NISE Network Online Workshop

The Science Behind the 2020 Explore Science: Earth and Space Toolkit - Using your toolkit to present the life cycle of stars

Tuesday, February 11, 2020

Welcome!

Today's presenters are:

- **Katherine Kornei,** NISE Net Earth & Space Content Expert
- **Laura Peticolas,** Sonoma State University
- **Frank Kusiak,** Lawrence Hall of Science, UC Berkeley
- **Darrell Porcello,** Children's Creativity Museum

As we wait to get started with today's discussion, please:

Introduce yourself! Type your name, institution, and location into the Chat Box

Questions? Feel free to type your questions into the Chat Box at any time throughout the webinar or use the raise your hand function in the participants list and we'll unmute your microphone.

Today's discussion will be recorded and shared online at nisenet.org/events/online-workshop

Online Workshop Overview

5 min
NISE Network introductions & toolkit overview

30 min
Drs. Katherine Kornei and Laura Peticolas on star connections to the 2020 Explore Science: Earth & Space Toolkit

Frank Kusiak with highlights from "Star Formation" and "Nebula Spin Art"

20 min
Q & A from our audience

Image credit: NASA, ESA, Hubble Heritage Team

Your Friendly NISE Net Webinar Crew

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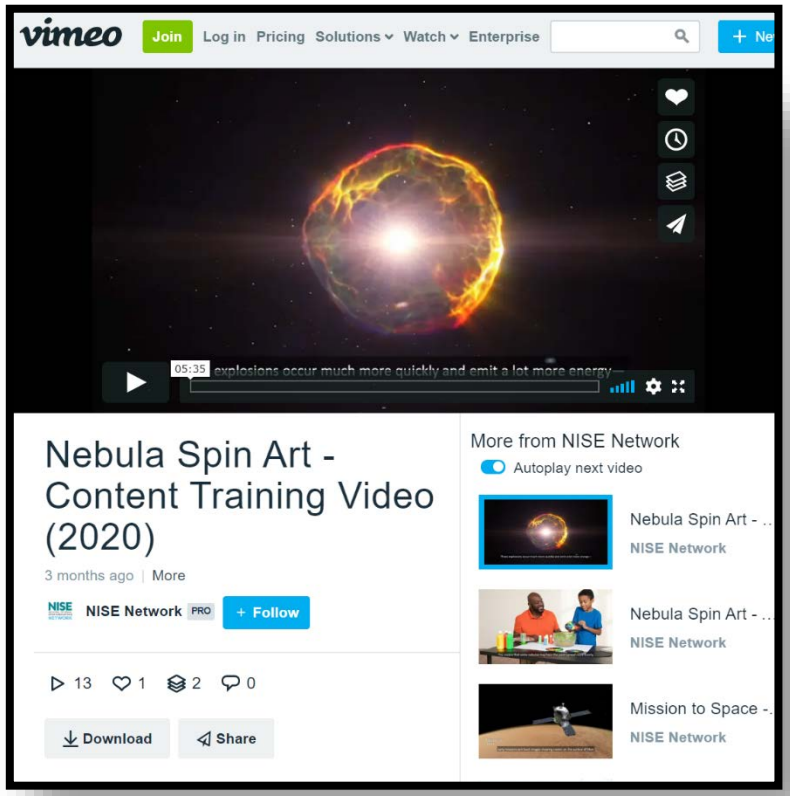
NISE Net Earth & Space, Co-I
Children's Creativity Museum

Lindsay Bartolone, M.S.
NISE Net Earth & Space Content Expert
Chicago, IL

2020 Explore Science: Earth & Space Toolkit + Videos



Watch all the facilitation and content training videos:
https://vimeopro.com/nisenet/explore-science-earth-space

Download the 2020 digital toolkit now:
http://www.nisenet.org/earthspacekit-2020

Submit your questions…

We will be collecting your Questions in the chat window to your right throughout the talk.

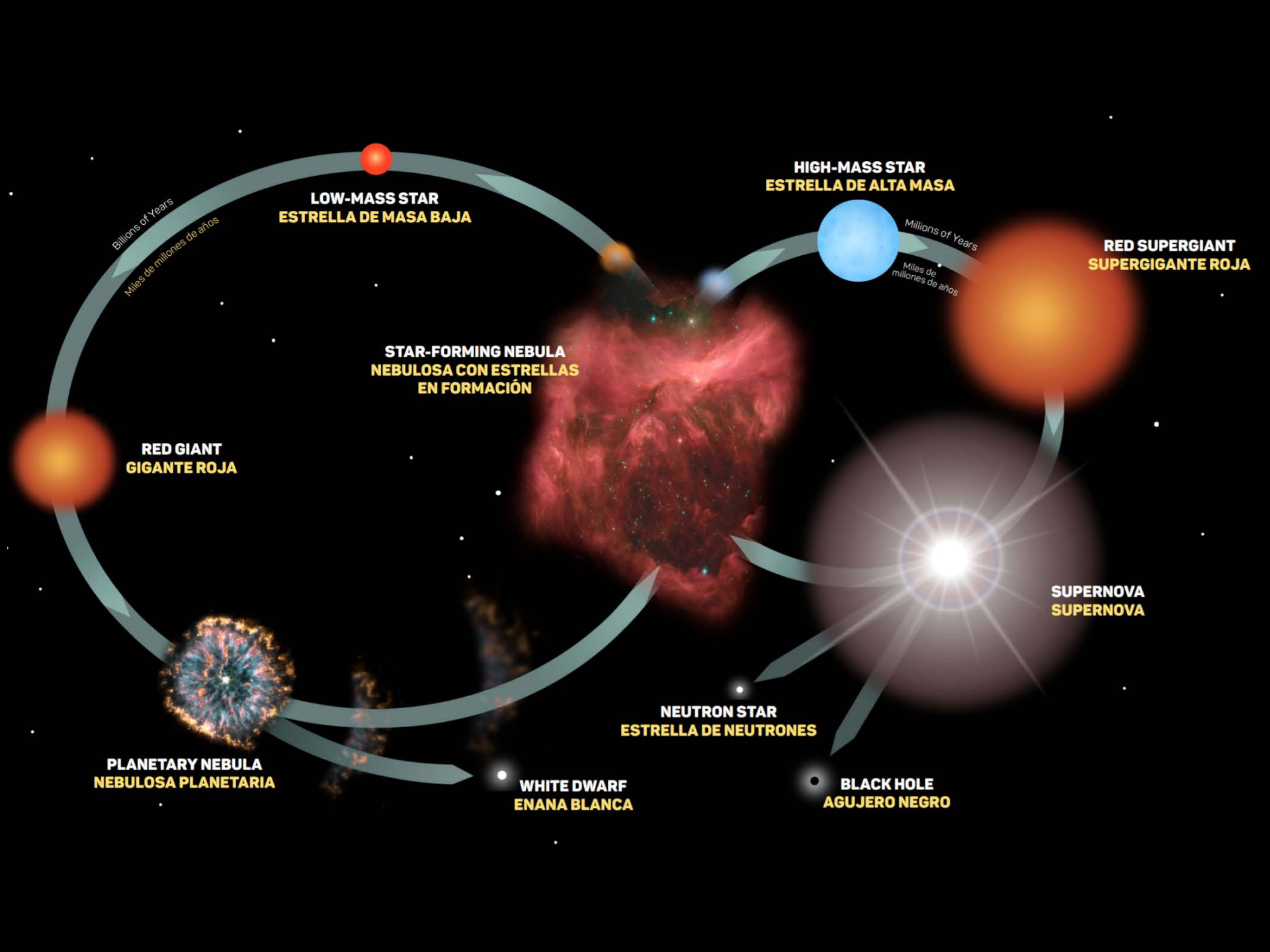
We will go through these questions in the Q&A section of the webinar. Those we don’t get to today we will reply over email.

…in the chat box.

The Science Behind 2020 Explore Science: Using your toolkit to present the life cycle of stars

Image credit: NASA, ESA, M. Robberto (Space Telescope Science Institute/ESA) and the Hubble Space Telescope Orion Treasury Project Team

Star Formation


LOW-MASS STAR
ESTRELLA DE MASA BAJA
Billions of Years
Miles de millones de años
HIGH-MASS STAR
ESTRELLA DE ALTA MASA
Millions of Years
Miles de millones de años
RED SUPERGIANT
SUPERGIGANTE ROJA
STAR-FORMING NEBULA
NEBULOSA CON ESTRELLAS EN FORMACIÓN
RED GIANT
GIGANTE ROJA
SUPERNOVA
SUPERNOVA
NEUTRON STAR
ESTRELLA DE NEUTRONES
PLANETARY NEBULA
NEBULOSA PLANETARIA
WHITE DWARF
ENANA BLANCA
BLACK HOLE
AGUJERO NEGRO

Carina Nebula

Image credit: NASA, ESA, and M. Livio and the Hubble 20th Anniversary Team (STScI)

Image credit: NASA's Goddard Space Flight Center, Conceptual Image Lab

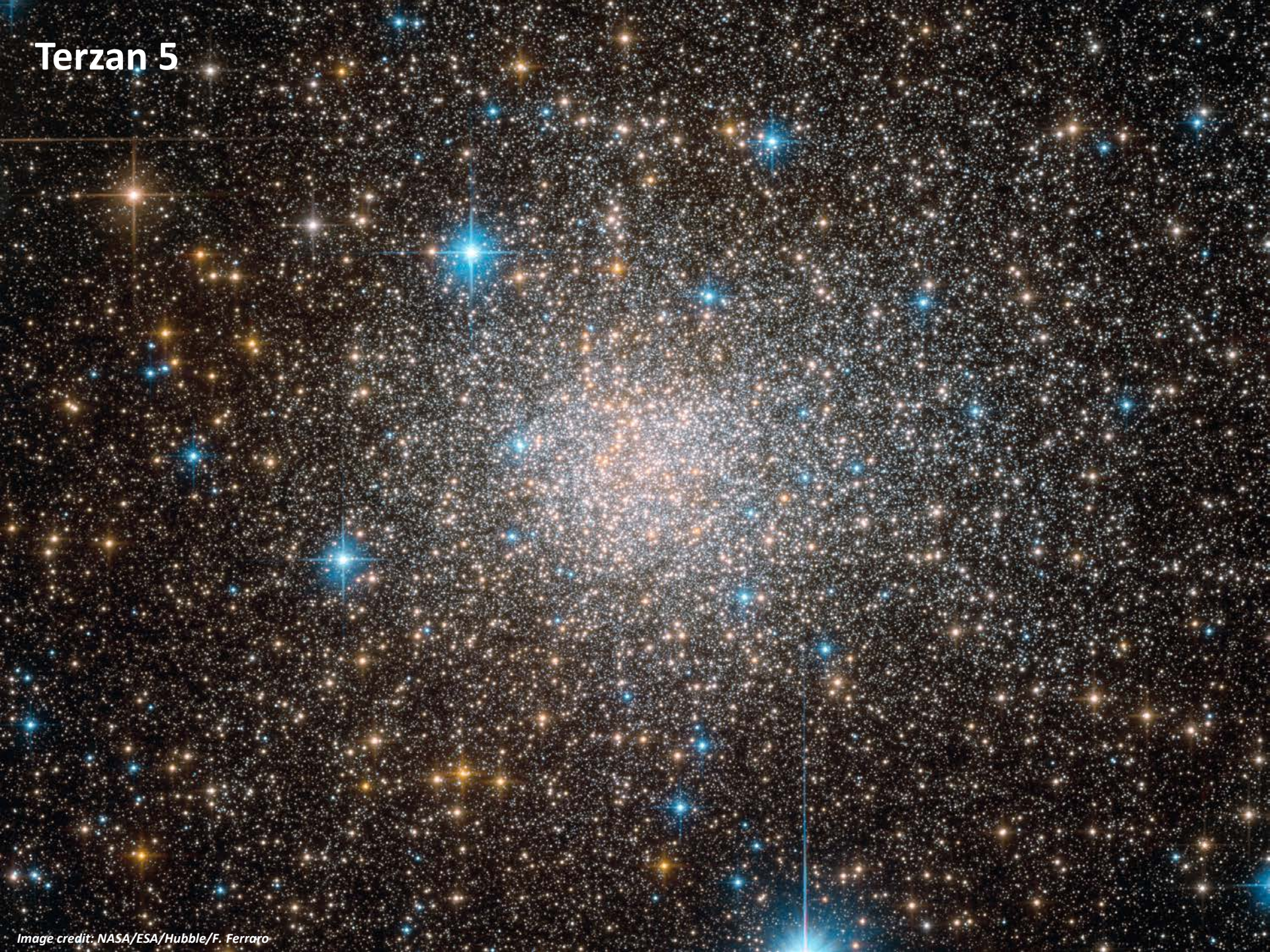


Image credit: NASA/ESA/Hubble/F. Ferraro

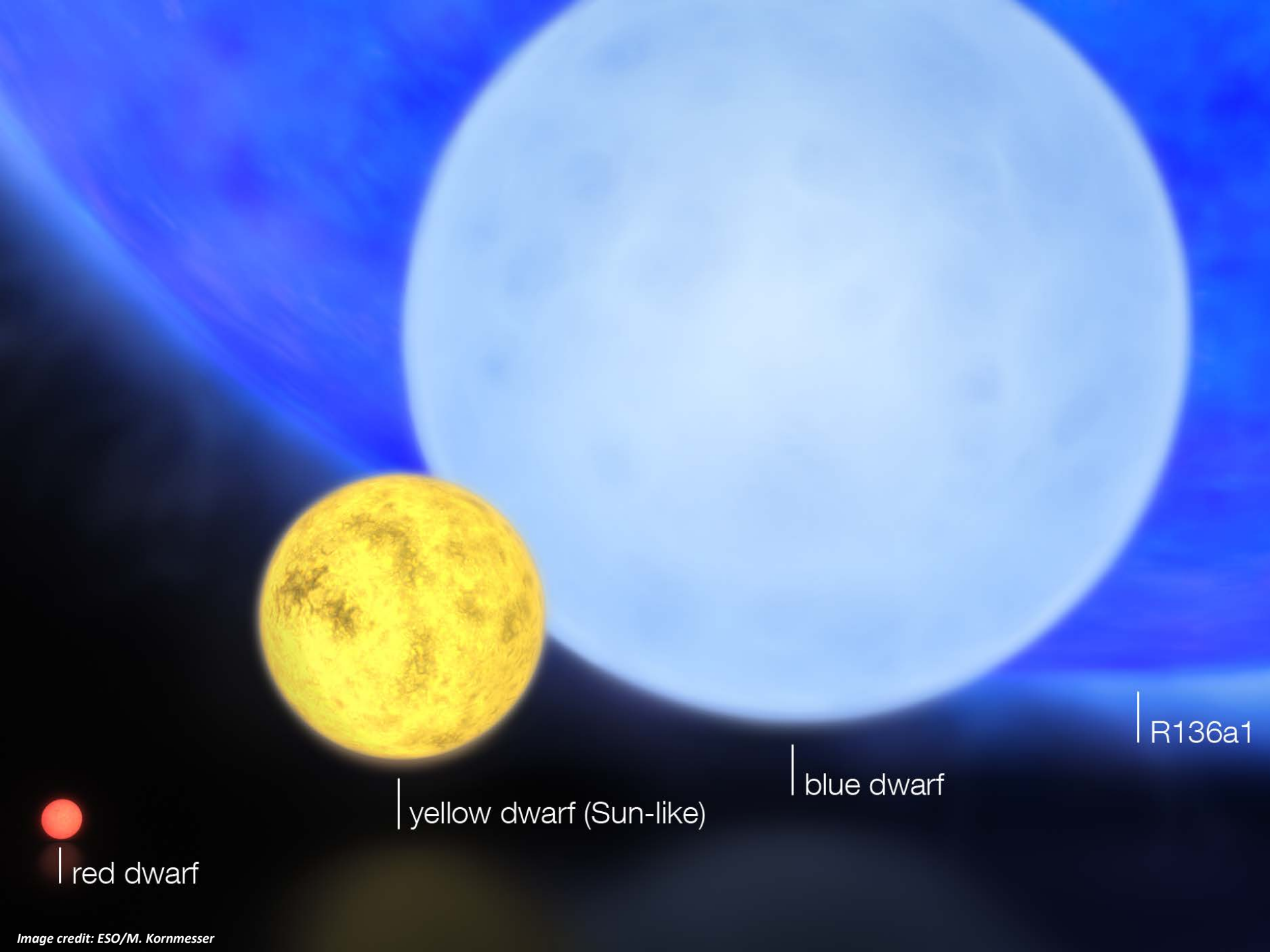


Image credit: ESO/M. Kornmesser

Nebula Spin Art

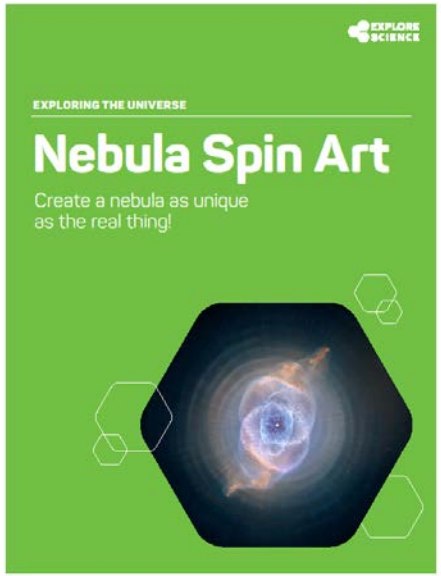


Image credit: NASA, ESA and the Hubble Heritage Team (STScI/AURA)

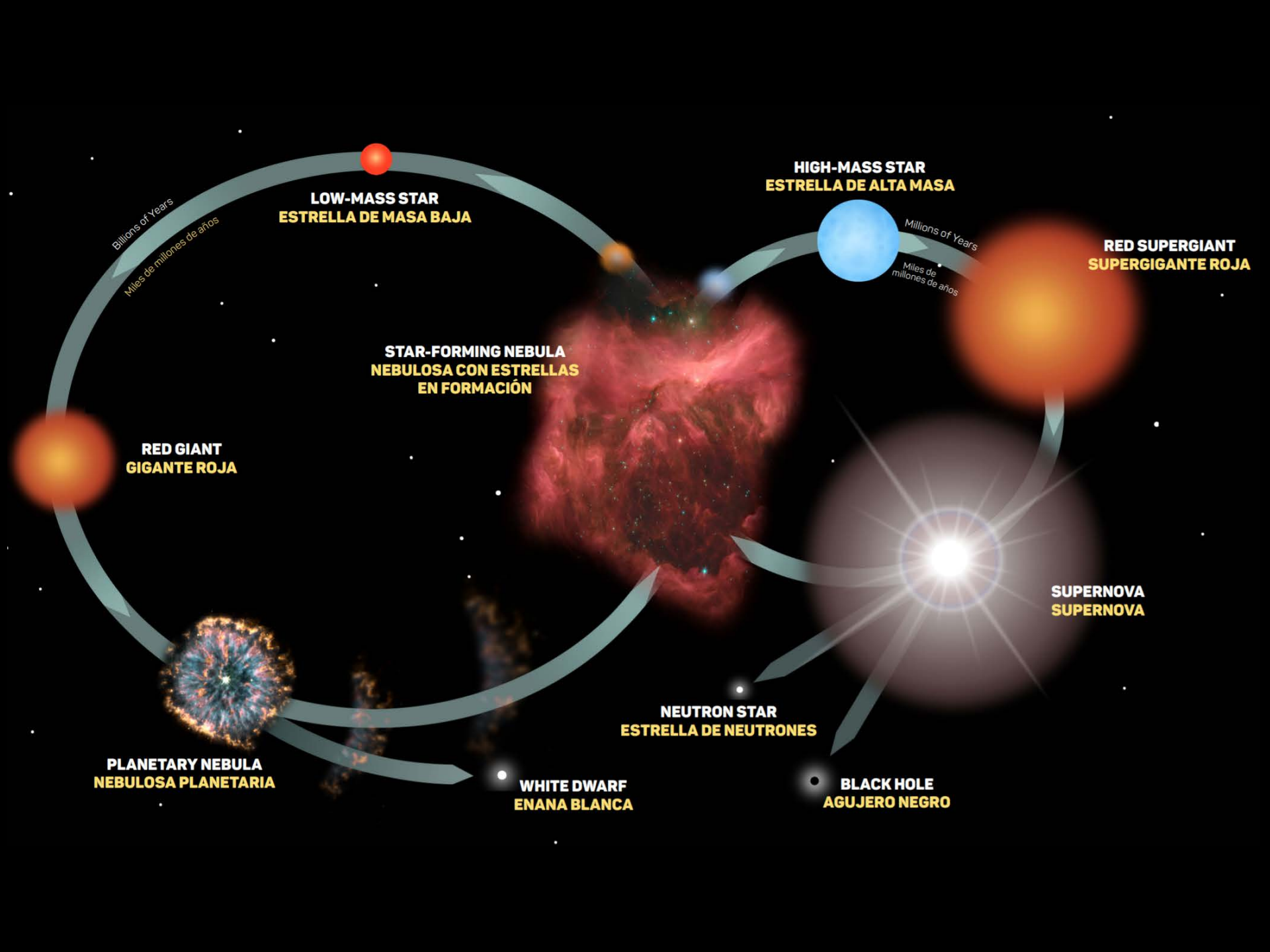

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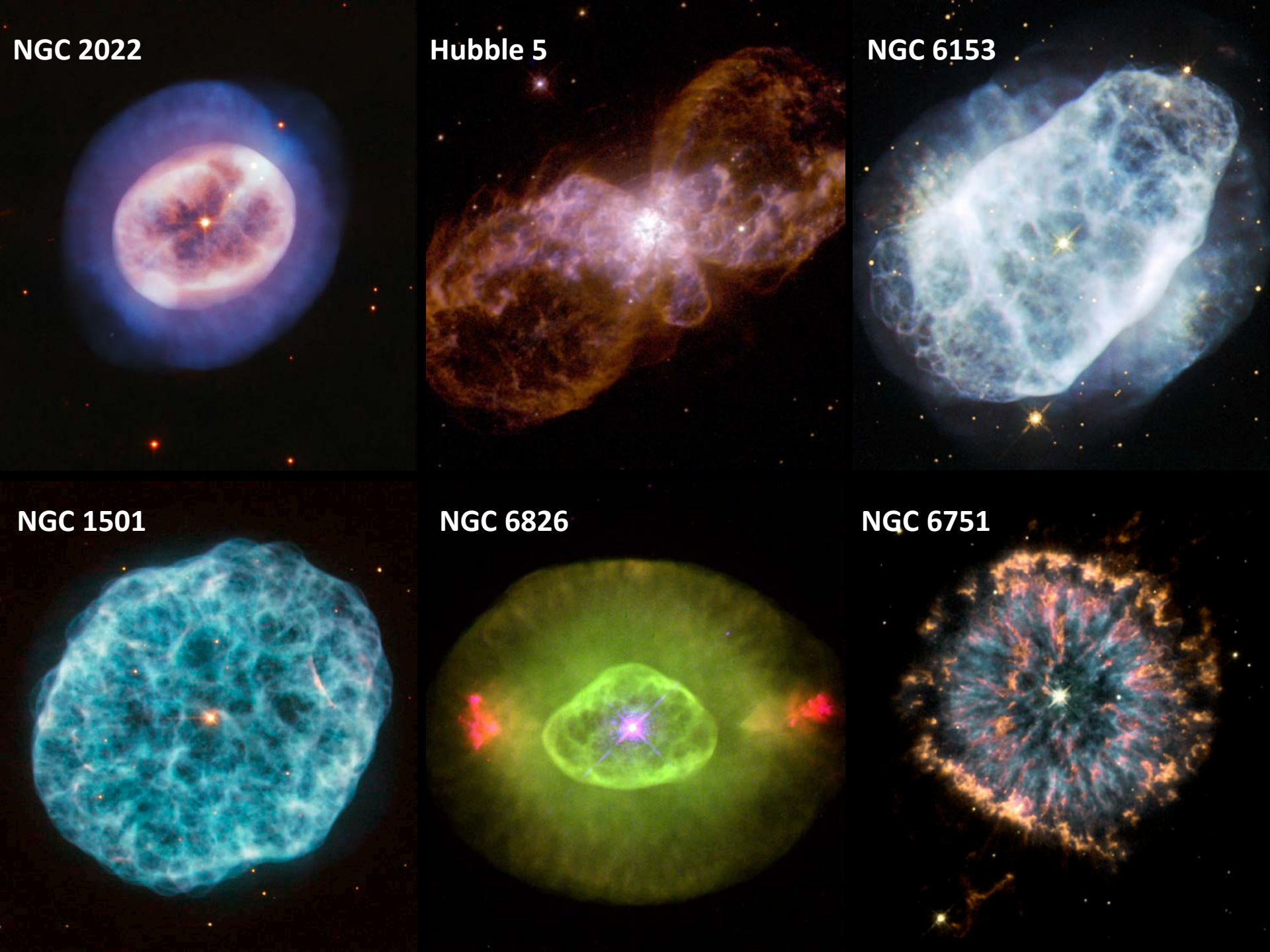
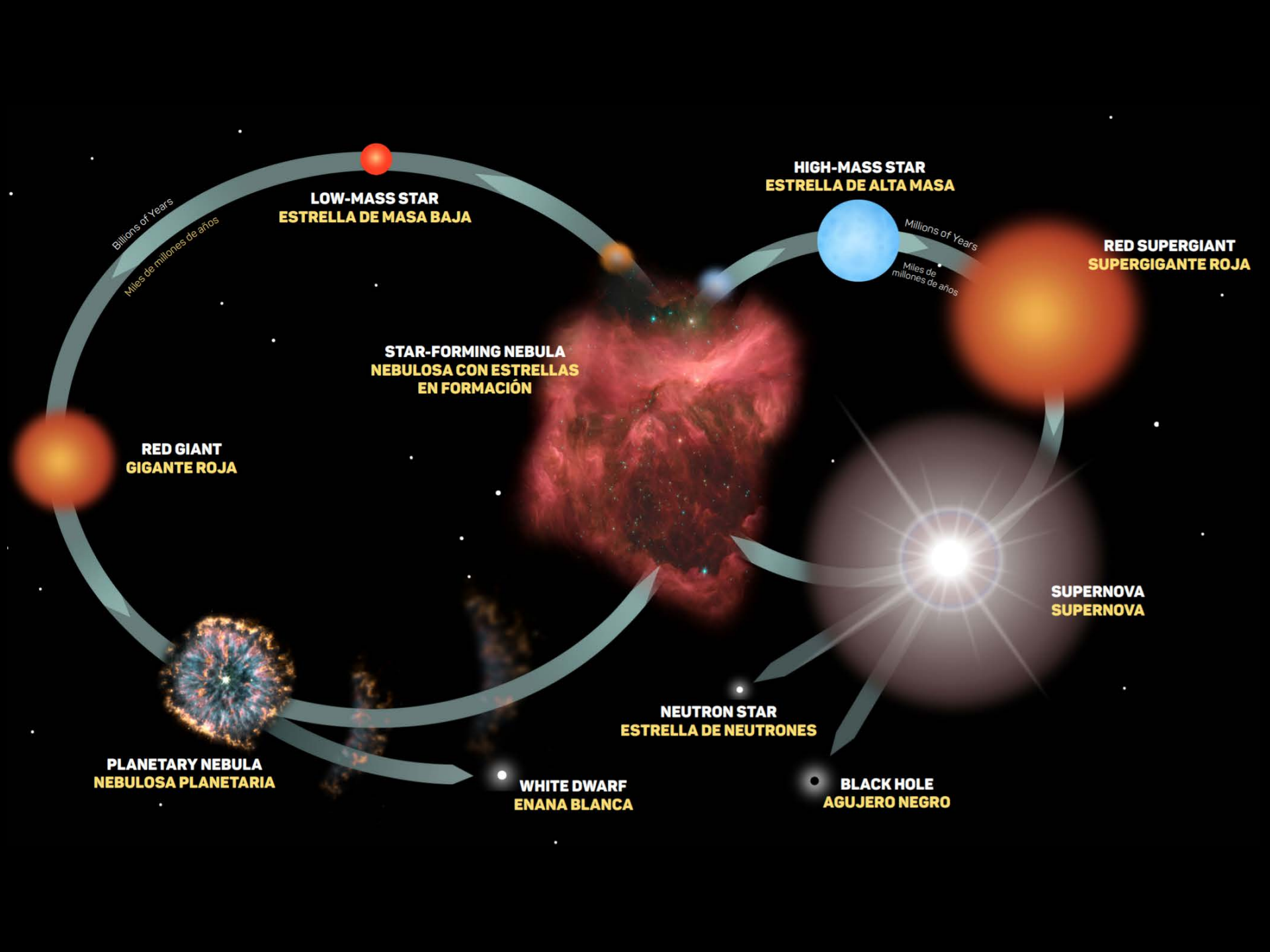
Image credit: NASA, ESA, C.R. O'Dell (Vanderbilt University), M. Meixner and P. McCullough (STScI)


NGC 2022
Hubble 5
NGC 6153
NGC 1501
NGC 6826
NGC 6751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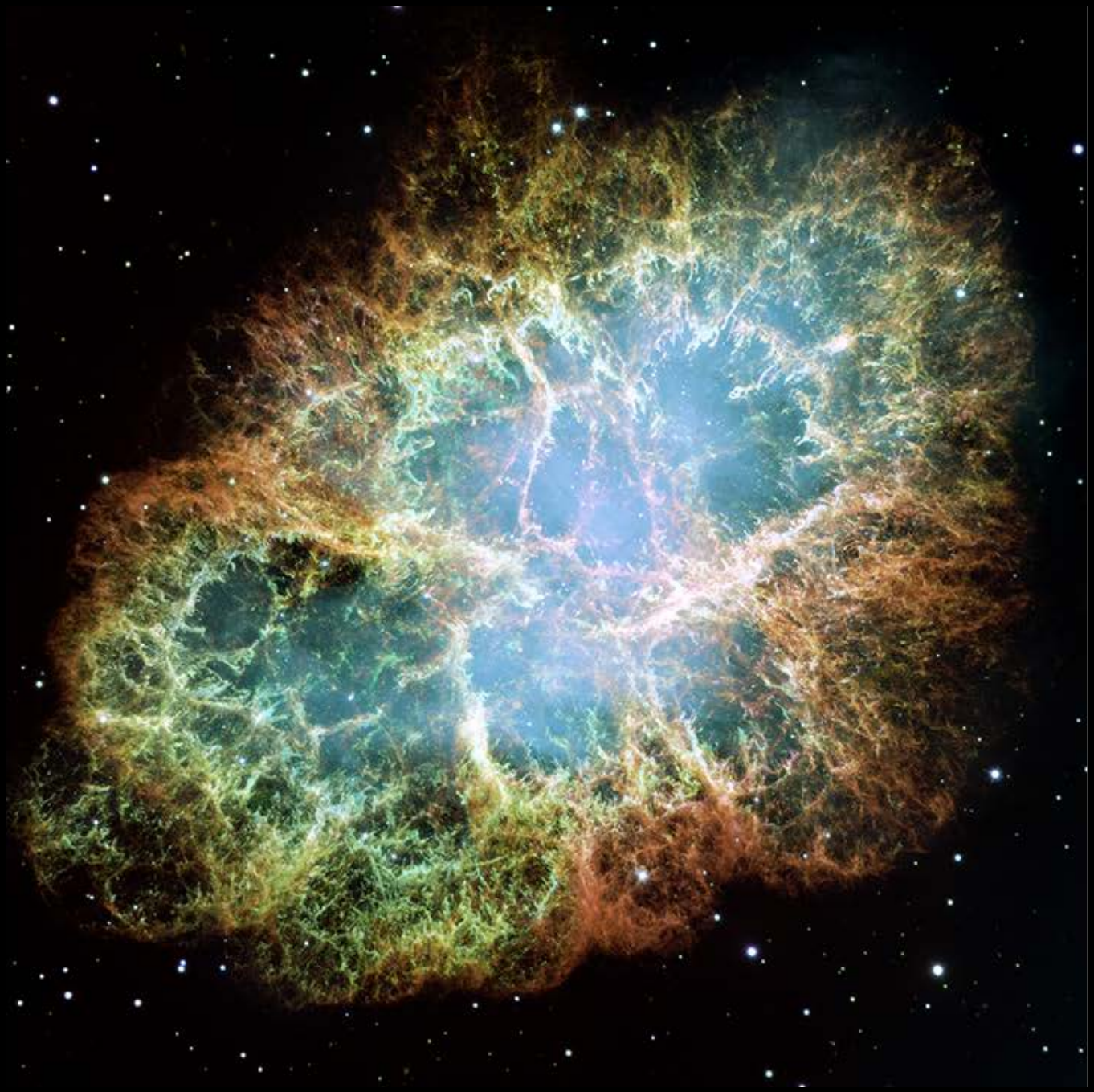


Image credit: NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

The Periodic Table of the Elements

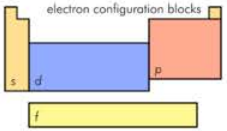
by Robert Compton version 1.4

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.00794 1 1312.0 2.20 +1 **H** Hydrogen $1s^1$																	4.002602 2 2372.3 **He** Helium $1s^2$
2	6.941 3 520.2 0.98 +1 **Li** Lithium $1s^2\ 2s^1$	9.012182 4 899.5 1.57 +2 **Be** Beryllium $1s^2\ 2s^2$											10.811 5 800.6 2.04 +3 **B** Boron $1s^2\ 2s^2\ 2p^1$	12.0107 6 1086.5 2.55 +4 −4 **C** Carbon $1s^2\ 2s^2\ 2p^2$	14.0067 7 1402.3 3.04 +5 −3 **N** Nitrogen $1s^2\ 2s^2\ 2p^3$	15.9994 8 1313.9 3.44 −2 **O** Oxygen $1s^2\ 2s^2\ 2p^4$	18.998403 9 1681.0 3.98 −1 **F** Fluorine $1s^2\ 2s^2\ 2p^5$	20.1797 10 2080.7 **Ne** Neon $1s^2\ 2s^2\ 2p^6$
3	22.98976 11 495.8 0.93 +1 **Na** Sodium [Ne] $3s^1$	24.3050 12 737.7 1.31 +2 **Mg** Magnesium [Ne] $3s^2$											26.98153 13 577.5 1.61 +3 **Al** Aluminium [Ne] $3s^2\ 3p^1$	28.0855 14 786.5 1.90 +4 −4 **Si** Silicon [Ne] $3s^2\ 3p^2$	30.97696 15 1011.8 2.19 +5 −3 **P** Phosphorus [Ne] $3s^2\ 3p^3$	32.065 16 999.6 2.58 +6 −2 **S** Sulfer [Ne] $3s^2\ 3p^4$	35.453 17 1251.2 3.16 +7 −1 **Cl** Chlorine [Ne] $3s^2\ 3p^5$	39.948 18 1520.6 **Ar** Argon [Ne] $3s^2\ 3p^6$
4	39.0983 19 418.8 0.82 +1 **K** Potassium [Ar] $4s^1$	40.078 20 589.8 1.00 +2 **Ca** Calcium [Ar] $4s^2$	44.95591 21 633.1 1.36 +3 **Sc** Scandium [Ar] $3d^1\ 4s^2$	47.867 22 658.8 1.54 +4 **Ti** Titanium [Ar] $3d^2\ 4s^2$	50.9415 23 650.9 1.63 +5 **V** Vanadium [Ar] $3d^3\ 4s^2$	51.9962 24 652.9 1.66 +6 **Cr** Chromium [Ar] $3d^5\ 4s^1$	54.93804 25 717.3 1.55 +7 **Mn** Manganese [Ar] $3d^5\ 4s^2$	55.845 26 762.5 1.83 +6 +5 +4 **+3** **+2** +1 −1 −2 **Fe** Iron [Ar] $3d^6\ 4s^2$	58.93319 27 760.4 1.91 +3 **Co** Cobalt [Ar] $3d^7\ 4s^2$	58.6934 28 737.1 1.88 +2 **Ni** Nickel [Ar] $3d^8\ 4s^2$	63.546 29 745.5 1.90 +2 **Cu** Copper [Ar] $3d^{10}\ 4s^1$	65.38 30 906.4 1.65 +2 **Zn** Zinc [Ar] $3d^{10}\ 4s^2$	69.723 31 578.8 1.81 +3 **Ga** Gallium [Ar] $3d^{10}\ 4s^2\ 4p^1$	72.64 32 762.0 2.01 +4 **Ge** Germanium [Ar] $3d^{10}\ 4s^2\ 4p^2$	74.92160 33 947.0 2.18 +5 −3 **As** Arsenic [Ar] $3d^{10}\ 4s^2\ 4p^3$	78.96 34 941.0 2.55 +6 −2 **Se** Selenium [Ar] $3d^{10}\ 4s^2\ 4p^4$	79.904 35 1139.9 2.96 +5 −1 **Br** Bromine [Ar] $3d^{10}\ 4s^2\ 4p^5$	83.798 36 1350.8 3.00 **Kr** Krypton [Ar] $3d^{10}\ 4s^2\ 4p^6$
5	85.4678 37 403.0 0.82 +1 **Rb** Rubidium [Kr] $5s^1$	87.62 38 549.5 0.95 +2 **Sr** Strontium [Kr] $5s^2$	88.90585 39 600.0 1.22 +3 **Y** Yttrium [Kr] $4d^1\ 5s^2$	91.224 40 640.1 1.33 +4 **Zr** Zirconium [Kr] $4d^2\ 5s^2$	92.90638 41 652.1 1.60 +5 **Nb** Niobium [Kr] $4d^4\ 5s^1$	95.96 42 684.3 2.16 +6 **Mo** Molybdenum [Kr] $4d^5\ 5s^1$	(98) 43 702.0 1.90 +7 **Tc** Technetium [Kr] $4d^5\ 5s^2$	101.07 44 710.2 2.20 +8 **Ru** Ruthenium [Kr] $4d^7\ 5s^1$	102.9055 45 719.7 2.28 +3 **Rh** Rhodium [Kr] $4d^8\ 5s^1$	106.42 46 804.4 2.20 +2 **Pd** Palladium [Kr] $4d^{10}$	107.8682 47 731.0 1.93 +1 **Ag** Silver [Kr] $4d^{10}\ 5s^1$	112.441 48 867.8 1.69 +2 **Cd** Cadmium [Kr] $4d^{10}\ 5s^2$	114.818 49 558.3 1.78 +3 **In** Indium [Kr] $4d^{10}\ 5s^2\ 5p^1$	118.710 50 708.6 1.96 +4 **Sn** Tin [Kr] $4d^{10}\ 5s^2\ 5p^2$	121.760 51 834.0 2.05 +5 −3 **Sb** Antimony [Kr] $4d^{10}\ 5s^2\ 5p^3$	127.60 52 869.3 2.10 +6 −2 **Te** Tellurium [Kr] $4d^{10}\ 5s^2\ 5p^4$	126.9044 53 1008.4 2.66 +7 −1 **I** Iodine [Kr] $4d^{10}\ 5s^2\ 5p^5$	131.293 54 1170.4 2.60 **Xe** Xenon [Kr] $4d^{10}\ 5s^2\ 5p^6$
6	132.9054 55 375.7 0.79 +1 **Cs** Caesium [Xe] $6s^1$	137.327 56 502.9 0.89 +2 **Ba** Barium [Xe] $6s^2$	174.9668 71 523.5 1.27 +3 **Lu** Lutetium [Xe] $4f^{14}\ 5d^1\ 6s^2$	178.49 72 658.5 1.30 +4 **Hf** Hafnium [Xe] $4f^{14}\ 5d^2\ 6s^2$	180.9478 73 761.0 1.50 +5 **Ta** Tantalum [Xe] $4f^{14}\ 5d^3\ 6s^2$	183.84 74 770.0 2.36 +6 **W** Tungsten [Xe] $4f^{14}\ 5d^4\ 6s^2$	186.207 75 760.0 1.90 +7 **Re** Rhenium [Xe] $4f^{14}\ 5d^5\ 6s^2$	190.23 76 840.0 2.20 +8 **Os** Osmium [Xe] $4f^{14}\ 5d^6\ 6s^2$	192.217 77 880.0 2.20 +3 **Ir** Iridium [Xe] $4f^{14}\ 5d^7\ 6s^2$	195.084 78 870.0 2.28 +2 **Pt** Platinum [Xe] $4f^{14}\ 5d^9\ 6s^1$	196.9665 79 890.1 2.54 +1 **Au** Gold [Xe] $4f^{14}\ 5d^{10}\ 6s^1$	200.59 80 1007.1 2.00 +2 **Hg** Mercury [Xe] $4f^{14}\ 5d^{10}\ 6s^2$	204.3833 81 589.4 1.62 +1 **Tl** Thallium [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^1$	207.2 82 715.6 2.33 +2 **Pb** Lead [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^2$	208.9804 83 703.0 2.02 +3 **Bi** Bismuth [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^3$	(210) 84 812.1 2.00 +2 +4 **Po** Polonium [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^4$	(210) 85 890.0 2.20 +1 **At** Astatine [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^5$	(220) 86 1037.0 **Rn** Radon [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^6$
7	(223) 87 380.0 0.70 +1 **Fr** Francium [Rn] $7s^1$	(226) 88 509.3 0.90 +2 **Ra** Radium [Rn] $7s^2$	(262) 103 470.0 +3 **Lr** Lawrencium [Rn] $5f^{14}\ 7s^2\ 7p^1$	(261) 104 580.0 +4 **Rf** Rutherfordium [Rn] $5f^{14}\ 6d^2\ 7s^2$	(262) 105 +5 **Db** Dubnium	(266) 106 +6 **Sg** Seaborgium	(264) 107 +7 **Bh** Bohrium	(277) 108 +8 **Hs** Hassium	(268) 109 +3 **Mt** Meitnerium	(271) 110 **Ds** Darmstadium	(272) 111 **Rg** Roentgenium	(285) 112 **Cn** Copernicium	(284) 113 **Uut** Ununtrium	(289) 114 **Uuq** Ununquadium	(288) 115 **Uup** Ununpentium	(292) 116 **Uuh** Ununhexium	117 **Uus** Ununseptium	(294) 118 **Uuo** Ununoctium

atomic mass (or most stable mass number) — 55.845
1st ionization energy (in kJ/mol) — 762.5
atomic number — 26
electronegativity — 1.83
chemical symbol — Fe
name — Iron
electron configuration — [Ar] $3d^6\ 4s^2$
oxidation states (most common are bold) — +6 +5 +4 **+3** **+2** +1 −1 −2

- alkali metals
- alkaline metals
- other metals
- transition metals
- lanthanoids
- actinoids
- metalloids
- nonmetals
- halogens
- noble gases
- unknown elements
- radioactive elements have masses in parenthesis

138.9054 57 538.1 1.10 +3 **La** Lanthanum [Xe] $5d^1\ 6s^2$	140.116 58 534.4 1.12 +3 +4 **Ce** Cerium [Xe] $4f^1\ 5d^1\ 6s^2$	140.9076 59 527.0 1.13 +3 **Pr** Praseodymium [Xe] $4f^3\ 6s^2$	144.242 60 533.1 1.14 +3 **Nd** Neodymium [Xe] $4f^4\ 6s^2$	(145) 61 540.0 +3 **Pm** Promethium [Xe] $4f^5\ 6s^2$	150.36 62 544.5 1.17 +3 **Sm** Samarium [Xe] $4f^6\ 6s^2$	151.964 63 547.1 +3 **Eu** Europium [Xe] $4f^7\ 6s^2$	157.25 64 593.4 1.20 +3 **Gd** Gadolinium [Xe] $4f^7\ 5d^1\ 6s^2$	158.9253 65 565.8 +3 **Tb** Terbium [Xe] $4f^9\ 6s^2$	162.500 66 573.0 1.22 +3 **Dy** Dysprosium [Xe] $4f^{10}\ 6s^2$	164.9303 67 581.0 1.23 +3 **Ho** Holmium [Xe] $4f^{11}\ 6s^2$	167.259 68 589.3 1.24 +3 **Er** Erbium [Xe] $4f^{12}\ 6s^2$	168.9342 69 596.7 1.25 +3 **Tm** Thulium [Xe] $4f^{13}\ 6s^2$	173.054 70 603.4 +3 **Yb** Ytterbium [Xe] $4f^{14}\ 6s^2$
(227) 89 499.0 1.10 +3 **Ac** Actinium [Rn] $6d^1\ 7s^2$	232.0380 90 587.0 1.30 +4 **Th** Thorium [Rn] $6d^2\ 7s^2$	231.0358 91 568.0 1.50 +5 **Pa** Protactinium [Rn] $5f^2\ 6d^1\ 7s^2$	238.0289 92 597.6 1.38 +6 **U** Uranium [Rn] $5f^3\ 6d^1\ 7s^2$	(237) 93 604.5 1.36 +5 **Np** Neptunium [Rn] $5f^4\ 6d^1\ 7s^2$	(244) 94 584.7 1.28 +4 **Pu** Plutonium [Rn] $5f^6\ 7s^2$	(243) 95 578.0 1.30 +3 **Am** Americium [Rn] $5f^7\ 7s^2$	(247) 96 581.0 1.30 +3 **Cm** Curium [Rn] $5f^7\ 6d^1\ 7s^2$	(247) 97 601.0 1.30 +3 **Bk** Berkelium [Rn] $5f^9\ 7s^2$	(251) 98 608.0 1.30 +3 **Cf** Californium [Rn] $5f^{10}\ 7s^2$	(252) 99 619.0 1.30 +3 **Es** Einsteinium [Rn] $5f^{11}\ 6s^2$	(257) 100 627.0 1.30 +3 **Fm** Fermium [Rn] $5f^{12}\ 7s^2$	(258) 101 635.0 1.30 +3 **Md** Mendelevium [Rn] $5f^{13}\ 7s^2$	(259) 102 642.0 1.30 +3 **No** Nobelium [Rn] $5f^{14}\ 7s^2$



notes

- as of yet, elements 113-118 have no official name designated by the IUPAC.
- 1 kJ/mol ≈ 96.485 eV.
- all elements are implied to have an oxidation state of zero.

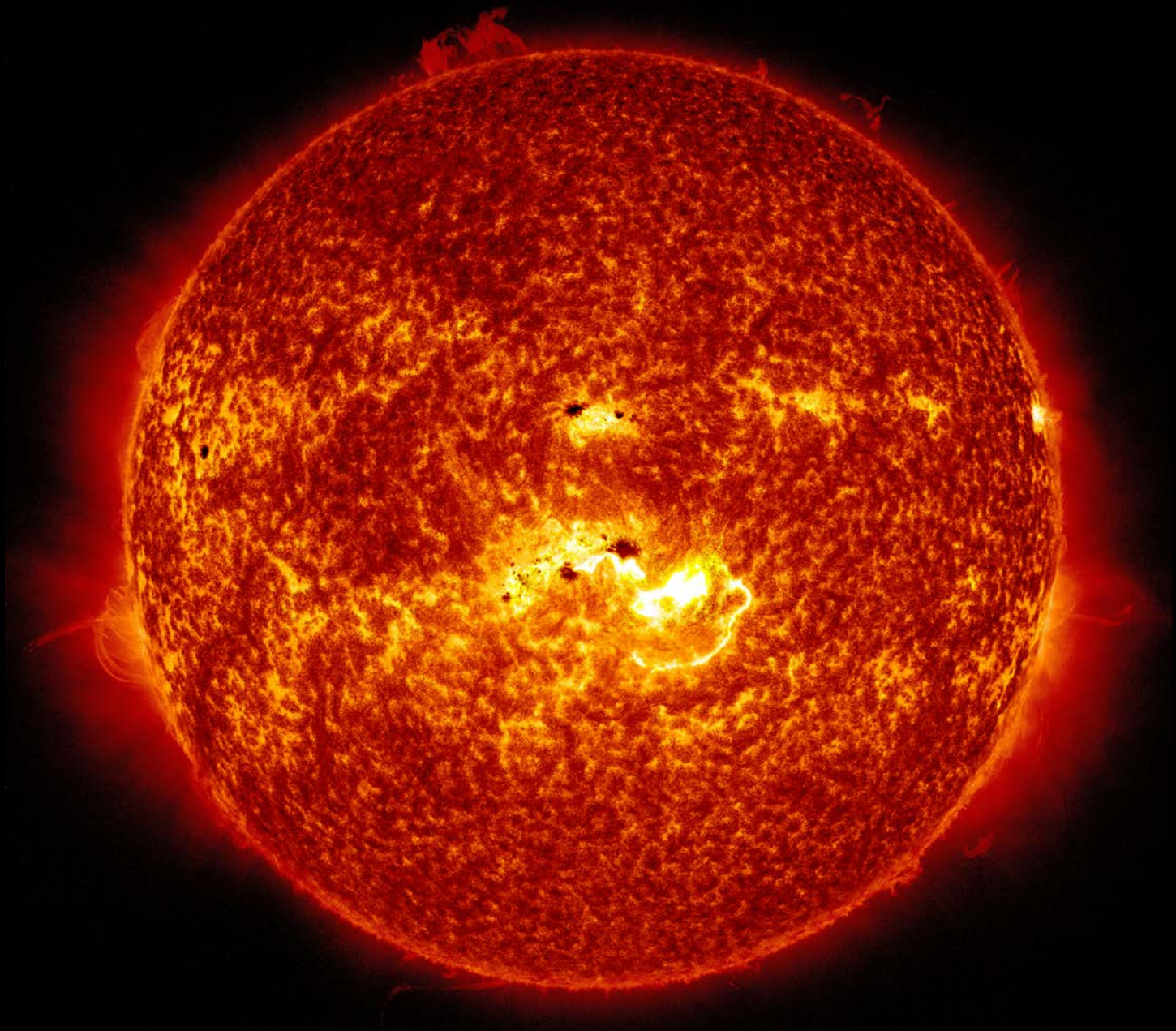


Image credit: NASA/SDO

Image credit: Image Science and Analysis Laboratory, NASA-Johnson Space Center

Questions?

Our Next Workshop

The Science Behind the 2020 Explore Science: Earth and Space Toolkit – Asteroid Mining (Part 3)

Dr. Jim Bell

Tuesday, March 24, 2020: 2pm-3pm Eastern / 11am-12pm Pacific

Sustainability Series

SUSTAINABLE FUTURES

This three-part series of online workshops is aimed at supporting Network partners in engaging their staff, visitors and communities in creating a sustainable future. Participants will also learn about new NISE Network public programming resources for use in your Earth Day 2020 offerings and beyond.

Sustainability in Museums Around the World: Working Together to Create a Sustainable Future

Tuesday, February 18
2-3pm Eastern / 11am-12pm Pacific

Sustainability and Museum Operations: Practices, Partnerships, and Resources to Help Your Organization Become More Sustainable

Tuesday, February 25
2-3pm Eastern / 11am-12pm Pacific

Sustainability and Museum Visitors: Exhibits, Programs, and Other Ways to Engage the Public

Tuesday, March 3
2-3pm Eastern / 11am-12pm Pacific

Check out nisenet.org/earth50 for all your Earth Day resources!

Toolkits shipped!

Get Involved

Learn more and access the
NISE Network's online digital resources
nisenet.org

Subscribe to the monthly newsletter
nisenet.org/newsletter

Continue the toolkit conversation
bit.ly/nisenetryver

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Thank You

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NATIONAL INFORMAL STEM EDUCATION NETWORK

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