**How Bright are Popstars and the Sun?**

**A Next Generation Science Standards (NGSS) curriculum for 5th graders**

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**Big Question:** How does the brightness change over time?

**Objectives:**

* Students will be able to describe how brightness changes over time.
* Students will be able to make claims of changes of brightness over time.

**NGSS Standards Addressed:**

5-ESS1-1Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. [*Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).*]

5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

[Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [*Assessment Boundary: Assessment does not include causes of seasons.*]

**Common Core Math Standards Addressed:**

CCSS.MATH.CONTENT.5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. Represent and interpret data.

CCSS.MATH.CONTENT.5.MD.B.2 Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots. For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.

CCSS.MATH.CONTENT.5.G.A.1 Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).

CCSS.MATH.CONTENT.5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

**Description of Lessons:**

*Lesson 1:* Using the analogy of popstars, students will make claims on the relationship between the popularity of a popstar (through YouTube analytics/music awards/albums) and their distance from us in the present day.

*Lesson 2:* Students will collect data on how much shade the tarp that covers the administration building and the restroom changes throughout the day. Students will then make recommendations for best times to use that area for P.E. or outdoor activities.

*Lesson 3:* Students will collect data on sunrise and sunset from an online database and how sunrises and sunsets change from month to month.

*Lesson 4:* Using popstars as an analogy, students will look at the statistics of popstars and the popularity of their seasonal songs. Students will look at data at when certain popstars have high view counts and what time of the year their songs have these high view counts.

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| --- | --- | --- | --- | --- |
| **Suggested Calendar** | | | | |
| **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** |
| **Week 1**  Lesson #1  Introduction and walk through | Lesson #1 Students collect data on Worksheet 1 | Lesson #1  Students compare data on Worksheet 2 and make claims | Lesson #1  Share claims made from data | Lesson #2 |
| **Week 2**  Lesson #2 (Continued) | Lesson #2 (Continued) | Lesson #2 (Continued) | Lesson #2 (Continued) | Lesson #2 (Continued) |
| **Week 3**  Lesson #2 (Continued) | Lesson #2 (Continued) | Lesson #3 | Lesson #3 (Continued) | Lesson #3 (Continued) |
| **Week 4**  Lesson #3 (Continued) | Lesson #4 | Lesson #4 (Continued) | Lesson #4 (Continued) |  |

**LESSON #1**

**Course/ Grade Level:** 5th Grade Science

**Overview:** Using the analogy of popstars, students will make claims on the relationship between the popularity of a popstar (through YouTube analytics/music awards/albums) and their distance from us in the present day.

**Standard(s) Addressed:**

5-ESS1-1Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.

**Lesson Objective:**

* Students will be able to explain how and why they collected data and metrics of popstars
* -Students will be able to explain the relationship between their data and claim of a popstar’s popularity.

**Materials Used:**

* Computer or tablet to collect data with access to YouTube and Wikipedia
* Access to Excel sheet or Google sheets
* Worksheet 1

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| **Teacher’s Step-by-Step Directions** | **Teacher Questions** | **Students’ Role & Answers to Teacher Questions** |
| **DAY 1:**  Introduce the concept by asking questions about brightness of the sun and stars. | 1. What is brighter, the sun or the stars? 2. Which is further distance from us, the sun or the stars? 3. How are we able to measure brightness and capture distances of sun and stars? Is it possible for us? | 1. Students will vote which one they think is brighter. 2. Students will develop an explanation using claim, evidence, and reasoning to defend their answer 3. Answers will vary but it is difficult for scientists to measure brightness and distance without scientific tools |
| Play one song from the teacher’s childhood. Discuss who the artist was and how they were popular in your everyday life. Please indicate when this song was released | 1. Ask students who they think this artist is. 2. Is this artist popular today? How do you know? | 1. Will vary 2. Will vary |
| Ask the students for suggestions on songs they think are popular now. How do they know the artist and song is popular? | 1. Is this artist popular today? How do you know? | 6) Will vary |
| Ask the students to vote which song they think is better, your song or their song. Discuss how we can measure brightness of stars and popstars.  Make the analogy of using popstars and the data of their music to talk about brightness/popularity.  We can use websites such as SocialBlade.com to look at the number of video views, subscribers, videos uploaded, after entering in the username of the YouTube channel (make sure it is the official channel and not a fan made channel). | 1. How else can you tell how popular a song is? 2. What are the metrics we can use to indicate how popular they are? | 7) # of albums sold, # of views on YouTube, revenue in $, # of awards, # of subscribers  8) Above |
| Using Worksheet 1, use Wikipedia and YouTube analytics to compare and contrast your song, an older singer, and their two song?  Walk through students through SocialBlade.com, YouTube, and Wikipedia. |  |  |
| Using the timeline, draw how far the singer has been active from and what their ranking is | 1. Who do you think is brighter, Selena Gomez (student’s song), your choice of songs, the older singer or Celine Dion (your song) based on the data? 2. During what times were the four singers active?   Based on the data, how do you rank the popularity of your singers? |  |

**Worksheet #1**

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| --- | --- | --- | --- | --- |
|  | **Teacher’s Favorite Singer** | **Older Singer** | **Your Class’s Favorite Singer** | **Your Favorite Singer** |
|  | **Celine Dion** (YouTube username: CelineDionVevo) | **Elvis Presley** (YouTube username: ElvisPresleyVevo**)** | **Justin Bieber** (YouTube username: JustinBieberVevo) | **Macklemore** (YouTube username: RyanLewisProductions) |
| **Metrics for Measuring Popularity** |  |  |  |  |
| Last 30 Days of Subscribers | 38,729 | 17,698 | 451,899 | 119,569 |
| Last 30 Days of Video Views | 27,973,140 | 10,101,090 | 171,764, 580 | 79,280,267 |
| Yearly Projections of Subscribers | 464,700 | 213,100 | 5,500,000 | 1,400,000 |
| Yearly Projections of Views | 335,700,000 | 121,200,000 | 2,100,000,000 | 951,400,000 |
| Video View Rank | 793 | 6,377 | 4 | 311 |
| Subscriber Rank | 2,286 | 13,870 | 8 | 381 |
| Total Video Views | 1,351,242,247 | 240,011,593 | 16,519,289,047 | 2,659,220,788 |
| Total Video Subscribers | 1,785,276 | 411,244 | 32,585,318 | 5,640,380 |
| Years Active | 1980-Present | 1953-1973 | 2007-Present | 2000-Present |
| How many years have they been active? | 2017-1980 = 37 | 1973-1953=20 | 2017-2007 = 10 years | 2017-2000 = 17 years |
| Top Viewed Song | My Heart Will Go On | Can’t Help Falling in Love | Sorry | Thrift Shop |
| # of Views on Top Viewed | 108,300,000 | 75,000,000 | 2,800,000,000 | 1,100,000,0000 |

**Worksheet #2 Rank Each Artist on the Metrics**

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| --- | --- | --- | --- | --- |
|  | **Teacher’s Favorite Singer** | **Older Singer** | **Your Class’s Favorite Singer** | **Your Favorite Singer** |
|  | **Celine Dion** (YouTube username: CelineDionVevo) | **Elvis Presley** (YouTube username: ElvisPresleyVevo**)** | **Justin Bieber** (YouTube username: JustinBieberVevo) | **Macklemore** (YouTube username: RyanLewisProductions) |
| **Ranking Metrics for Measuring Popularity** |  |  |  |  |
| Last 30 Days of Subscribers | 3 | 4 | 1 | 2 |
| Last 30 Days of Video Views | 3 | 4 | 1 | 2 |
| Yearly Projections of Subscribers | 3 | 4 | 1 | 2 |
| Yearly Projections of Views | 3 | 4 | 1 | 2 |
| Video View Rank | 3 | 4 | 1 | 2 |
| Subscriber Rank | 3 | 4 | 1 | 2 |
| Total Video Views | 3 | 4 | 1 | 2 |
| Total Video Subscribers | 3 | 4 | 1 | 2 |
| Top Viewed Song | 3 | 4 | 1 | 2 |
| # of Views on Top Viewed | 3 | 4 | 1 | 2 |
| Add the Total Up | 30 | 40 | 10 | 20 |
| To find the ranking, divide by the number of metrics (10 metrics) | 3 | 4 | 1 | 2 |

**Timeline**

1. Identify when the singer was first active on the timeline
2. After you identified the singer, place the ranking of the singer on top.

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|  | Elvis  Presley  4th (1953) |  |  |  |  |  | Celine Dion 3rd  1980 |  |  |  | Macklemore 2nd (2000) | Justin Bieber  1st(200**7)** |  |  |  |
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| **1950** | | **1960** | | **1970** | | **1980** | | **1990** | | **2000** | | **2010** | | **2017** | |

1. Based on the data, how do you rank the popularity of your singers?
2. How do older popstars feel to you today?
3. How do you think that the current popstars of today will feel to you in the future? Will you remember them as well today?
4. What is the relationship between the popstars ranking and their popularity?

**LESSON #2**

**Course/ Grade Level:** 5th Grade Science and Math

**Overview:** Students will collect data on how much shade the tarp that covers the administration building and the restroom changes throughout the day. Students will then make recommendations for best times to use that area for P.E. or outdoor activities.

**Standard(s) Addressed:**

5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

**Lesson Objective:**

* Students will be able to use the formulas and measurements to find the area of a shape.
* Students will be able to graph a variable across time
* Students will be able to construct an argument about the relationship between the variable of interest as time changes.

**Materials Used:**

* Computer or tablet to collect data with access to Excel sheet or Google sheets
* Meter sticks
* Chalk

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| **Teacher’s Step-by-Step Directions** | **Teacher Questions** | **Students’ Role & Answers to Teacher Questions** |
| **DAY 1:**  Review finding the area. Review how the area of an oddly shaped figure can be found by adding the area of all the parts together.  **DAY 2:**  Ask students how well they think the tarp provides shade on the blacktop. Students will then go outside and gather a first measurement of the area of the shadow of the tarp. Students should take a meter stick and draw ticks on the floor using chalk to determine the length and the width of the shape. Data that will be collected will include TIME OF DAY and AREA OF SHADE PROVIDED BY TARP in actual area covered and percentage (25% of the blacktop is covered by the tarp or 7 meters squared of the blacktop is covered by the tarp) | 1. Find area of these shapes: square, rectangle, triangle, trapezoid 2. Find area of combined figures 3. Does it change throughout the day from morning to lunch to after school? 4. What are the best times in which the tarp covers the most ground? |  |
| **DAY 3-6:**  Continue to gather measurements of the tarp coverage during various times of the day. |  |  |
| **DAY 7:**  Students should then find out the average % covered and average area of tarp coverage using the data they have gathered. Then students should create a timeline with Time on the Y axis and Percentage covered on the X axis. This can either be made on a timeline using graph paper or on Excel. Students should make claims from the data about the general pattern of the shade coverage. |  | 1. Students make conclusions from their data and reflect on what they learned |
| **DAY 8:**  Wrap up. Students should be able to make presentations and recommendations about the best times to play outside and when using their data. | 1. What are the best times to go out and play in the tarped areas? 2. Can we make more tarped areas based on these findings? |  |

**LESSON #3**

**Course/ Grade Level:** 5th Grade Science

**Standard(s) Addressed:**

5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

**Overview:** Students will collect data on sunrise and sunset from an online database and how sunrises and sunsets change from month to month.

**Lesson Objective**

* Students will be able to describe how sunrise and sunset occurs at any given month
* Students will be able to describe the relationship between sunrise and sunset from month to month
* Students will be able to explain the relationship between time and sunrise and sunset.

**Materials Used (be specific):**

* Computer, tablet, or smartphone with access to Excel/Google Docs
* Access to Internet to find sunrise and sunset times: <http://www.sunrisesunset.com/calendar.asp>

**Procedures**

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| **Teacher’s Step-by-Step Directions** | **Teacher Questions** | **Students’ Role & Answers to Teacher Questions** |
| **DAY 1:**  Introduce the concept of sunrise and sunset and ask questions to spark their theories. | 1. Is the sunset for today different than a time during winter break? 2. What are some hypotheses? |  |
| **DAY 2-3:**  Students should gather data on the times the sun sets and rises using information from online resources such as <http://www.timeanddate.com/sun/usa/los-angeles>. By month, students should be able to create what the average time for sunrise and sunset is for each month. This can be done on graph paper or google docs/excel. | 1. What are the times the sun sets and rises during each month? 2. What is the average time for sunrise and sunset of each month? 3. Graph the data you collected |  |
| **DAY 4:**  Review questions on data | 1. Why do certain months have more or less sunrises or sunsets? |  |
| Connect to how we can use science in our everyday lives to solve problems | 1. What can we do with the information? |  |
| Generate ideas for students to use their data and claims to make changes with science. | 1. What are some community problems that can be solved? 2. Does this affect how much time students can play outside in parks? |  |

**LESSON #4**

**Course/ Grade Level:** 5th Grade Science

**Standard(s) Addressed:**

5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

**Overview:** Using popstars as an analogy, students will look at the statistics of popstars and the popularity of their seasonal songs. Students will look at data at when certain popstars have high view counts and what time of the year their songs have these high view counts.

**Lesson Objective**

* Students will be able to collect the data on the relationship between brightness/popularity of stars (artists/singers) based on season
* Students will be able to make an argument about the changes of popularity of popstars based on the season of their seasonal song.

**Materials Used (be specific):**

-Access to the internet to check viewer trends on YouTube music videos (using SocialBlade.com) from Lesson 1

- Access to Google Sheets

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| **Teacher’s Step-by-Step Directions** | **Teacher Questions** | **Students’ Role & Answers to Teacher Questions** |
| **DAY 1:**  Introduce the content by asking students about stars in different seasons | 1. Do you see the same stars everyday? 2. Do you see different patterns of stars each day? If so, why? |  |
| **DAY 2:**  Provide them examples of seasonal songs and have them search on YouTube the viewer trends through the years using the username on SocialBlade.com  Example: All I Want for Christmas is You – Arianna Grande or Mariah Carey  Thriller - Michael Jackson | 1. What trends do you notice about these songs? 2. When are their views at the highest? When are they at their lowest? |  |
| **DAY 3:**  Ask questions so students can reflect on their data collection on song viewership trends | 1. Did you detect any spikes on the graphs? 2. What months were songs at their highest? 3. Why are views higher during certain seasons over others? |  |
| Connect this reflection to our view of stars in the sky | 1. How do you think this relates to stars in the sky? 2. How does it change? 3. What is reason for us to see different stars during different seasons? |  |
| Relate it to everyday problems | 1. Why might the seasonal appearance of stars be a problem for people? 2. Why might it be a problem for travelers? 3. How can we resolve this problem? |  |