Cosmic Connection Webinar Transcript

Slide 1:

This presentation is an overview of the Cosmic Connection card set and activity included with the Stellar Evolution educational materials and supporting resources posted on the Chandra X-ray Observatory website. The materials were developed for classroom use as an astronomy unit, enrichment, or individual projects. These materials are also an excellent resource for Science Olympiad teams and coaches preparing for the Astronomy and Reach for the Stars space science events. If you are not familiar with these materials, please listen to the Introduction to Stellar Evolution webinar first which discusses all the materials, including introduction and background, teachers guide, and all activities and investigations and additional resources.

Slide 2:

These materials are part of NASA’s Universe of Learning; Astrophysics STEM outreach program. These materials were developed for the Chandra mission, and have been used extensively with formal and informal educators and for Science Olympiad clinics and workshops for the NASA Astrophysics Division via the Universe of Learning network and the Chandra X-ray Center Education & Communications Office, and its partnership with the National Science Olympiad.

Slide 3:

The Stellar Evolution materials are located at <http://chandra.harvard.edu/edu/formal/index.html>. They are accessed from the chandra.harvard.edu homepage under the Education menu and Classroom-Ready Activities and scrolling down to Stellar Evolution. If you have not used these materials, watch the first webinar listed as it is an introduction for the entire Stellar Evolution unit; three additional webinars are being recorded using the three card sets that are the basis for the activities. This webinar is centered on the Our Cosmic Connection card set.

Slide 4:

The Cosmic Connection card set can be downloaded in either a PDF or a PowerPoint format. You can also request the card sets using the request form at <http://chandra.harvard.edu/edu/request_special.html>. The card sets are on heavy card stock. A description of the images is located at <http://chandra.harvard.edu/edu/formal/stellar_ev/cosmic/image_desc.html>.

A student handout is included with the materials with a scenario to begin the activity; however, this is a basic sequencing activity using the card set.

Slide 5:

This graphic is a summary of the evolutionary stages through which stars progress depending upon their initial mass. The Introduction and Background gives a complete and in-depth description of stellar evolution so I am not going to do that here. Basically the graphic shows that stars with a mass similar to the Sun progress through a red giant stage and result in a planetary nebula and white dwarf. Stars with more mass result in more catastrophic collapses and more exotic end products – such as neutron stars, pulsars and black holes. Yes, there are variations; however the basic sequences are enough for students to gain a basic understanding and appreciation of how stars evolve over time.

Slide 6:

There is an extensive Teacher Guide on the logistics of using the Cosmic Connection image set at <http://chandra.harvard.edu/edu/formal/stellar_ev/teachers_guide.html> so I am not going to discuss that here. I am going to focus on using the card set. The first task is to arrange the images numbered 5, 7, 8, 10, 13, 20 and 23 into a sequence that represents the evolutionary stages of a mid-sized star such as the Sun. So students can pull out only these cards for this first sequencing activity. Have students work in groups and give them plenty of time for discussion. After students have finished their sequences you can show them the sequence you have exactly the way I am doing now. Remind them that this is one possible sequence – there are other ways to arrange the cards and if their sequence does not exactly match this one that does not mean that theirs is wrong. Maybe they did not identify one of the images as the evolutionary stage it represents but they still have the sequence correct. Ask the students what image is first. Once they give some answers bring up the first image. Keep going until the sequence is complete. The final click is a list of what the objects are and what spacecraft or telescope acquired the image. Explain that sometimes an artist illustration is the best way to represent something that is not easy to image or does not look as one would expect.

Slide 7:

The next sequence works exactly like the first one – only this time the students will use image numbers 4, 5, 8, 9, 12, 15, 16 and 24 to arrange a sequence of evolutionary stages of a massive star. They should easily get the first two images this time since they are the same ones used for the previous sequence. This time I have arranged the final two possible end products above each other to show a different orientation for the placement of the images. The last click brings up the description of what the images are.

Slide 8:

The sequences for Sun-sized and massive stars can also be combined so students understand that star formation regions are huge and many are prolific producers of protostars of all masses. Massive and less massive stars form together in the same regions.

Slide 9:

There is one more sequence. The massive and mid-sized stellar sequences were for stars that undergo a core collapse that results in the end products. There is another type of destructive event – the thermonuclear destruction of a white dwarf. Again this is all explained in the Stellar Evolution Introduction and Background section located at <http://chandra.harvard.edu/edu/formal/stellar_ev/story/>. This event requires a white dwarf which was the end product in the evolution of a Sun-sized star. So the first part of the sequence is exactly the same as before. However, the star has to have a companion in order to accrete material to result in the thermonuclear event. So students will use the images numbered 2, 3, 5, 7, 8, 10, 13, 18 and 23 and arrange them into a sequence that results in a Type Ia supernova event. The descriptions for 6 of the images were given before so only descriptions for the 3 additional images are shown this time.

Slide 10:

This slide shows 4 possible sequences using a variety of the images in the card set that represent the evolutionary stages of a Sun or mid-sized star.

Slide 11:

This slide shows 3 possible sequences using a variety of the images in the card set that represent the evolutionary stages of a massive star.

Slide 12:

This slide shows 2 possible sequences using a variety of the images in the card set that represent the evolutionary stages necessary for a Type Ia supernova event.

Slide 13:

To request any of the infographics, lithographs or other materials go to <http://chandra.harvard.edu/edu/request.html> and follow the directions. If you want the supporting PowerPoint slide set that is used for this webinar presentation please email me at [dlyoung.nso@gmail.com](mailto:dlyoung.nso@gmail.com) and I will send it to you.