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Improv with the Stars!

Overview

After learning about four stellar classifications and the characteristics of stars, groups of students act out an improvisation of a personification of the four stars while the audience has to guess which star type is which.

What's the point?

The planets in the Solar System orbit the Sun, but the Sun is one of billions of stars in the Milky Way Galaxy. The Milky Way Galaxy is one of an estimated 100 billion galaxies, and our galaxy alone has an estimated 100 to 400 billion stars! These numbers are estimated because the more we look at our galaxy and within the Universe, our understanding of it improves. Stars come in many sizes. The bigger the star, the brighter and hotter it is. Bigger stars don't live as long as smaller stars, but smaller stars tend to have a lot more storms. Smaller stars outnumber the big stars.

In this activity, students will learn about different types of stars found in the Milky Way Galaxy.

Learning goals

After doing this activity, students will be able to:

- Explain the difference between a bright, hot star and a dim, small star
- Explain stellar classification

Time

One hour

Materials

Materials per student:

- Copy of the Quick Guide to Stellar Classification
- At least five copies of Star Classification per student, cut into half sheets

Materials per actor:

- One of each "Star Status" sheet in a sheet protector

Preparation

- Make copies of student sheets

Alternate ideas

- Many improv games exist. Students can even come up with their own games.
- This could also be a writing exercise where students create dialogue or come up with additional stories about the stars.
- Offer prizes to students who guess the star classifications correctly

Procedure

- Pass out the "Quick Guide to Stellar Classification" sheets and give students time to read and discuss the material
- Tell students, "We are going to play a game. We are going to pretend that stars have personalities and are famous. Some stars are really big, bright stars, and those will be the O, B and A class stars. Some are more average stars, the F, G, K and M stars. Some students are going to act out a role of a star "personality." You'll have to decide, based upon the way they act, what star class each actor is representing."
- Remind students that the Sun is a star and looks the brightest in our sky. Other stars are very very far away, so even the biggest and brightest stars appear dim compared to the Sun.
- Familiarize students with the concepts of improvisation.
- Tell students that they can opt to be in the audience, but can also volunteer to act.
- Students should write down the star's name and guess the classification on the Star Classification half sheets.

Game 1: Stars Stuck in an Elevator

Choose 2-3 students.

- Take volunteers to be the actors
- Choose a role for each of the students from the Star Status Sheets
- Without the audience overhearing, tell the actors they will be stuck in an elevator together. They are not to reveal their star's classification to the audience, but can reveal other information from the Star Classification Sheets.
- Students should read their Star Status Sheets, and also the sheets of the other actors

- Give them a few minutes to think about how they will act onstage, and assist if necessary.
- Tell students to say their name at some point during the "show."
- Tell the audience that the actors are stuck in an elevator together and that they are famous stars. Based upon how they act, the audience has to decide what class star each of the actors is representing. Students should mark the star classification sheets and circle a star class guess for each star.

Game 2: The audition

- One student will be the director for a major movie, interviewing actors.
- Choose 3-5 students to portray roles from the Star Status Sheets
- Each student should read their role and decide how they will act during an interview for a part in the movie. They may read the roles of the other actors quietly and without the audience overhearing.
- Tell the audience that the actors are auditioning for a role in a major movie. Based upon how they act, the audience has to decide what class star each of the actors is representing.
- The director will "audition" and interview each star (name, what role they think they should be in the movie, details about themselves). The director might also, for example, ask a star to sing a song, dance, or pretend to read from a script. The director should ask stars some questions about themselves. Students should mark the star classification sheets and circle a star class guess for each star.

Safety Tips

Remind students never to stare at the sun. Staring at the sun can cause serious eye injury.

Notes: No F class stars are in the activity because they are very close in size to G class stars.

Credits and Inspiration:

Bennett, J. et al, The Cosmic Perspective, 6th edition, Addison-Wesley, 2010.

Kepler Mission website: http://www.nasa.gov/mission_pages/kepler/main/index.html

Space.com was exceedingly helpful for gathering information.

Wikipedia was referenced for temperature, mass, age and classification information, as well for some open-source images.

Simbad Astronomical Database was used to confirm stellar classifications: http://simbad.u-strasbg.fr/simbad/

Jude Schanzer, East Meadow Public Library in New York, provided the inspiration for this lesson.

Name of Star: *Star Classification*

Mass of the star (place an "X" along the line)

Most massive O Class | Like the Sun G Class | Least massive M Class

Temperature of the star (place an "X" along the line)

Hottest (Blue) O Class | Like the Sun G Class | Coolest (Red) M Class

Guess which classification this star is in (circle your answer):

O B A F G K M

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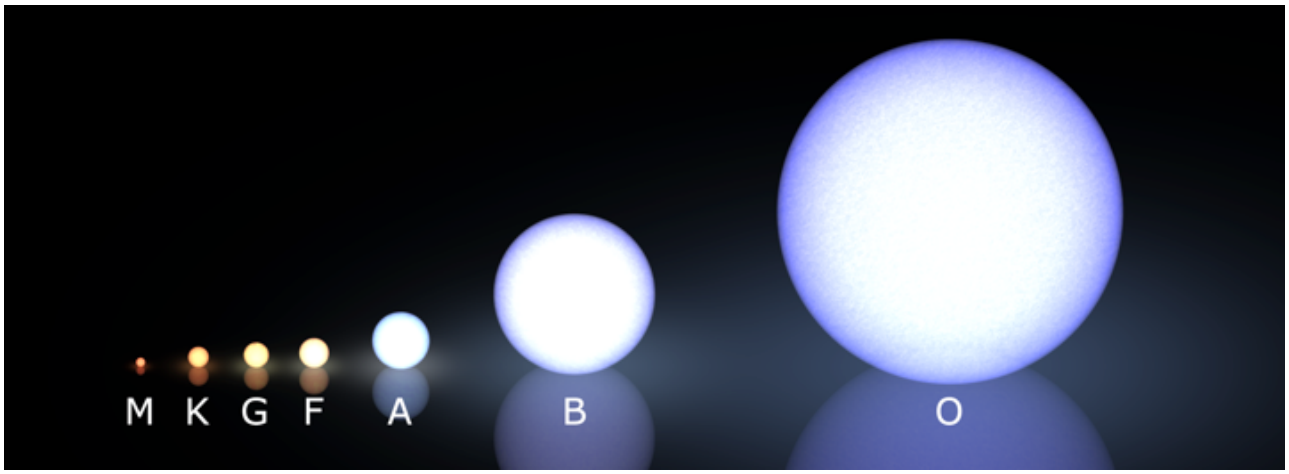
A Quick Guide to Stellar Classification



O Class

About: Largest, brightest, hottest, and most rare stars. They consume fuel very quickly, and don't live for more than about 10 million years. The bigger they are, the less long they live.

Mass: Greater than fifteen times the mass of the Sun.

Temperature: Greater than six times hotter than the Sun.

Color: Blue

How they die: These stars expand to become supergiant stars after they consume most of their fuel. Eventually, they supernova (explode).

A Class

About: These stars live between about 1 billion and 10 billion years.

Mass: Between about 1.5 and two times the mass of the Sun

Temperature: Between about 1.5 and two times the temperature of the Sun

Color: bluish white

How they die: These stars become a red giant. The outer layers of the star expand before they blow off into space leaving a white dwarf star behind.

B Class

About: These stars are similar to O stars, however there are more B class stars than O class stars. They live between 10 to 900 million years. The bigger they are, the less long they live.

Mass: Between about two and fifteen times the mass of the Sun

Temperature: Between about two to six times hotter than the Sun

Color: Bluish or blue-white

How they die: If they are greater than eight times the mass of the Sun, they die like O class stars. If they are less than eight times the mass of the Sun, they still become a supergiant star, but instead of exploding, the outer layers of the star blow off into space and leave a white dwarf star behind. A white dwarf star is like a glowing piece of coal.

F Class

About: These stars live around 10 billion years.

Mass: Between about one and 1.5 times the mass of the Sun

Temperature: Between about one and 1.5 times the temperature of the Sun

Color: yellowish white

How they die: Similarly to A Class stars.

G Class

About: These stars live around 10 billion years. The Sun is a G class star.

Mass: Around the mass of the Sun.

Temperature: Around the temperature of the Sun.

Color: Yellowish white/ white

How they die: Similarly to A Class stars.

K Class

About: These stars live from 15 billion to around 30 billion years

Mass: About 0.5 to 0.8 times the mass of the Sun (smaller than the Sun)

Temperature: Around 0.6 to 0.9 times the temperature of the Sun (cooler than the Sun)

Color: Reddish white/orange

How they die: Similarly to A class stars.

M Class

About: 70% of all stars in the Milky Way are M class. They live from 30 billion to possibly trillions of years.

Mass: From about 0.1 to 0.5 times the mass of the Sun (much smaller than the Sun)

Temperature: Less than 0.6 times the temperature of the Sun

Color: Reddish

How they die: Similarly to A class stars.

G, K, and M class stars and the search for planets

We haven't found life anywhere but Earth—but the Kepler Mission is looking for planets similar to Earth orbiting stars like the Sun (G, K, and M class). Kepler's seeking planets in the habitable zone, an area around stars where liquid water could exist, also called the Goldilocks zone (not too hot, not too cold, but just right). Life on Earth requires liquid water and is in the Goldilocks zone around our G class star, the Sun! A planet in the Goldilocks zone doesn't necessarily have water or life, but the possibility exists.

G, K and M class stars live a long time, and life takes a long time to evolve. The oldest fossil on Earth is 3.8 billion years old. It's a fossil of bacteria that was living 700 million years after Earth formed. That means it took 700 million years to form the bacteria! On a planet orbiting a B Class star that only lives 900 million years, would life have time to evolve before the star dies?

G, K, and M stars have storms like flares, which produce X rays, and Coronal Mass Ejections (CMEs), explosions of material. M class stars have the most storms, and some flare so frequently, they are called "flare stars." Earth's atmosphere protects us from flares and our magnetic field shields us from CMEs. Kepler can't tell anything about the atmosphere or magnetic field of a planet, but a planet would need to both to be habitable.

As of 2015, Kepler has found over 2,000 planets orbiting stars, but only 12 are similar in size to Earth in the Goldilocks zone. The Kepler team is looking at the data to confirm nearly 5,000 more planet candidates, so these numbers can only go up!

Star Status

Zeta Ophiuchi (Zay-tah Oaf-few-key)

Star type: O class

Color: Blue

Temperature: Six times the Sun

Mass: 19 times the Sun

Interesting facts: Moving at a huge speed through the galaxy, and creating shockwaves. Considered a runaway star.

Age: A young star, at only 3 million years old, based upon size, is likely to die in another 3 million years because it consumes fuel very quickly. It is expected to expand into a red supergiant before it goes supernova.

Zeta Ophiuchi (star near the center) creating shock waves in the gas and dust surrounding it, seen here in infrared. Courtesy NASA

Star Magazine: Star spotting

One of the hottest stars out there today, Zeta Ophiuchi made her debut on Broadway at a young age. Just a few (million) years later, she is a runaway star, flying through Hollywood faster than most other stars, and literally creating shockwaves in the Hollywood community. Zeta has a bigger presence on the set, and glows more brightly than most other stars. There just aren't very many like Zeta on the scene today.

Critics of Zeta say that this bright star's days are numbered. With late-night partying and excessive consumption of doughnuts she's been caught consuming on the set, some wonder when her waistline will expand—so far, so good—Zeta has a great metabolism, and stuns her fans and critics alike with her shocking beauty. She seems to have little time for her fans, however, as she rushes from studio and star-studded location to the next. Some are suspecting she's a stuck-up diva.

Recently, former friend and rap-star, Sirius A, said, "I got so sick of her running off on me at parties and stuff. She's always got to move through the crowd so she can be "seen." She thinks she's hot stuff."

Star Status

Eta Ursae Majoris (eh-tah ur-say ma-jor-iss)

Common Name: Alkaid (Ahl-kayed)

Star type: B class

Color: Blue-white

Temperature: Three times the Sun

Mass: Six times the Sun

Interesting facts: The last and brightest star in the handle of the Big Dipper. For latitudes above 41 degrees on Earth, the stars of the Big Dipper never set because they are circumpolar (they circle the North Star, also called Polaris (pole-air-iss)).

Age: Ten million years old, will live for about 35 million more years before it becomes a red supergiant, eventually blows off its outer layers and ends life as a white dwarf star.

The Big Dipper appears over a home. Eta Ursae Majoris is the star closest to the roof. Wikicommons, share alike

Star Magazine Exclusive Interview

Recently, Star Magazine caught up with one of our favorite stars, Alkaid, to talk about life, fame, and the future. Check out our interview:

SM: So, when we last talked to you, you were making headlines in large parts of the United States, and you seem to be popular in some really big cities.

A: Yeah, that's true. There are some places like New York and San Francisco where my show is on all the time! Even if people don't recognize me specifically, they are really familiar with the cast. The name of my cast, Big Dipper, is a household name, even if I'm not.

SM: But you are definitely a big star. People say you are hotter than the Sun! How do you feel about that?

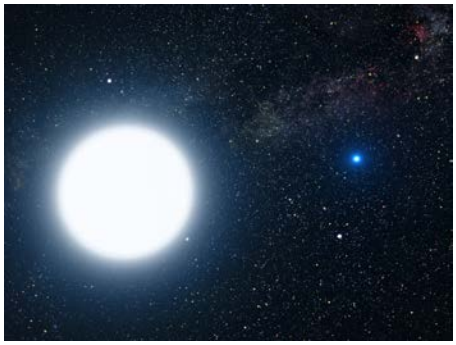
A: Well, it's pretty humbling this early on in my career to be told things like that. Sun has been a star for, like, five billion years! I think I'd burn out. When Sun is onstage, I feel like I can finally breathe because I don't have so many people focused on me. Sun is super reliable and I can just relax. Although, then, I hit the European and Asian scene… so I guess I can never just switch off. When the lights go out, I come onstage for a big part of the world, and I've got to be on my game.

SM: Where do you think you're headed in the future?

A: I plan to keep doing what I love for the next ninety (million) years if I can, and then I think I'll settle down someplace cool.

Star Status

Sirius A (sounds like “serious”)



Sirius A with dim companion, Sirius B, courtesy of NASA

Common name: The Dog Star

Star type: A class

Color: Bluish white

Temperature: about 1.5 times hotter than the Sun

Mass: Two times more massive than the Sun

Interesting facts: Called the Dog Star because it is the brightest star in Canis Major, a constellation of a dog. It is also the brightest star in our sky (aside from the Sun) because it is fairly close to the Earth, so looks much brighter than most stars. It has a companion star called Sirius B, a small white dwarf, that orbits Sirius A. Sirius B is so faint, it can only be seen through a telescope.

Age: About 250 million years old, will live at least 500 million more years before it becomes a red supergiant, eventually blows off its outer layers and ends life as a white dwarf

Star Magazine: Star spotting

What can we say about rap star, Sirius A that he hasn’t said himself, like in his lyrics to *Siriously* on his hit album *Dog Daze*: “I’m not that big, but I’m bigger than you. I’m not that bright but I’m smarter than you, too. Dang, Dog, are you jokin’? No, I’m Sirius! A! And this little guy is Sirius B.”

So, Sirius A comes across as a little bit egotistical. While his music career is topping the charts, his acting career hasn’t been so successful with appearances in low-budget films that look glitzy, but fall flat. To top it off, he has made an impression as someone who doesn’t work well with others.

“He totally upstaged me at the music awards last year,” complained Kepler-62, Sirius A’s co-host at the music awards. “We were supposed to, you know, introduce the winners of the award and make small talk. Sirius came in this sequined suit and got so close to the camera he looked brighter than anybody who walked onstage. Looking bright doesn’t make you look smarter.”

Last week, during a party at the home of famous stage actor, Alkaid, Sirius A broke up with long-term girlfriend, Zeta Ophiuchi (Zay-tah Oaf-few-key). Said Alkaid, “Sirius got in my face about being brighter than me. I was thinking, please, Dog, I went to Harvard—and shortly after he started yelling at Zeta, and I saw her jet off.”

His faithful sidekick, Sirius B, is almost never seen in public and could not be reached for comment.

Star Status

The Sun

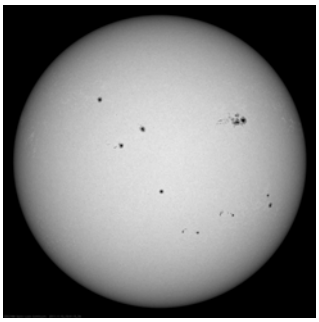


Image from Solar Dynamics Observatory, courtesy of NASA

Star type: G class

Color: Yellowish white or off-white

Temperature: Over 5000 degrees Celsius

Mass: 1 Solar mass (333,000 times Earth)

Interesting facts: brightest and closest star in the sky, and orbited by eight planets.

Age: 4.5 billion years old, will live 5.5 billion more years before it becomes a red giant, blows off its outer layers, and ends as a white dwarf

Star Magazine Exclusive Interview

I was unprepared for how warm and welcoming internationally known star, Sun, would be. After preparing me a cup of tea, we sat cozy on the couch, and Sun described a phenomenal life—of the most influential star in the Solar System.

SM: This is really a nice place you have here, Sun.

S: Thanks. It's a nice plot of farmland. One of my kids, Earth, carved out a part of the land, oh, about 150 (million) kilometers from here, and calls it "the most habitable part of the Solar System." You wouldn't believe the number of species of plants and animals she has. My son, Mars, on the other hand, couldn't grow a turnip if you paid him. Ha! It's funny how different kids turn out.

SM: How many children do you have?

S: I've got eight fully-grown kids, and so far, six little—I call them dwarves—running around. I feel like my family has spread all over the Solar System! One of my older grandkids, Pluto—he recently won an award for landscape architecture.

SM: You've influenced so many! To what do you owe your success?

S: Early in my career, I threw tantrums if I didn't get a part and even took it out on my kids—Mercury got the brunt of that. Finally, I got my big break in *Mass Extinction*—really low budget—about an asteroid strike. The other actors weren't very intelligent. I just lost it one day! I almost got fired for flaring up at some big lump of a trilobite. My agent was disappointed. She sat me down and told me I had to "grow up," so I did.

I used to think I had to be bigger and brighter than everyone else. You know what? I'm just average—like billions of others. So, I asked, how can I be more meaningful? That's what I strive for. I'm middle aged now, and still have big roles—but I love that new star systems, like from the Kepler Mission, have been discovered. They do it all—and have families, too. It's really inspirational.

SM: So, what's up next for you?

S: I really can't reveal my next production to you! That would be like gazing into the future.

Star Status

Kepler Mission Stars (requires two students)

An artist's depiction of a K class star, top, and an M class star, bottom. Courtesy of Kepler/NASA

Kepler-62

Star type: K class

Color: Orangish

Temperature: 0.89 times the Sun (less hot than the Sun)

Mass: 0.69 times the Sun (smaller than the Sun)

Interesting facts: In 2014, the Kepler Mission discovered five planets orbiting Kepler-62. Two of the planets are located in the Habitable Zone. It is unknown whether these two planets have life or water, but they are similar in size, but a bit bigger, than Earth.

Age: Not known exactly, but between 3 and 11 billion years old. This star could live another 20 to 30 billion years before becoming a red giant and eventually blows off its outer layers. It will end life as a white dwarf star.

Kepler-186

Star type: M class

Color: orangish-red

Temperature: 0.69 times the Sun (less hot than the Sun)

Mass: 0.48 times the Sun (smaller than the Sun)

Interesting facts: In 2014, the Kepler Mission confirmed five planets orbit Kepler-186. One of the planets is almost the same size as Earth and orbits in the habitable zone, although it is unknown whether the planet supports life. M class stars make up 70% of all stars in the galaxy, so it is a pretty common size for a star.

Age: Unknown. Assumed to be at least a couple of billion years old, this star could live for at least another 100 billion years!

Star Magazine Exclusive Interview

Star Magazine caught up with Kepler Mission's Kepler-62 and Kepler-186. These stars are part of a group that manages to wow audiences with their shows that include pyrotechnics, singing, dancing, and even theater. They've rocked audiences from Las Vegas to the half-time at the Super Bowl. To top it off, all members of the Kepler Mission have families. We got the scoop on their fame.

SM: So, you two are really good friends. You must live really close to one another.

K62: Hardly! I live, like, 500 light years from Earth and Kepler-186 lives twice that far away, but we see each other practically every day because of the show.

SM: How many members are in the Kepler Mission group? Seems like a lot…

K186: There are over 2000 members in the Kepler Mission Planet Show alone! The Kepler Mission producers discovered them over the past few years. It seems like we add more members to that show, like, everyday! There are nearly 5000 candidates, too. They are waiting in the wings for their shot. Most will probably get in. The criteria are weird—you have to have a family of planets… otherwise you don't get in the show. The directors confirm everyone has a family before we let them in. So, even though they may be really talented, it could take years with that many lined up. We're both pretty average members of the group.

K62: There's way more like you than like me.

K186: Whatever. A lot of stars have talent, but we're both exclusive members because our kids are in the advanced program at the Goldilocks School for the Arts. Only about a dozen Kepler Mission members have kids in the advanced program at the school. We think they'll be more talented than Sun's Earth someday.

K62: Those kids are in the zone! They could be in Kepler Mission's Habitable Planet show in the future.

SM: That seems kind of strange to me, actually.

K62: I don't know, not really. We want the group to be like a family, even though it's so big—like a family run circus. It's cool to think someday I'll be performing with my kids. I think I can last that long!

K186: My daughter is crazy talented. It would be fun to be on stage together.

SM: How long do you think you can it keep up?

K186: We have fun. I love every minute of it, and couldn't imagine doing anything else with my life.

K62: Yeah, we are just having the time of our lives out there! I think we'll be doing this for a looooong time.

Star Status

Proxima Centauri (prok-seh-mah sen-taw-rhee)

Star type: M class

Color: Red

Temperature: about half the Sun's

Mass: 0.12 times the Sun (much smaller than the Sun)

Interesting facts: Proxima means "next to" and is the closest star to the Sun, at just a little over four light years away (too bad we can't travel at the speed of light). Scientists think Proxima Centauri and stars, Alpha Centauri A and Alpha Centauri B, are orbiting eachother, but Proxima takes 500 thousand years to make one full orbit. Since Proxima is so dim, it can only be seen through a telescope, but Alpha A is the third brightest star in the sky. Proxima Centauri is a flare star that randomly produces flares with x-ray radiation.

Age: 4.85 billion years old. It is expected to live about three trillion years!

Hubble Space telescope took this image of our nearest neighbor, Proxima Centauri. Courtesy Hubble/ESA

Star Magazine: Star Spotting

Proxima Centauri, close friends with our favorite star, Sun, was seen at the award ceremony this weekend with twin brothers, Alpha Centauri A and Alpha Centauri B.

Proxima mostly takes roles in artistic films, and when making a rare public appearance, often goes unrecognized. At the award ceremony, Proxima actually threw a glass at a waiter.

Proxima said, "I just wanted more shrimp, and the waiter told me the food was only for invited guests. How did he think I got in? I just flared up and threw that glass at his head. I'm calm now… and I feel really bad."

Alpha A and Alpha B are bigger stars, and have a lot more energy on the screen. Alpha A is most famous in the family. Said Alpha A, "Proxima doesn't mean to have such a temper, and is usually pretty cool. It's hard having famous brothers."

"We I grew up together in the same neighborhood and are close friends," said Sun, "Fame wise, Proxima is not that well known, but has lasting power on screen, and will definitely be around for a long time.