

Songs of the Universe - The AstroCappella Project

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Abstract

The AstroCappella Project is a classroom-ready collection of upbeat pop songs, lesson plans, and background information, rich in science content. It was developed as a collaboration between working research astronomers, educators, and our contemporary vocal band, The Chromatics. A multimedia music CD ("AstroCappella 2.0") has been produced containing 13 astronomically correct songs with original lyrics and music. Song topics range from the Sun, Moon, planets and small bodies of the Solar System, through the Doppler shift, the nearest stars, and extra-solar planets, to radio astronomy, X-ray astronomy, and the Hubble Space Telescope and Swift astronomy satellites. The extensive CD-ROM materials include science background information, curriculum notes, lesson plans and activities for each song; images, movies, and slide shows. The songs and accompanying information have been field-tested, and align to the K-12 National Science Education Standards. The AstroCappella materials are in widespread use in classrooms and homes across the US, and are supplemented with frequent live performances and teacher workshops.

Song	Topic	Activity	Grade
Nine Planets	Solar System	Build an edible scale model of the solar system	All
Sun Song	The Sun	What's it like inside the sun? Convection in a bowl of miso soup	6-9
Habitable Zone	Earth, Venus, Mars	What's it like on Venus and Mars? "Lead" fondue and ice cream "polar caps"	3-5
Lunar Love	The Moon	Arms around the Moon. Learn about the phases of the moon	4-6
HST-Bop	Hubble Space Telescope	How many stars in the Milky Way? Statistical sampling methods	9-11
Come and Visit Mars	Mars	Remote sensing. Learn how scientists use 0s and 1s to create an image	4-6
A Little Bit of Rock	Meteors, asteroids, comets	Build a comet. Create a comet from easily-obtained ingredients	7-11
Dance of the Planets	Extra-solar systems	Extrasolar planet quest. Map out another solar system	6-8
Doppler Shifting	Spectra, redshift	Here it comes, there it goes! Build a "Doppler ball"	7-9
Wolf 359	Nearest stars	Land Safely. Build a package to deliver a raw egg to the ground	6-8
Cosmic Radio Show	Radio waves, history	Communications lab. Build a parabolic dish receiver	7-9
High Energy Groove	X rays, gamma rays	The universe in a different light. Card game	6-8
Swift Song	Swift mission, gamma-ray bursts	How far, how powerful? Measure the distance to a gamma-ray burst	11-14

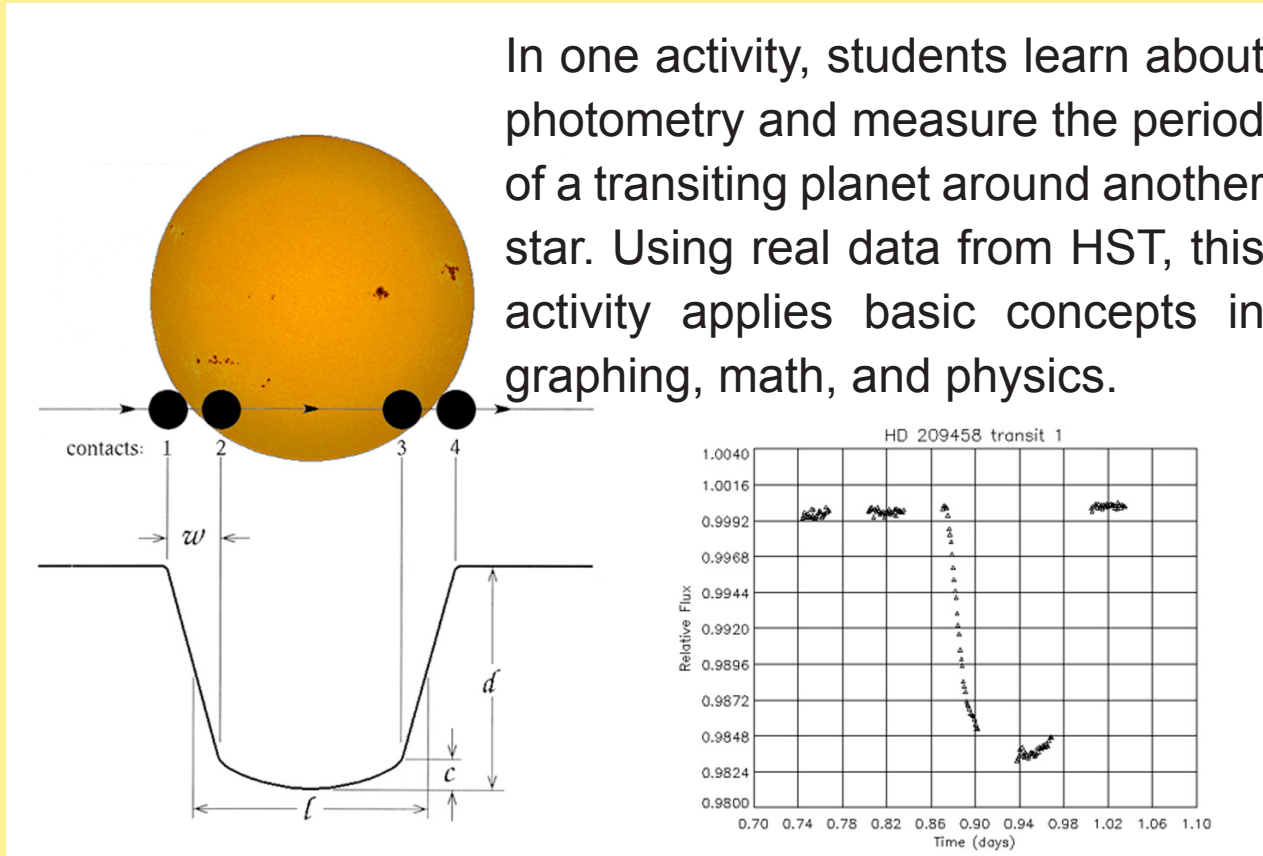
Music, Memory, and Learning

The connection between music and memory is now firmly established (e.g. Rumelhart & McClelland 1986; Scientific American 1999). Music reinforces subject matter memory because the same information is stored in multiple areas of the brain in a complex network. Gardner's (1993) "Multiple Intelligences" include linguistic, musical, logical-mathematical, spatial, body-kinesthetic, intrapersonal, and interpersonal. For some students, math anxiety raises heart rates and causes a physiological state of worry. Reducing this worry improves performance (Geary 2001). Music is a calming influence. The upshot is: **to reach all kids, you need to teach the same subject matter using a variety of methods.**



The Chromatics performing. Pictured above are (left to right) Padi Boyd, Alan Smale, Deb Nixon, Barry Mahaffey, Karen Smale, and John Meyer. The singers on the AstroCappella 2.0 CD include the above (except Barry Mahaffey) plus Paul Kolb and Lisa Kelleher.

Our AstroCappella project aims to use catchy songs to teach core concepts of astronomy and physics that students will carry with them for the rest of their lives. The songs also help cast science in a positive light: they make students happy and may dispel their worry about science and math, and the singer-scientists present an image that is far from the stereotypical graybeard in a shabby lab coat.



In one activity, students learn about photometry and measure the period of a transiting planet around another star. Using real data from HST, this activity applies basic concepts in graphing, math, and physics.

Education Workshops

Goals:

- Broadening and deepening educators knowledge in astronomy and related sciences;
- Increasing educators appreciation and understanding of the science behind today's astronomy discoveries;
- Giving teachers new tools with which to provide enriching and challenging learning opportunities in science for ALL students;
- Connecting teacher training to state-of-the-art space science by using real data from operating space science missions;
- Demonstrating that every teacher can feel comfortable with teaching science, to show that technology can be easily incorporated into the science classroom; and
- Demonstrating to students that science can be fun, and not intimidating.

Success Indicators:

- Discussion among teachers, including innovative ways of using the songs and activities in their own classrooms, during the workshops themselves;
- E-mail testimonials from teachers and students reporting the positive responses their students and colleagues have to AstroCappella; and
- Requests from teachers and students (and other professional development experts) for new songs on timely topics (Transit of Venus, Saturn's Rings, and so on).



Teachers attending the North Bay Science Project create "comets." Workshops are listed in the timeline to the right in GREEN.

Acknowledgments

The AstroCappella lyrics and original songs were written, performed, and recorded by The Chromatics, a vocal band based in Greenbelt, Maryland. When AstroCappella 2.0 was released the members of The Chromatics were Padi Boyd, Alan Smale, Karen Smale, John Meyer, Deb Nixon, Lisa Kelleher, and Paul Kolb; Lisa and Paul have since left us, and Barry Mahaffey has joined. We thank Dr. Laura Whitlock, former head of NASA/GSFC's High Energy Astrophysics education and public outreach program, a tireless supporter of the AstroCappella idea, who helped us share our music and activities with many hundreds of teachers in Florida, Nevada, California, Maryland, and Virginia. Kara Granger supplied copious input on the lesson plans and materials for the first AstroCappella release, and was a coauthor on the 36-page booklet. Thanks are due to Libby Truelove and the countless other teachers who have attended our national and regional workshops, helped us test lyrics, lesson plans, and activities, and provided valuable feedback on the songs and educational materials, especially the participants in the Prince George's County Middle School Science Teachers Workshop (1997) and the North Bay Science Project (2001). In addition to our original IDEA grant, we acknowledge financial support in the early stages of the Project obtained through Nick White (HEASARC, NASA/GSFC), and David Holdridge (USRA).

The AstroCappella materials are copyrighted, but permission is given to photocopy the written materials for classroom use, and broadcast the songs in a classroom or other educational setting, as long as due credit is given to the composers and performers, and a link (or text reference) to <http://www.astrocappella.com/> is included where appropriate. Appropriate permissions must be sought from the authors before combining the AstroCappella materials with other audiovisual materials (in e.g. a planetarium setting).

References

- Gardner, H., 1993, Multiple Intelligences: The Theory in Practice, NY: Basic Books.
 Geary, David C. as quoted in Science News, June 30, 2001; Vol. 159, No. 26, p. 405.
 Rumelhart, D., & McClelland, J. (Eds.), 1986. Parallel distributed processing: Explorations in the microstructure of cognition, Cambridge, MA: MIT Press.
 Scientific American, 1999, The Scientific American Book of the Brain, Antonio R. Damasio Int. (Eds.), New York: The Lyons Press.

Your songs maintain the integrity of poetry and music AND they teach. Congratulations!
-Lori V. Webster U., St. Louis, MO

If science at school had been this interesting, I wouldn't have always slept through it.
- Anonymous student at South Carolina 4-H workshop

www.astrocappella.com

AstroCappella Milestones

January 1997: Received IDEAS grant to record 4-6 astronomy songs and produce 500 cassettes and activity booklets.

June 1997: First AstroCappella performance at summer school camp in Maryland. Received first feedback.

Late 1997 - early 1998: continued testing and revising songs and activities.

October 1997: Workshop/performance at California Science Teachers Association meeting (Palm Springs).

November 1997: Workshop/display at Virginia Association of Science Teachers meeting (Virginia Beach).

March 1998: Released music CD with 6 songs in minimal packaging, with an accompanying 36-page b/w booklet of lyrics and classroom activities.

April 1998: Workshop/performance at National Science Teachers Association meeting (Las Vegas).

1998: Performance at Owens Science Center (Maryland), Performance and workshop at 4-H Conference (South Carolina), Performance at National Space Day (Washington DC). **Matching funds obtained to press a total of 10,000 CDs and booklets.**

April 1999: Passport to Knowledge videotaped the Chromatics singing two songs ("The Sun Song", "Doppler Shifting") for *Live from the Sun* program.

April 1999: Commissioned to write "Swift Song" about the Swift satellite.

Spring 1999: Songs and website included on NASA EPO CD "Imagine the Universe!" 25,000 copies distributed.

December 1999: The AstroCappella CD was taken into space on the Space Shuttle (STS-103, Hubble Repair Mission) by Dr. John Grunsfeld.

April 2000: Performance at Hudson River Museum (New York).

August 2000: Videotaped 4 new AstroCappella songs about the solar system for Passport to Knowledge.

November 2000: Presented teacher workshop on gamma-ray bursts at HEAD meeting (Hawaii).

March 2001: Finished recording "Lunar Love", the last song for the AstroCappella 2.0 CD.

April 2001: Presented teacher workshop at Gamma2001, an expanded version of the workshop given in Nov. 2000. Recorded a "Science, Science" show for local cable TV.

July 2001: 1-week workshop for North Bay Science Project (Sonoma State U.)

September 2001: AstroCappella 2.0 released.

November 2001: Performance at National Air & Space Museum (Washington DC).

January 2002: "A Little Bit of Rock" is nominated for a Contemporary A Cappella Recording Award (CARA).

February 2002: Started "News Archive" of press releases about topics in AstroCappella songs (800+ articles by Dec. 2004).

March 2002: New web-only activity for "Dance of the Planets."

August 2002: Performed at the Maryland Science Center.

January 2003: Group and CD nominated for 3 Wammies (Washington Area Music Awards).

April 2003: Performance at National Air & Space Museum (Washington DC).

May 2003: Performances at Huntsville's Von Braun Astronomical Society and University of Alabama's Chan Auditorium.

January 2004: New activity: treasure hunt through the online-only news archive.

February 2004: Workshop/performance at Farpoint Science Fiction Convention (Baltimore).

April 2004: Performances at National Air & Space Museum (Washington DC) and Hudson River Museum (New York).

May 2004: Performance at Maryland Science Center (Baltimore).

October 2004: Workshop and performance at National Teacher Training Institute (Harrisonburg, VA).

2005: "High Energy Groove" forms basis of planetarium show "Hotter than Blue" produced by NASA and Audio Craft Productions, narrated by Nichelle Nichols (Uhura).

Press, Radio, TV

1997 An astronomy class set to music.
- Sky & Telescope

Lively, entertaining, and educational.
- Astronomy Today

Ear-catching music with an educational twist.
- The Baltimore Sun



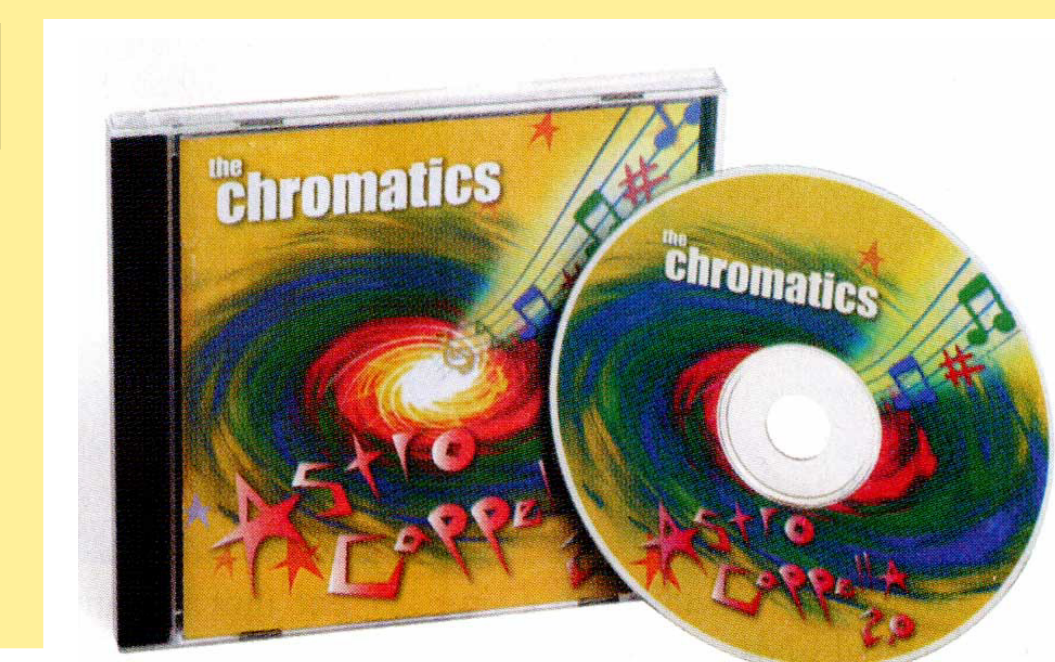
April 1999: *Live from the Sun* broadcast on PBS stations.

Spring 1999: Mentioned in *New Scientist* magazine and *Physics Today*, feature article in *Contemporary A Cappella News*, *New Zealand Science Monthly*, appeared briefly on CNN Headline News.



January 2000: "Swift Song" played during end credits of *Soundprint* broadcast on NPR.

June 2000: *The New York Times* published a "Word for Word" column about "Singing Scientists" featuring the Chromatics and two other acts from California and Switzerland. Quotes from "High Energy Groove" and "The Sun Song" are highlighted.



December 2001: The Astronomical Society of the Pacific published an online Teachers' Newsletter: *The Universe in the Classroom*, featuring AstroCappella.

Early 2002: The e-zine *Astronomy Today* published an interview with Padi Boyd, about AstroCappella. *Sky & Telescope* features AstroCappella 2.0 in their "New Products Showcase." *The Baltimore Sun* runs an article about AstroCappella & the Chromatics. Featured in Penn State PBS show and e-zine *Space Gazette*.

March 2002: "The Sun Song" is featured in the NASACONNECT show "Having a Solar Blast."

Spring 2002: Local newspapers in Maryland and Virginia feature articles about the group and AstroCappella project.

May 2003: "Swift Song" wrongly triggers RIAA cease-and-desist letter at Penn State. We are slash-dotted.

June 2003: NASACONNECT show featuring "The Sun Song" wins an Emmy. BBC Radio 4's *The Material World* features part of "High Energy Groove" on program about SIRTf.

November 2003: Penn State's PBS program *What's in the News* features "Swift Song."

May 2004: BBC Radio 4 features "Habitable Zone" on program about the Transit of Venus.

October 2004: "Swift Song" featured in the UK's National Space Centre.

November 2004: An excerpt from "Swift Song" appears in *Popular Science*.

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