



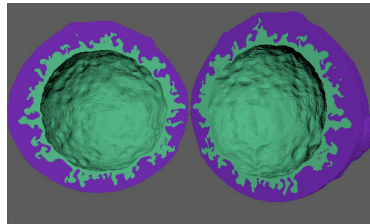
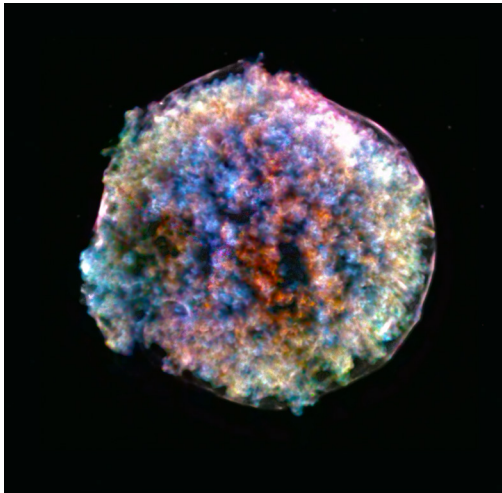
3D SUPERNOVA PAPER SNOWFLAKE CHAIN: TYCHO'S SUPERNOVA REMNANT

The Science: Stellar Evolution and Exploded Stars

Stars are born, live for a period of time, and die. Some of them – the very biggest – end their lives in dramatic explosions called “supernovas.” These supernova explosions leave behind intricate glowing debris fields (known as supernova remnants) that contain the elements necessary for life. Every supernova remnant is unique. Like snowflakes, they seem similar at first glance, but are exquisitely varied as we explore them in detail.

The curve drawn on the template originates from real 3-dimensional data from a supernova explosion studied by scientists working with NASA's Chandra X-ray Observatory. Packets of energy emitted from the high-energy explosion

radiate in all directions, and Chandra records their energy and positions as they hit its sensors. Figuring out which of the light is moving towards us versus away from us and other physical processes help us understand the positions in 3-dimensional space. The result is a 3D model of Tycho's Supernova Remnant. This model was output by scientists and shared with our artist, who cut through its center using 3D modeling software, and transposed the outer curve back onto a 2-dimensional plane, then simplified the curve to make it reasonable to cut out of paper. The pieces can then be assembled into an approximation of the actual supernova remnant, once again in 3D.



As with many supernova remnants, Tycho glows brightly in X-ray light because shock waves generated by the stellar explosion heat the stellar debris up to millions of degrees. Supernovas like Tycho sprinkle elements such as iron and silicon, that are essential for life as we know it, into the next generation of stars and planets.



You can 3D print your own (much, much smaller!) version of Tycho like the one shown in the photos at left, to the lower right.

Glossary

star: a luminous ball of gas, mostly hydrogen and helium, held together by its own gravity.

supernova: an explosion produced when a white dwarf becomes unstable due to the accretion of too much material or merger with another white dwarf.

supernova remnant: the structure resulting from the explosion of a star in a supernova. The supernova remnant is bounded by an expanding shock wave, and consists of ejected material expanding from the explosion.

LISTEN TO A
SONIFICATION
OF TYCHO!





3D SUPERNOVA PAPER SNOWFLAKE CHAIN: TYCHO'S SUPERNOVA REMNANT

Make your own snowflake chain using real 3D information!

This activity features one of the most famous supernova remnants called Tycho, named after a Danish astronomer who spotted the explosion hundreds of years ago.

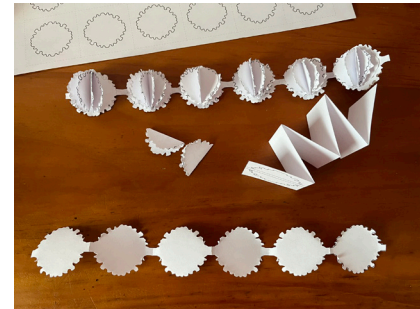
Cost: About \$0.50 (50 cents) per item

Time: 20-30 minutes to complete.

Ages: 11+

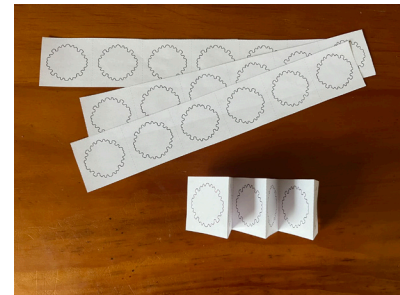
Materials:

- paper
- a black and white printer
- scissors
- tape or glue
- good background music



Directions: Print the first page with the strip showing the outline of one supernova at the end.

1. Fold into sixths, using the dotted lines as a guide, accordion-style, so that the outline of the supernova shows on the outside.
2. Cut through the 6 layers of paper, along both solid lines making a curvy outline of a supernova with a connecting strip through the center, your connected chain.
3. Print the other 2 pages, each showing a grid of 6 x 5 supernova outlines.
4. Cut out all 60 supernova outlines from p. 2 & p. 3. This goes fastest if you cut into strips and accordion fold each strip, cutting out 6 at a time.
5. Fold each separate supernova circle in half.
6. Using glue or scotch tape, affix 5 of the folded circles together to look like the pages of a book laying open on a desk.
7. Using one of the circles in your connected chain as the “book cover” affix a 5-piece folded structure to it.
8. Repeat steps 5-6 for each circle in your connected chain.
9. Flip the chain over and repeat steps 5-6 for the back side of the chain.



WATCH THE
VIDEO
DIRECTIONS

