ScienceNews
EDUCATOR GUIDE

EHT Collaboration

December 21, 2019 & January 4, 2020

2019 Year in Review

SOCIETY FOR SCIENCE & THE PUBLIC

SN EDUCATOR GUIDE

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About this Guide

This Guide, based on the biggest science stories of 2019 as reported by *Science News,* asks students to read and dissect a story of their choice and practice their summarizing skills. An activity from the Digital Library asks students to analyze and graph data about the moon's orbit. The activity, based on *Science News*' coverage of the 50th anniversary of the Apollo 11 moon landing, complements the No. 9 story of 2019.

This Guide includes:

Article-based Comprehension Q&A — These questions ask students to analyze one of *Science News*' Top 10 stories of the year, though the questions are general enough that they can be applied to any article. Related standards include NGSS-DCI: HS-ESS1; HS-ESS3; HS-LS1; HS-LS2; HS-LS4; HS-PS4.

> **Student Comprehension Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular Discussion Q&A — Students will discuss what makes a good summary and practice their summarizing skills. After summarizing an article of their choice, students will share their summaries and get feedback from classmates. This exercise is based on *Science News*' Top 10 stories of the year but can be used with any article. Related standards include NGSS-DCI: HS-ETS1.

> **Student Discussion Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

Activity: Lunar Orbit

> **Summary:** In this activity, students will practice analyzing and graphing data about the moon's orbit to better understand the Earth-moon system and the nature of elliptical orbits. Related standards include NGSS-DCI: HS-ESS1; HS-PS2; HS-ETS1.
>
> **Approximate class time:** 1 class period to complete the activity questions, calculations and graphing.

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Article-based Comprehension, Q&A

Directions for teachers: Have each student pick one of *Science News*' Top 10 stories of 2019 to read. Ask students to answer questions No. 1 and 2 before they read (5 minutes). After students read the article on their own (10 minutes), have them answer questions No. 3 through 11 (20 minutes). Afterward, you can ask students to briefly summarize their article for the rest of the class. Note: If you'd like to dig deeper into summarization with your students, check out "How to write a summary" in this Guide's discussion section for a related exercise that includes tips on summary writing.

Top 10 stories include:

1. "First black hole image made its debut"
Readability score: 10.8

The Event Horizon Telescope team reported the first direct image of a black hole this year. The image, a shadow of the black hole at the center of galaxy M87 against its glowing disk of gas and dust, aligns with expectations of what a black hole should look like according to Albert Einstein's general theory of relativity. The image also helped determine the best way to measure a black hole's mass and offered good evidence that event horizons are real. Next, researchers hope to create movies of galaxy M87's black hole and Sagittarius A*, the black hole at the center of the Milky Way.

2. "The fight against measles got intense"
Readability score: 10.9

Measles is a serious illness that can lead to pneumonia and dangerous brain swelling, and leave immune systems vulnerable to other infections. The virus that causes measles sickened more than 1,200 people in the United States in 2019, which nearly cost the country its hard-won elimination status. Most cases occurred in people who hadn't been vaccinated, or didn't know whether or not they'd been vaccinated. Other countries, including Congo and Samoa, struggled with measles outbreaks this year. In Congo, about 250,000 people contracted measles and thousands died. Samoa was hit by a measles outbreak late in the year. More than 3,700 people contracted the disease, and dozens of people died.

3. "Student activists push for climate action"
Readability score: 10.4

Millions of people, many of them students, marched to demand action on climate change this year. In March, 16-year-old Swedish activist Greta Thunberg led 1.6 million students in a worldwide climate strike. In September, a record-breaking 7.6 million people across the world participated in another strike during the United Nations' Climate Action Summit. The protests happened alongside 2019's record-

breaking heat waves. The intense heat, along with wildfires, hurricanes and other extreme climate events, appear to be shifting everyday conversations away from debates over the existence of human-caused climate change toward climate change solutions.

4. "Dozens of deaths were linked to vaping this year"
Readability score: 12.1

More than 2,000 people in the United States became ill from vaping THC products this year, and at least 47 people have died. Many were young and otherwise healthy. Federal officials suspect vitamin E acetate may be to blame, but it's possible that more than one vaping ingredient is involved. Illnesses and deaths are linked to THC products, but nicotine vapers aren't exempt from potential harm. About 28 percent of U.S. high school students reported vaping in a 30 day-period, a 2019 survey found. Besides the potential for an increased risk of heart disease and addiction to other drugs, vaping puts teens at higher risk of chronic respiratory symptoms.

5. "Denisovans emerged from the shadows"
Readability score: 13.8

Several fossil and DNA finds reported in 2019 add to an increasingly complex portrait of Denisovans. Skeletal fragments and a facial reconstruction support the idea that these mysterious hominids — discovered in a Siberian cave — had a mix of traits unique to them and traits similar to other hominids with whom they mated, including Neandertals, *Homo erectus* and *Homo sapiens*. Denisovans weren't confined to the cave or its immediate environment. A jaw bone places Denisovans on the Tibetan Plateau 160,000 years ago. And at least three genetically distinct populations mated with ancient human groups in parts of Asia, DNA evidence shows.

6. "CRISPR gene editing entered tests in people"
Readability score: 12.0

Researchers began testing the safety and efficacy of the gene-editing technology CRISPR/Cas9 in people in the United States for the first time. A test of immune cells edited to enhance their cancer-fighting abilities suggests that the treatment is safe, but the cells didn't slow patients' cancer growth. In a different test, edited cells from two women with blood disorders appear to be safe and relieve disease symptoms. Scientists are also testing a treatment for an inherited form of blindness.

7. "Google claimed quantum supremacy"
Readability score: 11.4

Google claimed that its quantum computer Sycamore is the first to achieve quantum supremacy — that is,

performing a calculation that is impossible for even the world's most powerful standard computer. In October, Google announced that Sycamore performed a calculation in 200 seconds that the researchers estimate would take a supercomputer thousands of years to solve. But IBM, another company pursuing quantum computing, cast doubt on Google's claim. IBM said that an improved supercomputing technique could perform the calculation in a couple of days.

8. "Big threats to biodiversity startled the world"
Readability score: 12.4

Reports from nature stunned people this year. Burning in Brazil's Amazon region is the worst it has been since 2005. A report by the United Nations estimated that around a million species face accelerated extinction due to habitat damage and loss. A separate analysis of American and Canadian birds found that the total bird population dropped by 3 billion since 1970. And a study about planting trees to capture huge quantities of carbon from Earth's atmosphere stirred controversy.

9. "Moon landings were all the rage in 2019"
Readability score: 10.8

Trips to the moon in 2019 signaled the beginning of a moonshot renaissance. China's Chang'e-4 lander touched down on the moon's little-explored farside. The spacecraft's rover found hints of lunar mantle mixed with surface soil — that may help scientists figure out how the moon, once a ball of molten rock, cooled and hardened. Israel and India also sent spacecraft toward the moon, but the spacecraft lost contact and crashed. China plans to launch another lunar lander in 2020, and NASA plans to send multiple landers over the next decade as part of a plan to send astronauts to Mars. The European Space Agency is working with Russia's space agency on moon landing missions as well.

10. "New drug approved for severe depression"
Readability score: 12.2

The U.S. Food and Drug Administration approved a new drug for severe depression. Called Spravato, the nasal spray is the first fundamentally new drug for depression in decades. Derived from ketamine, Spravato is an anesthetic and hallucinogen. The drug comes with many side effects and can be abused, which is why the FDA requires that Spravato be administered in certified clinics. There are currently more than 2,000 certified clinics in the United States. But it's not clear if the drug will work for everyone. Tests in people have had mixed results.

1. Read the headline of the article. What background information do you already know about the topic based on the headline?

2. Given the headline, what do you want or expect to learn when you read the article?

3. What main finding or advance does the article describe? What scientific field(s) are related to the finding or advance?

4. What evidence supports the main finding or advance? How does the article present that evidence?

6. Who is quoted in the article? Describe the relationship that each person has to the finding or advance? Why do you think the author included their quote?

5. Is there anything controversial about the main finding or advance? Explain based on the evidence given in the article.

7. Does the main finding or advance leave any questions unresolved? If so, what do scientists hope to do next?

8. How does the article challenge your existing knowledge? Cite an example.

9. What questions do you have after reading the article?

10. Why do you think this article was chosen as one of the Top 10 science stories of the year?

11. What science news do you hope to read about in the coming year?

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Student Comprehension Worksheet

Directions: Pick one of the *SN* Top 10 articles to read. Before reading the article, take 5 minutes to answer questions No. 1 and 2. Read your article silently for 10 minutes. Then take 20 minutes to answer questions No. 3 through 11. Be prepared to share your answers with the class.

1. Read the headline of the article. What background information do you already know about the topic based on the headline?

2. Given the headline, what do you want or expect to learn when you read the article?

3. What main finding or advance does the article describe? What scientific field(s) are related to the finding or advance?

4. What evidence supports the main finding or advance? How does the article present that evidence?

6. Who is quoted in the article? Describe the relationship that each person has to the finding or advance? Why do you think the author included their quote?

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9. What questions do you have after reading the article?

10. Why do you think this article was chosen as one of the Top 10 science stories of the year?

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Cross-curricular Discussion, Q&A

Directions for teachers:

Discuss

Begin by introducing your students to the concept of summarizing. Merriam-Webster defines a summary as "a short restatement of the main points (as of an argument) for easier remembering, for better understanding or for showing the relation of points." Class assignments often ask students to summarize, but students also summarize in conversations with friends and family members.

Divide your students into pairs or small groups and ask them to use the following prompts to think about when and how they summarize information.

1. When do you summarize or interact with summaries from others? Be sure to consider examples outside of class assignments.

2. For each of the scenarios you described above, what is the goal of the summary? How does the goal affect the information included in the summary?

3. For each of the scenarios described above, who is the summary for? How does the information included in a summary depend on the audience?

4. How might your goal or audience affect the length of your summary and the language you choose to use?

5. When you've encountered complex information in the past (in a story, presentation or conversation), what techniques have helped you turn that info into a summary?

Read and take notes

Ask each pair or small group to choose one of the *Science News*' Top 10 articles of the year to read. Make sure students know that they will have to summarize the article after reading. You can ask students to identify a note-taking technique in advance and/or encourage them to identify the following key points as they read. If time is available, consider having students answer the associated comprehension questions to aid in understanding.

Key points to look for

As you read an article, identify the following:

- The main point and any details that support the main point
- A secondary idea and any supporting details
- The who, what, where when, how and why of the article
- Important events and the timeline of those events
- Problems and their resolutions
- Any caveats or counterpoints to the main or secondary ideas
- Any questions that come up along the way or remain unanswered at the end

Brainstorm and outline
Before students write their summaries individually, ask them to consider the prompts that follow.

1. What is the goal of your summary?

2. Who is your audience?

3. Given your goal and audience, how long should your summary be?

4. What was the main point of the article? That should be the start of your summary.

5. Given the length you've chosen, what information can you include and what must you leave out? Refer back to your notes to identify the most important information to include.

Write and review
Students should now write their summaries. After writing the summary, students should review the summary they've written using the prompts that follow. Then, students can revise the summary based on the answers.

1. Have I been brief?

2. Have I restated the essential information without repeating the exact words and phrases used in the original article — or, have I "used my own words"?

3. Have I missed any key points that I identified under the "Read and take notes" header that should be included?

4. What specific facts have I used from the original article? Have I incorporated those facts correctly?

5. Have I attributed information where necessary?

Share and reflect
Now have students read their summaries aloud in their small groups and answer the following prompts.

1. How were the summaries similar? Was there information that every group member thought was essential?

2. How were they different? What did some group members choose to leave out that others included? Why?

3. Could your summary be improved? What would you change about your summary after hearing other summaries?

4. How might you write your summary differently if you had chosen a different audience and/or goal?

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Student Discussion Worksheet

Directions:

The word "summarize" might make you think of a class assignment, but you also do a lot of summarizing in your daily lives. You summarize when you tell a friend about a movie you saw last weekend, or when you tell a family member about your day. In this activity, you will explore what makes a good summary and practice your summarizing skills on an article from *Science News*.

Discuss
Form pairs or small groups and begin to think about how you summarize by discussing the following prompts:

1. When do you summarize or interact with summaries from others? Be sure to consider examples outside of class assignments.

2. For each of the scenarios you described above, what is the goal of the summary? How does the goal affect the information included in the summary?

3. For each of the scenarios described above, who is the summary for? How does the information included in a summary depend on the audience?

4. How might your goal or audience affect the length of your summary and the language you choose to use?

5. When you've encountered complex information in the past (in a story, presentation or conversation), what techniques have helped you turn that info into a summary?

Read and take notes
Your group should choose one of the *Science News*' Top 10 articles of the year to read and summarize. Once you've made the selection, you will read and summarize the article on your own. Before reading, review the key points to look for below and answer any questions provided by your teacher.

Key points to look for

As you read an article, identify the following:

- The main point and any details that support the main point
- A secondary idea and any supporting details
- The who, what, where when, how and why of the article
- Important events and the timeline of those events
- Problems and their resolutions
- Any caveats or counterpoints to the main or secondary ideas
- Any questions that come up along the way or remain unanswered at the end

Brainstorm and outline
After reading, consider the following prompts before writing your summary on your own.

1. What is the goal of your summary?

2. Who is your audience?

3. Given your goal and audience, how long should your summary be?

4. What was the main point of the article? That should be the start of your summary.

5. Given the length you've chosen, what information can you include and what must you leave out? Refer back to your notes to identify the most important information to include.

Write and review
Write your summary and then review the summary using the prompts that follow. You may choose to revise your summary.

1. Have I been brief?

2. Have I restated the essential information without repeating the exact words and phrases used in the original article — or, have I "used my own words"?

3. Have I missed any key points that I identified under the "Read and take notes" header that should be included?

4. What specific facts have I used from the original article? Have I incorporated those facts correctly?

5. Have I attributed information where necessary?

Share and reflect
Now take turns reading your summaries aloud in your small group. After sharing your summaries, discuss the following prompts.

1. How were the summaries similar? Was there information that every group member thought was essential?

2. How were they different? What did some group members choose to leave out that others included? Why?

3. Could your summary be improved? What would you change about your summary after hearing other summaries?

4. How might you write your summary differently if you had chosen a different audience and/or goal?

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Activity Guide for Teachers: Lunar Orbit

Purpose: Students will practice analyzing and graphing data about the moon's orbit. The activity will help students understand the Earth-moon system and the nature of elliptical orbits.

Procedural overview: After reading the *Science News* article "Apollo astronauts left trash, mementos and experiments on the moon," students will graph lunar orbital data, analyze how the moon's orbit changes over time and consider the implications of those changes.

Approximate class time: 1 class period to complete the activity questions, calculations and graphing.

Supplies:
Lunar Orbit student activity guide
Calculators
Graph paper or computers with graphing software
Online access to research additional information as needed
A projector for introducing the activity (optional)

Directions for teachers:

Before engaging in this activity, frame the general concepts behind the data being analyzed by having students read the *Science News* article "Apollo astronauts left trash, mementos and experiments on the moon." If students have time and need an extra challenge, there is a set of bonus questions about how the moon's orbit and phases can explain certain lunar phenomena.

If a projector is available, show students the data on perigee and apogee in Table 1 on the screen. If a projector is not available, explain to students where to find the data table in their activity guide.

Discuss the following questions and answers with your students before allowing them to engage with the data on their own.

1. Based on the *Science News* article "Apollo astronauts left trash, mementos and experiments on the moon," why is it important to understand how the distance between the moon and Earth changes?

The positions of the Earth and moon are determined by the laws of motion and gravity. Understanding how those positions change over time can offer a test of Einstein's theory of general relativity.

2. What are some implications of the moon moving closer to and/or farther from Earth?

Answers may include how tides are affected (higher tides when the moon is closer and lower tides when the moon is farther) or how the timing of a day may be affected by tidal friction.

3. The moon orbits Earth in an elliptical path. What does this path mean for the distance between the moon and Earth?

In a single orbit of the moon (a lunar month, about 29 days), the moon reaches both its farthest distance (apogee) and closest distance (perigee).

4. What do the data in Table 1 show?

The data in Table 1 show every perigee and apogee in 2019 and the distance between Earth and the moon at each occurrence.

Note to teacher: The Teacher Answer Key provides answers for student questions.

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Activity Guide for Students: Lunar Orbit

Directions for students:

After a class discussion covering the general information about the moon's orbit, look at Table 1 and answer the questions that follow. When needed, use additional resources to find background information.

Table 1

Apogee — 2019		**Perigee — 2019**	
Date	**Distance (km)**	**Date**	**Distance (km)**
January 8	406,117	January 21	357,342
February 5	406,555	February 19	356,761
March 4	406,391	March 19	359,377
March 31	405,577	April 16	364,205
April 28	404,582	May 13	369,009
May 26	404,138	June 7	368,504
June 23	404,548	July 4	363,726
July 20	405,481	August 2	359,398
August 17	406,377	August 30	357,176
September 13	406,377	September 27	357,802
October 10	405,899	October 26	361,311
November 7	405,058	November 22	366,716
December 4	404,446	December 18	370,265

Source: https://www.timeanddate.com/astronomy/moon/distance.html?year=2020&n=59

Background questions

1. The moon's orbit around Earth is elliptical. Explain what this means.

2. The equation that follows describes the eccentricity of the moon's orbit — how much the orbit varies from being a perfect circle. In this equation for eccentricity (e), a is apogee distance and p is perigee distance.

$$e = 1 - \frac{2}{\frac{a}{p} + 1}$$

When a and p are approximately equal, what is the rough value of e? What happens to e as a becomes much larger than p? How does the value of e affect the shape of the ellipse?

3. In which month is the moon's closest approach (perigee)? In which month is its farthest approach (apogee)? What do you notice? Describe your observations.

4. In which month is the farthest perigee? In which month is the closest apogee? How does this compare with the closest perigee and farthest apogee?

5. What is the average distance for perigee? What is the average distance for apogee?

6. If the moon continues moving away from Earth at the rate indicated in the article, 3.8 centimeters per year, how long will it take the moon to move one kilometer away?

7. If the radius of the moon's orbit did increase by one kilometer but the moon still traveled along its path at the same speed, how would the length of the lunar month change?

Use the base distance of 398,304 km and the equation:

$$P^2 = \frac{4\pi^2 a^3}{G(M_1 + M_2)}$$

In this equation, a is the average distance of the moon in meters, P is measured in Earth seconds and M_1 and M_2 are measured in solar masses.

8. How far would the moon have to move away from Earth to change the moon's orbit by one day?

Data analysis and graphing

9. Use graph paper, a computer or a calculator to graph the data for both perigee and apogee on the same set of axes to trace the path of the moon's orbit. What type of graph might you use?

10. What does the shape of the graph tell you about the moon's orbit around Earth?

11. Where on the graph is the difference between perigee and apogee distance the greatest? During what month is the difference least? Calculate the rough eccentricity for these months.

12. How did your calculations of the two eccentricities compare? What does that tell you about the shape of the moon's orbit?

13. If the eccentricity of the moon's orbit were to double, how would the ratio a to p be affected?

14. What causes variations in the moon's eccentricity?

15. How do the variations in the moon's eccentricity affect Earth?

16. With the moon slowly moving away from Earth, how might the eccentricity of the moon's orbit be affected?

Bonus questions

17. Humans have known since ancient times that we can only see one side of the moon from Earth. Why do we only see one side of the moon?

18. The phases of the moon are caused by the orientations of Earth, the moon and the sun. Sketch and label what phases of the moon will occur at the various positions on the moon's orbit around Earth.

19. If a solar eclipse occurs when the moon comes between the sun and Earth, why don't eclipses occur every month? What is the difference between a total and partial eclipse?

20. Using your knowledge of the moon's orbit, can you explain what a "super moon" is?