict.</p>

**Explain: 30 Minutes**

<p>In groups, students will present their particular aspect of the conflict at Mauna Kea to the rest of the class. As groups present, one or more note takers should keep track on the board of the variety of standpoints involved in this conflict.</p>							
<p><b>What is the teacher doing?</b></p> <p>Direct the students to give presentations on their topic in the order listed in the Explore section above.</p> <p>Select a student to be a note taker. After each presentation, the note taker should write the point(s) of view associated with each aspect of the conflict and indicate whether that point of view supports the construction of the TMT or not. For example:</p> <table border="1" data-bbox="203 1381 795 1631"> <thead> <tr> <th data-bbox="203 1381 500 1455">For TMT construction</th> <th data-bbox="500 1381 795 1455">Against TMT construction</th> </tr> </thead> <tbody> <tr> <td data-bbox="203 1455 500 1528">Good observations from the mountain</td> <td data-bbox="500 1455 795 1528">Violates native religious beliefs</td> </tr> <tr> <td data-bbox="203 1528 500 1631">Economically beneficial for the area</td> <td data-bbox="500 1528 795 1631">Continues a history of American dominance in Hawaii</td> </tr> </tbody> </table>	For TMT construction	Against TMT construction	Good observations from the mountain	Violates native religious beliefs	Economically beneficial for the area	Continues a history of American dominance in Hawaii	<p><b>What are the students doing?</b></p> <p>With their group, present their aspect of the conflict to the class. Pay attention to their classmate’s presentations.</p> <p>If chosen as the note taker, keep track on the board of the various points of view and pros/cons of this issue.</p>
For TMT construction	Against TMT construction						
Good observations from the mountain	Violates native religious beliefs						
Economically beneficial for the area	Continues a history of American dominance in Hawaii						

**Elaborate: 15-20 Minutes**

<p>As a class, students will debate about possible outcomes for the conflict at Mauna Kea.</p>	
<p><b>What is the teacher doing?</b></p> <p>Leading the students in a debate over the conflict at Mauna Kea. You may go through the list that the note taker wrote on the board in the</p>	<p><b>What are the students doing?</b></p> <p>Debate about possible outcomes for the conflict at Mauna Kea and discuss the different points of view in the conflict with the class in an attempt to design</p>

<p>“Explain” portion of this lesson to prompt thorough discussion and get the students to think about the best ways to address each aspect of the conflict.</p>	<p>the best solution for all aspects of the issue.</p>
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**Evaluate:**

Students can be evaluated on their presentations and participation in the class debate. Optionally, students can write and submit a proposal for what they think should be done at Mauna Kea.

**Required/Recommended Reading and Resources**

Required Reading

- [https://www.noao.edu/outreach/kptour/kpno\\_tohono.html](https://www.noao.edu/outreach/kptour/kpno_tohono.html) (see KPNO Tohono O’odham Webpage document in the Supplemental Materials)
- Suwalsky, J. A. (2005). *Somewhere Touching Earth to Sky: The Lease of Kitt Peak and the Intersections of Citizenship, Science, and the Cultural Landscape*. New York, NY: Barnard College. (see Excerpt from “Somewhere Touching Earth to Sky” in the Supplemental Materials)

Recommended Resources for Research in the Explore Section

- Altemus-Williams, I. (2015, May 5). Hawaii’s Mauna Kea protectors aim to halt TMT construction on sacred mountain. Retrieved July 21, 2016, from <http://wagingnonviolence.org/feature/hawaiis-mauna-kea-protectors-aim-to-halt-tmt-construction-on-sacred-mountain/>
- Fox, C. (2015, April 13). Everything You Need To Know About The Viral Protests Against A Hawaii Telescope. Retrieved July 21, 2016, from [http://www.huffingtonpost.com/2015/04/13/hawaii-telescope-protests-tmt-mauna-kea\\_n\\_7044164.html](http://www.huffingtonpost.com/2015/04/13/hawaii-telescope-protests-tmt-mauna-kea_n_7044164.html)
- Witze, A. (2015, September 29). The mountain-top battle over the Thirty Meter Telescope. *Nature*. Retrieved July 21, 2016, from <http://www.nature.com/news/the-mountain-top-battle-over-the-thirty-meter-telescope-1.18446>
- Worth, K. (2015, February 20). World’s Largest Telescope Faces Opposition from Native Hawaiian Protesters. *Scientific American*. Retrieved July 21, 2016, from <http://www.scientificamerican.com/article/world-s-largest-telescope-faces-opposition-from-native-hawaiian-protesters/>

**Discussion Questions**

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

1. Who wrote/produced/published each document?
2. Who is the intended audience?
3. What is the tone of each document?
4. What information is included in one document and not the other? Why do you think this is?
5. What points of view on this conflict are missing from these documents?

6. Can you think of any aspects of this conflict that might not be addressed in either of these documents?

### Further Reading and Additional Resources

More resources about Kitt Peak:

- “Indigenous Peoples’ Human Rights Project: Tohono O’odham.” 2003, Indigenous Peoples Human Rights Project. Online Source: <http://www.hrusa.org/indig/reports/Tohono.pdf>
- National Optical Astronomy Observatory. (n.d.). Retrieved July 20, 2016, from <https://www.noao.edu/kp50/>
- Resources for Astronomy Outreach Providers and Teachers of Native Americans. (n.d.). Retrieved July 20, 2016, from <https://www.noao.edu/education/nativeamerican/ton.php>

Readings about a similar conflict at Mount Graham, AZ between the astronomical community and the Apache:

- Mount Graham. (2013). Retrieved July 20, 2016, from <http://sites.coloradocollege.edu/indigenoustraditions/sacred-lands/mount-graham/>
- Mt. Graham Telescope Project and the University of Minnesota Social Concerns Committee Position Report, March 2002. Social Concerns Committee, University Senate. The University of Minnesota. Online Source: <http://usenate.umn.edu/soccon/mountgraham.html>
- The Land and Its People. (n.d.). Retrieved July 20, 2016, from <http://www.sacredland.org/index.html?p=454.html>

### Extensions

N/A

### Common Core Standards

For more information on Common Core Standards, visit <http://www.corestandards.org/>.

Reading: Informational Text	
CCSS.ELA-LITERACY.RI.9-10.1	Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.RI.9-10.6	Determine an author's point of view or purpose in a text and analyze how an author uses rhetoric to advance that point of view or purpose.
CCSS.ELA-LITERACY.RI.9-10.8	Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.
CCSS.ELA-LITERACY.RI.11-12.1	Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
CCSS.ELA-LITERACY.RI.11-12.6	Determine an author's point of view or purpose in a text in which the rhetoric is particularly effective, analyzing how style and content contribute to the power, persuasiveness or beauty of the text.
CCSS.ELA-LITERACY.RI.11-12.7	Integrate and evaluate multiple sources of information presented in

	different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
<b>Speaking &amp; Listening</b>	
CCSS.ELA-LITERACY.SL.9-10.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
CCSS.ELA-LITERACY.SL.9-10.2	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
CCSS.ELA-LITERACY.SL.9-10.3	Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.
CCSS.ELA-LITERACY.SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
CCSS.ELA-LITERACY.SL.9-10.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
CCSS.ELA-LITERACY.SL.11-12.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
CCSS.ELA-LITERACY.SL.11-12.2	Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
CCSS.ELA-LITERACY.SL.11-12.3	Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.
CCSS.ELA-LITERACY.SL.11-12.4	Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.
CCSS.ELA-LITERACY.SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
<b>History/Social Studies</b>	
CCSS.ELA-LITERACY.RH.9-10.1	Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.
CCSS.ELA-LITERACY.RH.9-10.6	Compare the point of view of two or more authors for how they treat the same or similar topics, including which details they include and



	emphasize in their respective accounts.
CCSS.ELA-LITERACY.RH.9-10.8	Assess the extent to which the reasoning and evidence in a text support the author's claims.
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.11-12.1	Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.
CCSS.ELA-LITERACY.RH.11-12.6	Evaluate authors' differing points of view on the same historical event or issue by assessing the authors' claims, reasoning, and evidence.
CCSS.ELA-LITERACY.RH.11-12.8	Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.
CCSS.ELA-LITERACY.RH.11-12.9	Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.
Science & Technical Subjects	
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.9-10.8	Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
CCSS.ELA-LITERACY.RST.9-10.9	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
CCSS.ELA-LITERACY.RST.11-12.6	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
CCSS.ELA-LITERACY.RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
CCSS.ELA-LITERACY.RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Subject Writing	
CCSS.ELA-LITERACY.WHST.9-10.1	Write arguments focused on <i>discipline-specific content</i> .
CCSS.ELA-LITERACY.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
CCSS.ELA-LITERACY.WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject



	under investigation.
CCSS.ELA-LITERACY.WHST.9-10.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
CCSS.ELA-LITERACY.WHST.9-10.9	Draw evidence from informational texts to support analysis, reflection, and research.
CCSS.ELA-LITERACY.WHST.11-12.1	Write arguments focused on <i>discipline-specific content</i> .
CCSS.ELA-LITERACY.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
CCSS.ELA-LITERACY.WHST.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
CCSS.ELA-LITERACY.WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
CCSS.ELA-LITERACY.WHST.11-12.9	Draw evidence from informational texts to support analysis, reflection, and research.

### Next Generation Science Standards

For more information on the Next Generation Science Standards, visit <http://www.nextgenscience.org/>.

<a href="#">Dimension One: Practices</a>	6. Constructing explanations (for science) and designing solutions (for engineering) 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information
<a href="#">Dimension Two: Crosscutting Concepts</a>	2. Cause and effect: Mechanism and explanation 7. Stability and change
<a href="#">Dimension Three: Disciplinary Core Ideas</a>	Core Idea ESS3.C: Human Impacts on Earth Systems Core Idea ETS2: Links among Engineering, Technology, Science, and Society