Unheard Voices, Part 1: The Astronomy of Many Cultures
A Resource Guide by Andrew Fraknoi (Foothill College)

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The teaching of astronomy in our colleges and high schools often sidesteps the contributions of cultures outside of Europe and the U.S. mainstream. Few educators (formal or informal) receive much training in this area, and they therefore tend to stick to people and histories they know from their own training -- even when an increasing number of their students or audiences might be from cultures beyond those familiar to them.

Luckily, a wealth of material is slowly becoming available to help celebrate the ideas and contributions of non-western cultures regarding our views of the universe.

Sponsored by the Higher Education Working Group within the NASA Science Mission Directorate, this listing of resources about cultures and astronomy makes no claim to be comprehensive, but simply consists of a range of English-language materials that can be used both by educators and their students/audiences. We include formally published and web-based materials, as well as videos and classroom activities.

While we have divided most of the guide by culture, for those just beginning their investigation, some of the general resources in the first section may be the best place to start. A separate guide to the contributions of women in astronomy is available. Suggestions for additions are welcome; please send them to the author at: <fraknoi [at] fhda.edu>.

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The Temple of the Sun at Dzibilchaltun in Yucatan, Mexico. The sun has risen on the spring equinox. On this day the Temple of the Sun frames exactly the rising sun. (Image Credit: Jim Spadaccini, Ideum)
1. General Resources on the Astronomy of Different Cultures

Published Materials:

A quick overview.

Aveni, Anthony Conversing with the Planets. 1992, Times Books. Celebrates the traditions of many cultures; emphasizes the importance of seeing them in their own context.


Gleiser, Marcelo The Dancing Universe: From Creation Myths to the Big Bang. 1997, Dutton/Penguin. An exploration by a physicist of ideas from many cultures of how the universe came to be, including ancient legends and modern science.

Hadingham, Evan Early Man and the Cosmos. 1984, Walker & Co. A clear primer on the subject of ancient sites and the astronomical thinking of ancient cultures around the world.


Walker, Christopher, ed. Astronomy Before the Telescope. 1996, St. Martin’s Press. 17 essays on how people observed and interpreted the sky before modern instruments.


Websites and Articles on the Web:

Ancient Observatories, Timeless Knowledge from the Stanford Solar Center (An introduction to ancient sites where the movements of celestial objects were tracked over the years, with a special focus on tracking the Sun.): http://solar-center.stanford.edu/AO/
Astronomy Before History by Clive Ruggles and Michael Hoskin (from the Cambridge Concise History of Astronomy) -- a nice pdf file with a well-written introduction to ancient astronomy:
http://assets.cambridge.org/052157/2916/sample/0521572916web.pdf

The Center for Archaeoastronomy at the University of Maryland (Good site to learn more about the serious study of the astronomical relics of ancient cultures; some parts for the public, some for professionals in the field): http://www.wam.umd.edu/~tlaloc/archastro/

Cultural Astronomy Web Exhibit (Modules and resources on many cultures that have an astronomical tradition, created with the assistance of Chicago's Adler Planetarium): http://ecuip.lib.uchicago.edu/diglib/science/cultural_astronomy/

An Introduction to Archaeoastronomy (Clive Ruggles' 2003 Introductory Course Notes and Images at the University of Leicester): http://www.le.ac.uk/archaeology/rug/aa/a3015/index.html

Multicultural Cosmology Education Resource Center at Pomona College (Bryan Penprase and his collaborators have made this useful introductory site, which includes a world atlas of ancient astronomy, course outlines, a timeline and links to other resources): http://www.astronomy.pomona.edu/archeo/intro.html

Heritage Sites of Astronomy and Archaeoastronomy in the Context of the World Heritage Convention (a full report on how to preserve important sites in the history of astronomy around the world, with examples from many cultures):
http://www2.astronomicalheritage.net/index.php/thematic-study-content

Orion by Philip Glass (a musical composition created for the 2004 Olympics which is based on the mythology of Orion in a variety of cultures from around the world):

Solar Folklore from the Stanford Solar Center (Myths and legends about the Sun from cultures around the world): http://solar-center.stanford.edu/folklore/

Traditions of the Sun (The NASA Sun-Earth Connection Education Forum site offers virtual visits to astronomical sites and Chaco Canyon placed in appropriate historical, cultural, and scientific contexts): http://www.traditionsofthesun.org/

The Dec. 2007 issue of the Journal for Geoscience Education was devoted to broadening participation in the earth sciences: http://www.nagt.org/nagt/jge/abstracts/dec07.html

Classroom Activities:

Indiana Jones and the Astronomy of Yore (Issue of the Astronomical Society of the Pacific newsletter on teaching astronomy, by Louis Winkler, focusing on archaeoastronomy):
http://www.astrosociety.org/education/publications/tnl/31/31.html

Using Multicultural Dimensions to Teach Astronomy (by Nalini Chandra and John Percy):

Some Technical Volumes:


Batten, Alan, ed. Astronomy for Developing Countries. 2001, International Astronomical Union. Published by the Astronomical Society of the Pacific (www.astrosociety.org). Describes the many challenges of starting or continuing astronomy programs in countries without an extensive science infrastructure.


David Dearborn's bibliography of technical and nontechnical readings in archaeoastronomy can be found at: http://archaeology.about.com/od/archaeoastronomy/a/dearborn_bib.htm

2. Astronomy of African-American and Hispanic-American Cultures

Published Materials:


Sakimoto, Phil & Rosendhal, Jeff “Obliterating Myths about Minority Institutions” in Physics Today, vol. 98, #9, pp. 49-53 (September 2005). The authors, formerly the heads of NASA's space science education and public outreach program, offer some frank comments about the task of developing space science programs at minority colleges and universities.

Stassun, Keivan “Building Bridges to Diversity” in Mercury, May/June 2005, p. 20. The Chair of the Committee on the Status on Minorities in Astronomy for the American Astronomical Society discusses what could be done to increase the number of minority astronomers.


Neil deGrasse Tyson

**Websites and Articles on the Web:**


Follow the Drinking Gourd Guide (about how slaves used a song about the Big Dipper to find their way North in the U.S.; note however, the next reference in our list for some doubts about the modern song’s antiquity): [http://www.math.nus.edu.sg/aslaksen/gem-projects/hm/0203-1-20-follow/drinkinggourd/decoding.html](http://www.math.nus.edu.sg/aslaksen/gem-projects/hm/0203-1-20-follow/drinkinggourd/decoding.html)

Follow the Drinking Gourd Website: [http://www.followthedrinkinggourd.org/](http://www.followthedrinkinggourd.org/) An amateur music scholar has researched the history of the song about the Big Dipper more thoroughly and presents his work here. See especially, his teachers’ guide at: [http://www.followthedrinkinggourd.org/Appendix_Teachers_Guide.htm](http://www.followthedrinkinggourd.org/Appendix_Teachers_Guide.htm)


Greene, N. “African-Americans in Astronomy and Space (a concise guide with links to brief biographies of each): [http://space.about.com/od/astronomyspacehistory/tp/Black_History_Month.htm](http://space.about.com/od/astronomyspacehistory/tp/Black_History_Month.htm)


Article about the Bridge Program that Mexican-American astronomer Keivan Stassun is leading to increase the number of Latino PhDs: [http://nbclatino.com/2012/07/24/vanderbilt-university-program-bridges-latinos-to-phd-degrees/](http://nbclatino.com/2012/07/24/vanderbilt-university-program-bridges-latinos-to-phd-degrees/)


*Astronomy Circle of Puerto Rico* (highlights the life and work of a number of Puerto Rican astronomers): [http://astrocircle.org/](http://astrocircle.org/)
Profiles of astronomers on the History Makers website:

Gibor Basri: http://www.thehistorymakers.com/biography/gibor-basri-41
George Carruthers: http://www.thehistorymakers.com/biography/george-carruthers-41
William Jackson: http://www.thehistorymakers.com/biography/william-jackson
Derrick Pitts: http://www.thehistorymakers.com/biography/derrick-pitts

Interview with Claudia Alexander on the Women in Planetary Science web site:

“Jarita Holbrook: A Guiding Star” (nice profile of her life and work): http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2007_06_01/caredit.a0700079


Lawrence, Star “Hispanic Astrophysicist and Educator Boosts Women in Science” (a 2005 profile of Tania Ruiz): http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2005_03_04/nodoi.3021632384592204282

Committee on the Status of Minorities (AAS) Web site:
http://csma.aas.org/ Discussions of and resources about minority issues in the training of professional astronomers in the U.S.  See, in particular, their very useful SPECTRUM newsletter:
http://csma.aas.org/spectrum.html

http://sites.nas.edu/wocconference/files/2012/03/6.3.-American-Astronomical-Society.pdf

The National Association of Black Physicists has a blog called “Vector” and you can isolate just those posts that are connected w/merth astronomy at:
http://vector.nsbp.org/category/astronomy-and-astrophysics-astro/

Videos:

Hubble's Diverse Universe (a video about the research of African-American and Hispanic-American astronomers & astrophysicists) [1 hr. 52 min]: Order at https://www.createspace.com/410482

Reaching to the Stars: African American Astronomers (in celebration of Black History Month in 2011, Swarthmore hosted three African-American scientists: Derrick Pitts (Fels Planetarium), Eric Wilcott (U. of Wisconsin) and astronaut Mae Jemison, discussing the future of the field.) [90 min]:
http://www.youtube.com/watch?v=9q8I3bU68Gw

A Story about Race (Neil deGrasse Tyson reflects on cultural issues that arose during his college and graduate years) [12 min]: https://www.youtube.com/watch?v=eQLtPWPqsjA

Hakeem Olusey “Star Search,” an autobiographical talk at the Chicago Humanities Festival in 2014 [56 min]: https://www.youtube.com/watch?v=GRhgNw1siUo
3. Astronomy of Native North American Cultures

Published Materials:


Carlson, J. “America’s Ancient Skywatchers” in *National Geographic*, vol. 177, #3, Mar 1990, p. 76.


Krupp, E. “Whiter Shade of Pale” in *Sky & Telescope*, July 2000, p. 86. A rock that looks like the Milky Way and was used in ceremonies by Native Americans in California.


Maryboy, Nancy & David Begay *Sharing the Skies: Navajo and Western Cosmos*. 2006, Indigenous Education Institute & World Hope Foundation (available from Amazon.com). An authoritative compilation by Navajo and Western astronomers of illustrations, stories, and observations of Navajo constellations coupled with stories from corresponding Greek constellations and Hubble Space Telescope images of objects found in that part of the sky. This is a kit that includes an audio CD, a small poster of the Diné Universe, and learning activities.


Websites and Articles on the Web:

Aboriginal Star Knowledge: Native American Astronomy: [http://www.kstrom.net/isk/stars/starmenu.html](http://www.kstrom.net/isk/stars/starmenu.html)


Exploratorium Chaco Canyon Site: [http://www.exploratorium.edu/chaco/index.html](http://www.exploratorium.edu/chaco/index.html)
Garmany, Catharine *Resources for Astronomy Outreach Providers and Teachers of Native Americans* (helpful ideas and materials, from the National Optical Astronomy Observatories):

http://www.noao.edu/education/nativeamerican/

Profile of Native American astronomer Dennis Lamenti:


Solar Astronomy in the Pre-historic Southwest (P. Charbonneau, et al):

http://www.hao.ucar.edu/education/archeoslides/slide_1.php

Star Map and Sky Lore of the Ojibwe Native American People (compiled by Annette Lee):

http://web.stcloudstate.edu/aslee/OJIBWEMAP/home.html (Note: sometimes in the US the Ojibwe were referred to as Chippewa.)

*Videos:*

Animated story of “Coyote and Eagle Steal the Sun and Moon” (from Zuni tradition) [~2 min]: http://www.youtube.com/watch?v=EwyVDadt7QE

Annette Lee (a Native American astronomer discusses her personal development and work in the astronomy of native cultures in this brief video; hers is not the first one you come to, but just go down the page): http://www.northstarstem.org/about

“Grandmother Spider Brings the Sun to the Earth” (from the Cherokee tradition, told by Elaine Cohen) [~9 min]: http://www.youtube.com/watch?v=rNBNGI9uLCI (A shorter version is at: http://www.youtube.com/watch?v=rbTkP0gbNGQ)

NASA Connect: Indigenous Astronomers (a segment of NASA Connect’s Ancient Observatories episode follows Native American educators Nancy Maryboy and David Begay as they show examples of structures used to track the sun in the sky) [~7 min]: http://archive.org/details/NasaConnect-Ao-IndigenousAstronomers

*Classroom Activities:*

Ancient Eyes Looked to the Skies: Sunwatchers of the Southwest (Activities in Archaeoastronomy for the Classroom, Grades 4-8, from the Chabot Science Center): http://www.chabotspace.org/assets/teacher/sunwatchers.pdf

4. Astronomy of African Cultures

**Published Materials:**


**Websites and Articles on the Web:**

The Dogon Tribe and the so-called “Sirius Mystery”: [http://www.ramtops.co.uk/dogon.html](http://www.ramtops.co.uk/dogon.html) and [http://chandra.harvard.edu/chronicle/0400/sirius_part2.html](http://chandra.harvard.edu/chronicle/0400/sirius_part2.html)


**Video:**


*Ancient Astronomers of Timbuktu* (a video and website on the project to preserve the papers and knowledge of this Saharan city.) The website: [http://www.scribesoftimbuktu.com](http://www.scribesoftimbuktu.com) To purchase the video, go to: [http://www.planetarium.co.za/](http://www.planetarium.co.za/) and scroll down to the items that can be purchased from the planetarium book store. (For more on the video, also see: [http://www.planetarium.co.za/Timbuktu/Anc%20Astro%20of%20Tim-USE.pdf](http://www.planetarium.co.za/Timbuktu/Anc%20Astro%20of%20Tim-USE.pdf)

*Ancient Astronomers of Timbuktu* (A description of the project: [http://www.planetarium.co.za/Timbuktu/Anc%20Astro%20of%20Tim-USE.pdf](http://www.planetarium.co.za/Timbuktu/Anc%20Astro%20of%20Tim-USE.pdf)) To see the first seven minutes, go to: [https://vimeo.com/30076774](https://vimeo.com/30076774)

**Classroom Activity:**

5. Astronomy of Islamic Cultures

**Published Materials:**


**Web Sites and Web Articles:**

Arab and Islamic Astronomy (Leslie Welser): [http://www.starteachastronomy.com/arab.html](http://www.starteachastronomy.com/arab.html)

The Role of Astronomy in Islam (Dr. Shirin Haque-Copilah): [http://moonsighting.com/articles/roleofislam.html](http://moonsighting.com/articles/roleofislam.html)

Records of Eclipses in Muslim Astronomy: [http://www.muslimheritage.com/topics/default.cfm?ArticleID=810](http://www.muslimheritage.com/topics/default.cfm?ArticleID=810)


**Video:**

Video of a talk by Dr. George Saliba on the role of Arabic/Islamic astronomy in medieval and Renaissance culture (1 hr. 25 min): [http://www.youtube.com/watch?v=ZsI4Zrf8miA](http://www.youtube.com/watch?v=ZsI4Zrf8miA)

6. Astronomy of Central and South American Cultures

**Published Materials:**


Aveni, Anthony *Skywatchers*. 2001, U. of Texas Press. An updated version of *Skywatchers of Ancient Mexico*, this is an introduction to the astronomy of the Maya.


(See also some of the books by Aveni in section 1 of this guide.)


Van Stone, Mark *Science and Prophecy of the Ancient Maya*. This self-published book by a Maya expert addressed the issue of whether the Maya predicted Doomsday in 2012, but also has material on their astronomical and calendar systems, See: [http://markvanstone.com/books/](http://markvanstone.com/books/)

**Websites and Articles on the Web:**


Maya Exploration Center (Dr. Edwin Barnhart): [http://www.mayaexploration.org/](http://www.mayaexploration.org/) Includes tours of sites, resources, interviews, etc.

Calendar in the Sky (connects Maya knowledge to modern astronomy; produced by the education group at the Berkeley Space Sciences Lab): [http://www.calendarinthesky.org/](http://www.calendarinthesky.org/)


**Video:**

Maya Astronomy and Mathematics (from NASA Connect, with Sten Odenwald) [8 min]: [http://www.youtube.com/watch?v=5W9zFwBQb6c](http://www.youtube.com/watch?v=5W9zFwBQb6c)

Anthony Aveni on “The End of Time” at Marlboro College (on the Mayan calendar and why the world will not end in 2012; delivered 9/13/2010; 1 hr 2 min): [http://www.youtube.com/watch?v=exOGTvZ5aKw](http://www.youtube.com/watch?v=exOGTvZ5aKw)

“Why We Will Still Be Here on Dec. 21 [2012]” (a panel on the predictions of Doomsday 2012, with information on the Maya calendar by E.C. Krupp; recorded in 2012 at the SETI Institute): [http://www.youtube.com/watch?v=WASFC0jn6U8](http://www.youtube.com/watch?v=WASFC0jn6U8)
Classroom Activities:

Calendar in the Sky Lesson Plans:  
http://www.calendarinthesky.org/MultimediaResources/LessonPlans.aspx

Activity from NOVA to figure out your birthday in the Maya calendar (if you were born 1980 or after):  

Online Maya Calendar Converter:  http://www.mayaskies.org/mayacalendar.html

Educational Activities Accompanying the Tales of the Maya Skies planetarium show:  
http://mayaskies.org/onlineactivities.html

7. Astronomy of Hawaiian, Polynesian, and Native Australian Cultures

Published Materials:


Kyselka, Will & Ray Lanterman North Star to Southern Cross. 1976, University of Hawai‘i Press. A geologist and planetarium educator recounts how he became part of the project to rediscover the ancient art of navigating by the stars and a voyage to see how it was done.

Makemson, Maud The Morning Star Rises: An Account of Polynesian Astronomy. 1941, Yale University Press.

Websites and Articles on the Web:


A guide to the literature on aboriginal astronomy in Australia:  
http://www.atnf.csiro.au/research/AboriginalAstronomy/Literature.htm

Introduction to Maori Star Lore (New Zealand):  

Maori Lunar Calendar:  http://www.pixieplots.co.nz/Maori-Lunar-Calendar


Matariki: The Pleiades in Maori Culture:  

A south-polar projection star map from 1092 by Su Song, a Chinese scientist and mechanical engineer of the Song Dynasty (960-1279), from Su's book known as the Xin Yi Xiang Fa Yao (Wade-Giles).
Polynesian Voyaging Society (tries to keep the tradition of navigating by the stars alive; has profile of the people who have duplicated some of the ancient voyages, navigating by the stars): [http://hokulea.org/](http://hokulea.org/)

**Video:**

Polynesian Wayfinders (a nice introduction to the ancient voyages and navigation by the stars) [10 min]: [https://www.youtube.com/watch?v=_1ibG0Fj7oE](https://www.youtube.com/watch?v=_1ibG0Fj7oE)

The Light at the Edge of the World: Polynesian Wayfarers (a National Geographic video): [https://www.youtube.com/watch?v=DWp5MiiiVR1k](https://www.youtube.com/watch?v=DWp5MiiiVR1k)

**Classroom Activities:**


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### 8. Astronomy of Asian Cultures

**Published Materials:**


Pankenier, David *Astrology and Cosmology in Early China: Conforming Earth to Heaven*. 2013. Cambridge University Press. Shows how astronomy profoundly influenced every aspect of culture in the formative period, from art and architecture, to city planning, to political and military decision-making.


Peng, Eric “China’s Race to Study the Cosmos” in *Astronomy*, Mar. 2013, p. 44. Modern astronomical instruments China plans to build and projects it is joining with other countries to do.


Sun, Xiaochun and Jacob Kistemaker *The Chinese Sky During the Han: Constellating Stars and Society*. 1997, Brill. Reconstructs the appearance and understanding of the sky in Han time (206 BC – AD 220). Technical in parts (chapter on the dating of positional observations) but excellent introduction to the history of mapping the sky in China (and East Asia).

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**Websites and Articles on the Web:**

History of Chinese Astronomy: [http://idp.bl.uk/4DCGI/education/astronomy/history.html](http://idp.bl.uk/4DCGI/education/astronomy/history.html) (click on the next pages for more)


Copernicus in China (on the spread of Copernican ideas by Nathan Sivin of the University of Pennsylvania): [http://ccat.sas.upenn.edu/~nsivin/cop.pdf](http://ccat.sas.upenn.edu/~nsivin/cop.pdf)


The Lunar Calendar in Japan: [http://www.renshaworks.com/jastro/calendar.htm](http://www.renshaworks.com/jastro/calendar.htm)


Bibliography of Korean Astronomy: [http://www.hawaii.edu/korea/biblio/sci_astronomy.html](http://www.hawaii.edu/korea/biblio/sci_astronomy.html) (This is a nice list of articles, but mostly in scholarly journals.)


Aspects of Prehistoric Astronomy in India (a somewhat technical article by N.K. Rao): [http://bulletin.astron-soc.in/05December/3305499-511.pdf](http://bulletin.astron-soc.in/05December/3305499-511.pdf)
Appendix A: Astronomy of Ancient European Cultures

Selected Published Materials:


In addition, see many of the books suggested in section 1 of this Guide.

Selected Websites and Articles on the Web:

Archaeoastronomy at Stonehenge:

http://witcombe.sbc.edu/sacredplaces/stonehenge.html (an art historian examines Stonehenge from many perspectives, including the astronomical)

Stone Pages: http://www.stonepages.com/ (Mammoth web catalog about European stone circles and monuments, including Stonehenge and others with astronomy connections.)

Appendix B: Reports and Articles on Achieving Greater Diversity in Science in General

American Astronomical Society Recommendations for Inclusive Astronomy: https://docs.google.com/document/d/1lipEb7xz7kAh8SH4wsG59CHEaAJSJTAWRlVA1MiYGMM/edit


Lee, Okhee & Buxton, Cory *Diversity and Equity in Science Education: Research, Policy, and Practice*. 2010, Teacher's College Press.


