Bay Area Scientists in Schools Presentation Plan

Lesson Name Where Did All the Stars Come From?! The Life Cycle of Stars

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Grade Level 3rd **Standards Connection(s)** Astronomy; specifically star formation & life cycle

California Science Standards:
3rd Grade Earth Sciences: Objects in the sky move in regular and predictable patterns
c. Students know telescopes magnify the appearance of some distant objects in the sky including the Moon and the planets. The number of stars that can be seen through telescopes is dramatically greater than the number that can be seen by the unaided eye.
d. Students know that Earth is one of several planets that orbit the Sun and that the Moon orbits Earth.

Teaser:
The stars we see in the night sky could be over 1 million years old! Stars have life cycles just like humans do. During this lesson, students will explore the universe and learn about the different stages of a star's lifecycle. They will then use their knowledge to play a game and even learn about a very mysterious stage in a star's life: the black hole!

Objective:
After this lesson, students will know more about the life cycle of a star including what happens to cause each change. Also, the students will learn about black holes and how their immense gravitational pull can warp space-time!

Vocabulary/Definitions:
Nebula: a cloud of gas and dust in outer space.
Red Giant: a very large star of high luminosity and low surface temperature.
Supernova: an extremely bright star that results from a huge explosion that ejects most of its mass.
Planetary Nebula: a ring-shaped nebula that is composed of matter ejected from an aging star.
White Dwarf: a small, extremely dense, planet-sized star that results when a star runs out of fuel.
Black Hole: An area in space where gravity is so strong that nothing, not even light, can escape.

Materials:

What will you bring with you?	*What should students have ready?*
Laptop & projector. Jars of glitter and water (nebula) Star Life Cycle Game. Black Hole Simulation: - Large stretchy fabric, marbles & heavy ball. Indoor star light show projector.	Science notebooks to take notes if necessary

Classroom Set-up:
Please help us make the windows blacked out (for black hole demonstration) so the star projections can be seen clearly.

Classroom Visit Outline

1. Personal Introduction: 2 – 3 Min

The scientists will have a chance to introduce themselves.

2. Topic Introduction: 15 Min

Today we are going to talk about stars. How many of you have looked up at night and wondered what these little dots of light are and where they come from? Well, I'm here to tell you what scientists have discovered about the life of stars so far.

In 1915 Albert Einstein discovered the math behind a mysterious force called gravity. He noted that if any object has *mass* and takes up *space* it will have a *gravitational force*. Is that true? How can we check that?

Does the Earth have mass?
Does the Earth take up space?
Does the Earth have gravity?
Then Einstein's theory holds up!

Years later we discovered that all we need to make a star is gravity, hydrogen and time (100s of thousands of years to be exact!). After the birth of the universe (known as the big bang) the explosion left behind huge clouds of gas and dust called *nebulas.* In some areas, the gas was closer together, or more dense. We know from chemistry that when things get closer together and bump into each other they get hotter. As the cloud gets hotter and bigger, gravity attracts more stuff to it to form a super-hot, super-dense ball called a *protostar*. Over the next million years as pressure builds, the protostar becomes a smaller, brighter and hotter young star.

But how does the star stay alive once it's born? What does it "eat"? It turns out that when the star gets really hot, about 15 million degrees hot, a process called *fusion* takes place in the core of the star. Fusion is where two atoms bond together under extreme pressure & heat and in the process

release tremendous amounts of energy - some of which we see as light. This is why stars shine.

So now you know how stars are born and why they shine. But are all stars the same?? Absolutely not!

There are many different types of stars and it turns out the star's size determines what kind of star it will be. Let me tell you a story of two stars that were made of the same thing, but turned out to be very different. What shall we name our two stars?

Star A was born an average star, not too big and not too small (like our sun). An average star ejects a ring-shaped cloud of matter when it's born called a *planetary nebula* where planets like Earth eventually form. Over the course of its life of billions of years Star A burns up most of its fuel and turns into a *Red Giant*. A red giant has a relatively low temperature compared to its younger self. As it gets older and weaker some of the gas and dust manage to escape the center of the star and all that remains is a small dense mass called a *white dwarf*. The white dwarf eventually burns off all the remaining fuel and dissolves away quietly in the cold darkness of space billions of years later.

Star B was born a MASSIVE star and eventually got so big and became what we call a *Red Supergiant.* A red supergiant is about 10 times the mass of the sun and burns through its fuel much quicker than smaller stars. Eventually the star become so massive it collapses on to itself in a HUGE explosion called a *supernova.* A supernova explosion produces a tremendous burst of energy that makes them the brightest things in the universe. However, if a star is big enough it will be so massive that it will collapse on to itself, creating a *black hole.*

Trick question: how many of you have seen a black hole before?

No one can "see" a black hole because its gravity is so strong that light can't even escape! But we know they exist because we can see and predict the effects they have on the nebulas and stars around them.

3. Learning Experience(s): 25 Min

a. Activity: Star Life Cycle game
   i. Each student will receive a card. They must read their card to determine what stage of a star's life cycle they are and then must read and answer the question at the bottom of their card to find the next stage of the life cycle.
   ii. They must go up to other students and ask them what they are. When they find the person whose card answers their questions, they must link up with them and find the next person in the life cycle.
   iii. The team that links up all of the star life cycle stages correctly first, wins!

b. Black Hole Demonstration
   i. Ask for student volunteers (maybe the winners of the previous game?) and have them hold on the edge of the fabric and stretch it out (not too far).

ii. Show projection of stars to make it more 'realistic' for students (need to black out windows for optimum viewing)
iii. Talk about how the fabric represents space-time with the horizontal threads representing space and the vertical threads representing time. Notice how they are all about the same length and distance apart from each other.
iv. Talk about black holes and how strong their gravitational pull is. Demonstrate this by placing a heavy ball in the middle of the fabric. The fabric threads will stretch differently than before. Ask the students what happened to the fabric threads.
v. Add marbles to show orbit of planets and how they fall toward the black hole. Why do they think this happened? What does it mean for time as we get closer to the edge of the black hole?

4. Wrap-up: 10 Min

I would like to hear from the class about one new thing they learned about the stars. [Write responses on the board]

5. Connections & Close: 5 Min

a. What are some other things that you could see through a telescope in space?
b. How do you think those celestial objects came to be?
c. We know that some stars shine brighter than others. When you look through a telescope, try to make an observation about what kind of star you might be looking at.

Total 50 – 60 Minutes

Follow-up – After Presentation

1. Students can write a letter to the scientists explaining what they learned during the visit. Please send all letters to:

Community Resources for Science
1611 San Pablo Ave Ste. 10B
Berkeley, CA 94702

2. Astronomy Resources for Teachers
http://www.csun.edu/science/geoscience/astronomy/
http://astronomy.starrynight.com/content/free-astronomy-teaching-resources
3. Star Life Cycle Resources
www.montessoritraining.net/elementary_program/courses/matter_astronomy/sample_lessons.pdf
http://imagine.gsfc.nasa.gov/
4. Star Stuff: Carl Sagan and the Mysteries of the Cosmos by Stephanie Roth Sisson
The Magic School Bus: Lost in the Solar System by Bruce Degen
Cosmos by Giles Sparrow