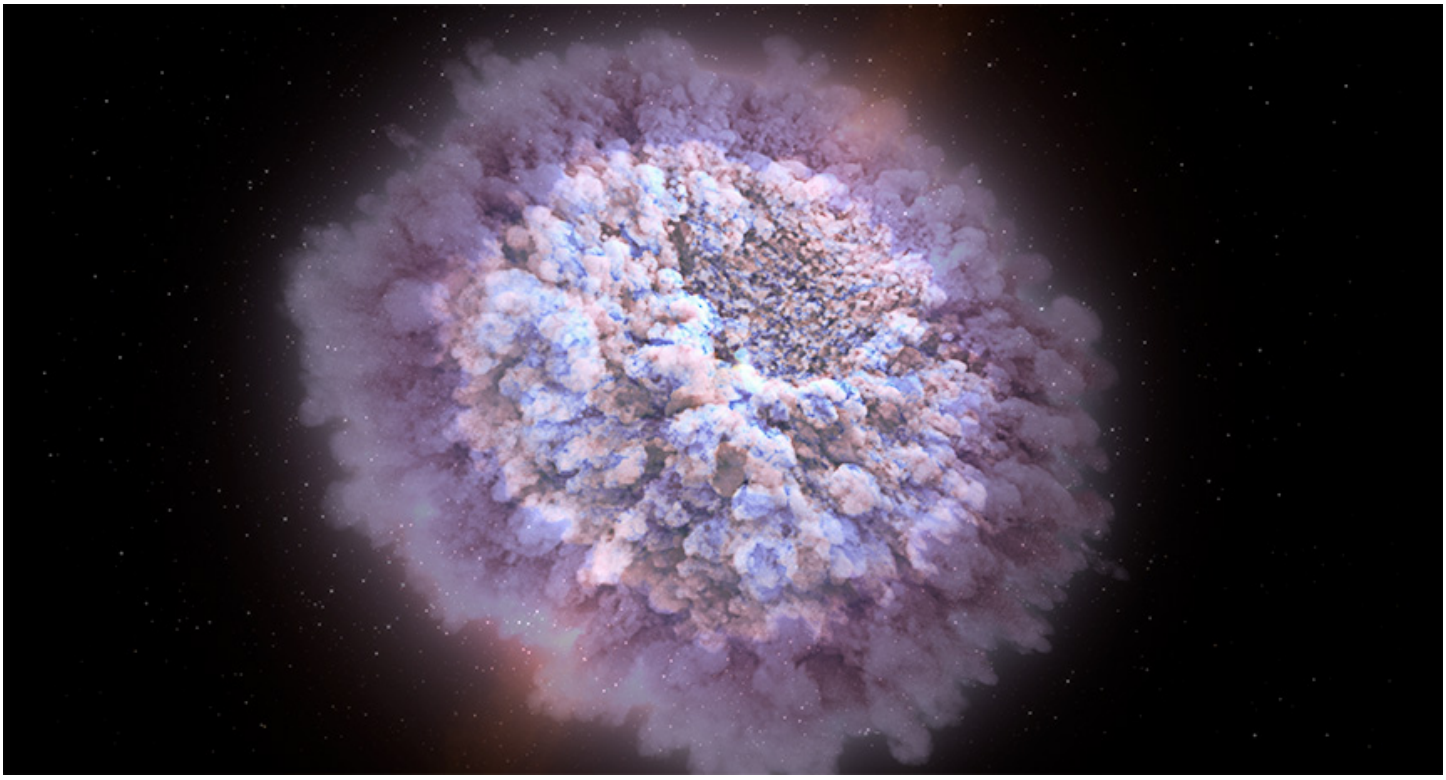
ScienceNews

IN HIGH SCHOOLS | EDUCATOR GUIDE



CI Lab/NASA Goddard Space Flight Center

December 23, 2017
& January 6, 2018

SN 2017 Year in Review

SOCIETY FOR SCIENCE & THE PUBLIC

SN EDUCATOR GUIDE

December 23, 2017 & January 6, 2018

SN 2017 Year in Review

About the Issue

***Science News* article(s):**

1. Cosmic mysteries unlocked in neutron star collision
Readability score: 11.5
2. CRISPR gene editing moves into humans, spurs debate
Readability score: 11.6
3. Larsen C ice break invites groundbreaking research
Readability score: 10.7
4. Fossils join genetic evidence to revise human origin story
Readability score: 11.5
5. Seven Earth-sized planets orbit the same ultracool star
Readability score: 9.2
6. Quantum communication goes global
Readability score: 12.6
7. Concerns grow that CO_2 rise may steal crop nutrients
Readability score: 10.7
8. FDA approves gene therapy for two blood cancers
Readability score: 12.1
9. CTE may be common among pro football players
Readability score: 11.5
10. Zika is not gone for good
Readability score: 11.0

***Science News for Students* article(s):**

Editor's top picks for 2017
Readability score: 7.3

The most popular stories of 2017
Readability score: 6.0

The articles in this issue revisit the Top 10 scientific discoveries from 2017. Students can focus on details reported in the articles, follow connections to earlier articles about related research and pursue cross-curricular connections to other major science topics in biology, earth science, physics and astronomy. In an activity, students can play a game and/or review information from this issue and present it to the rest of the class in the form of an infographic, skit or game. Students may also create their own list of Top 10 science experiences from the semester to begin a semester review.

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Article-based observation: What were some of the most important scientific discoveries and research advances during this past year? Questions allow students to work in groups to analyze one of the Top 10 *SN* science stories of 2017 and then present the findings to the whole class.

Quest through the archives: Use this short section to connect one of this issue's Top 10 stories to a previously published *Science News* articles covering similar research.

Cross-curricular discussion:

In order to fully appreciate the Top 10 science stories of this year, students have to have some scientific background knowledge. Use this section to help your students gain a better understanding of the key vocabulary and concepts covered in the *SN* Top 10. Discussion questions are divided by article and the related category (below) is listed.

Alternatively, as an extension of the article-based observation questions, have students work in groups to define and explain key scientific words or phrases from the articles. Then have the groups prepare to present this information to the rest of the class in a creative way.

Biological Sciences questions discuss scientific vocabulary words and phrases related to the 10 articles, such as hominids, CRISPR/Cas9, chimeric antigen receptors and Zika virus.

Earth Sciences questions address vocabulary including atmospheric carbon dioxide, climate change and Antarctic ice shelves.

Physics and Astronomy questions deal with vocabulary such as neutron stars, gravitational waves and quantum entanglement.

Activity: Top 10 Countdown

Purpose: To review 2017's top science stories or class content from the entire first semester.

Procedural overview:

Activity 1: Match it up! Students can work in a group of three to play an organism matching game after reading the "Life finds a way" page for homework. Groups may create their own game that classmates can play based on other information from the issue.

Activity 2: Top 10 semester in review Have students start a semester review by creating their own Top 10 list of science experiences from the semester. Have students describe what was learned in each experience, explain the concept covered and give an application of the learned concept. Students may present their Top 10 experiences in a timeline or infographic format.

Approximate class time: 1-2 classes.

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Standards

Next Generation Science	Common Core ELA
Matter and its Interactions: HS-PS1-1, HS-PS1-3, HS-PS1-8	Reading Informational Text (RI): 1, 2, 4, 5, 7
Motion and Stability: Forces and Interactions: HS-PS2-1, HS-PS2-2, HS-PS2-4, HS-PS2-6	Writing (W): 1, 2, 3, 4, 6, 7, 8, 9
Energy: HS-PS3-2, HS-PS3-4, HS-PS3-5	Speaking and Listening (SL): 1, 2, 4, 5, 6
Waves and their Applications in Technologies for Information Transfer: HS-PS4-2, HS-PS4-3, HS-PS4-5	Reading for Literacy in Science and Technical Subjects (RST): 1, 2, 3, 4, 5, 7, 8, 9
From Molecules to Organisms: Structures and Processes: HS-LS1-1, HS-LS1-2, HS-LS1-4	Writing Literacy in History/Social Studies and Science and Technical Subjects (WHST): 1, 2, 4, 7, 8, 9
Ecosystems: Interactions, Energy and Dynamics: HS-LS2-6, HS-LS2-7, HS-LS2-8	
Heredity: Inheritance and Variation of Traits: HS-LS3-1, HS-LS3-2	
Biological Evolution: Unity and Diversity: HS-LS4-1, HS-LS4-2, HS-LS4-4, HS-LS4-5	
Earth's Place in the Universe: HS-ESS1-1, HS-ESS1-2, HS-ESS1-3, HS-ESS1-4	
Earth's Systems: HS-ESS2-2, HS-ESS2-4, HS-ESS2-5, HS-ESS2-7	
Earth and Human Activity: HS-ESS3-1, HS-ESS3-2, HS-ESS3-4, HS-ESS3-5	
Engineering Design: HS-ETS1-1, HS-ETS1-2, HS-ETS1-3	

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Article-Based Observation: Q&A

Divide your students into 10 groups. Allow each group to pick one of the following articles, or if necessary assign articles to groups to ensure that all 10 articles are covered. Allow time for groups to convene and answer the pre-reading questions No. 1 and 2. Then, set aside about 20 minutes for silent article reading. As students finish reading the article, they should attempt to answer question No. 3 individually. Once all students have finished reading their article, allow about 15 minutes for each group to analyze and summarize their article by answering questions No. 3 through 5. When all of the groups are finished, have groups share their results with the whole class.

2017 Year in Review: Top 10

1. Cosmic mysteries unlocked in neutron star collision
2. CRISPR gene editing moves into humans, spurs debate
3. Larsen C ice break invites groundbreaking research
4. Fossils join genetic evidence to revise human origin story
5. Seven Earth-sized planets orbit the same ultracool star
6. Quantum communication goes global
7. Concerns grow that CO_2 rise may steal crop nutrients
8. FDA approves gene therapy for two blood cancers
9. CTE may be common among pro football players
10. Zika is not gone for good

1. Read the title of the article. What background information do you already know about the topic based on the title (from science class, *Science News* or other sources)?

Student answers will vary.

2. Given the title of your article, what do you want to find out when you read it?

Student answers will vary.

3. Summarize what you learned from the article in less than 100 words, being as thorough as you can within that limit.

Possible student responses:

1) Cosmic mysteries unlocked in neutron star collision

The collision of two neutron stars in a galaxy 130 million light-years from Earth was spotted by gravitational wave detectors and, later, telescopes looking for visible, infrared and ultraviolet light, as well as X-rays and radio waves. Data from the observations offered new clues to how heavy elements are formed, provided a new measurement for the expansion rate of the universe and confirmed that

gravitational waves travel at the speed of light, thus ruling out many alternative theories to dark energy (the mysterious force that appears to be accelerating the expansion rate of the universe).

2) CRISPR gene editing moves into humans, spurs debate

In 2017, several groups used CRISPR/Cas9 gene editing to alter the DNA in viable human embryos; if they developed, those embryos would become genetically altered people that could pass their alterations down to future generations. Research teams used CRISPR/Cas9 to fix disease-causing mutations in embryos and to create mutations in a gene important for development.

3) Larsen C ice break invites groundbreaking research

In July 2017, a Delaware-sized iceberg, the largest one in decades, broke off from one of the Antarctic Peninsula's ice shelves, called Larsen C. While most media attention focused on the break itself and whether it was linked to climate change, scientists have used the opportunity to study the stability of the remaining Antarctic ice, as well as creatures living below where the iceberg used to be.

4) Fossils join genetic evidence to revise human origin story

The exact time and place of the origin of modern *Homo sapiens* has been difficult to pin down. Analyses of fossil evidence suggest that species or subspecies in different regions of Africa had different features found in *Homo sapiens* — high, rounded braincases, chins and small teeth — which integrated only later into the full modern human package.

5) Seven Earth-sized planets orbit the same ultracool star

Telescopes have identified seven roughly Earth-sized planets, at least three of which might have the right temperatures for water to be liquid, orbiting the small, cool TRAPPIST-1 star approximately 39 light-years from Earth. The sheer number of planets and the fact that very small stars live so long increases the chances that the system might harbor life. Unfortunately, such stars are prone to frequent, powerful stellar flares that could damage the atmospheres and, thus, reduces chances for life.

6) Quantum communication goes global

China launched in 2016 the world's first quantum communications satellite, Micius, which can beam pairs of quantum entangled particles as a quantum key to enable ultrasecure communications. In 2017, Micius first used its onboard lasers to quantumly link two Chinese cities 1,200 kilometers apart, then teleport the quantum properties of photons 1,400 kilometers from the ground to space and finally to permit a quantum-encrypted video chat between Beijing and Vienna.

7) Concerns grow that CO_2 rise may steal crop nutrients

Experiments have shown that rising carbon dioxide levels in the atmosphere might mean crops such as wheat and rice become less nutritious in the future, which could impact both humans and farm animals that rely on these crops for food. In particular, some crops exposed to higher CO_2 levels had lower levels of zinc, iron and protein than crops grown under today's conditions, and the concentrations of other nutrients are still being measured.

8) FDA approves gene therapy for two blood cancers

A newly approved treatment for two blood cancers (acute lymphoblastic leukemia, or ALL, in young people and non-Hodgkin lymphoma in adults) involves removing some of the patient's T cells, genetically modifying them to recognize the cancer cells, multiplying them in the lab and then injecting them back into the patient to kill the cancer cells. This treatment, called chimeric antigen receptor T cell, or CAR-T cell, therapy helped 83 percent of ALL patients go into remission within three months.

9) CTE may be common among pro football players

Postmortem analysis of brains showed that 110 of 111 NFL football players, 3 of 14 high school players and 48 of 53 college players had signs of chronic traumatic encephalopathy (CTE), which is associated with memory loss, emotional outbursts, depression and dementia. Compared with postmortem brains from healthy people and even those with Alzheimer's, brains from people with CTE had higher levels of the inflammation protein CCL11, hinting that CCL11 levels might be a measure of brain health in living people.

10) Zika is not gone for good

Compared with 2016, Zika virus cases in the Western Hemisphere have been much less common, perhaps because people who have been previously infected are now immune. Meanwhile, scientists have learned more about how Zika spreads through sexual contact and about reservoirs of Zika between human outbreaks, and have made strides in developing vaccines that could potentially protect against Zika.

4. Having read your article, what new questions do you have about that topic?

Student answers will vary.

5. What predictions do you have for future related research?

Student answers will vary.

6. If time permits, choose and analyze a second article.

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Article-Based Observation: Q

Directions: Check with your teacher about which article is assigned to your group. With your group members, answer the pre-reading questions No. 1 and 2. Next, silently read the article. When you are finished, answer question No. 3 individually. Once your teacher tells you to do so, analyze and summarize your article by answering questions No. 3 through 5 with your group. When answering question No. 3 together, try to incorporate information from each group member's response into your final summary. Be prepared to present all of your answers to the class.

2017 Year in Review: Top 10

1. Cosmic mysteries unlocked in neutron star collision
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1. Read the title of the article. What background information do you already know about the topic based on the title (from science class, *Science News* or other sources)?

2. Given the title of your article, what do you want to find out when you read it?

3. Summarize what you learned from the article in less than 100 words, being as thorough as you can within that limit.

4. Having read your article, what new questions do you have about that topic?

5. What predictions do you have for future related research?

6. If time permits, choose and analyze a second article.

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Quest Through the Archives: Q&A

1. Find the most recent article in the archives that closely relates to one of the 10 year-end articles. Briefly describe the article, and give the citation for the article you found (ask your teacher about which citation style to use).

Example student response for neutron star collision article: The previous article "Neutron star crash seen for first time," published in the November 11, 2017 issue, covers the public announcement of the neutron star collision observations and the scientific discoveries that followed from those observations.

APA:
Conover, E. (2017, November 11). Neutron star crash seen for first time. *Science News*, 192(8), 6-7.

MLA:
Conover, Emily. "Neutron star crash seen for first time." *Science News*, 11 Nov. 2017, pp. 6-7

2. What information is the same in the archive article and the year-end article? Explain.

Example student response for neutron star collision article: Both articles describe the collision of the neutron stars 130 million light-years away. Both describe the separate observations of gravitational waves and light waves from the collision. Both describe some of the important discoveries from those observations: the creation of heavy elements in this collision, the nearly simultaneous arrival of both gravitational and electromagnetic waves and the new measurement of the expansion rate of the universe.

3. What information is different between the two articles? Explain what information is only in one article or the other and what new research or information has been added or changed in the year-end article when compared with the earlier article.

Example student response for neutron star collision article: The article "Neutron star crash seen for first time," published in the November 11, 2017 issue, gives more details about the neutron stars (their masses were between 1.17 and 1.60 times that of the sun) and how their location was determined (the gravitational waves were coming from a small area of the sky that was a blind spot for the Virgo gravitational wave detector in Italy). "Neutron star crash seen for first time" gives more details about the observations, such as that detectable gravitational waves lasted for about 100 seconds, and also the order and general length of time between when the various types of radiation were detected. Finally, "Neutron star crash seen for first time" gives more information about some of the discoveries that those observations enabled, such as confirming where the r-process for forming heavy elements occurs, confirming the origin of short gamma-ray bursts and gaining clues to the rough stiffness of neutron star material.

The year-end neutron star article gives more context to the event: It was one of the most significant events in the last two decades of astronomy, and roughly 15 percent of astronomers were involved in the

observations and discovery. Though the concept was mentioned in the previous article, the year-end article gives a deeper explanation about how the near-simultaneous detection of gravitational and electromagnetic waves from the neutron star collision ruled out hundreds of theories that had been proposed as alternatives to the existence of dark energy, the mysterious force that appears to be accelerating the expansion rate of the universe. Finally, the year-end article mentions that the LIGO and Virgo gravitational wave detectors are now shut down for upgrades, and that additional gravitational wave detectors in Japan and India are planned.

Optional: Create a Venn diagram or chart showing the information that is shared between the two articles and the information unique to each article.

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Quest Through the Archives: Q

Directions: After reading one of the 10 year-end articles, log in to your *Science News* in High Schools account and use the Search page to answer these questions. Make sure you adjust the filters to include articles written before 1999 if the question requires you to do so. An optional approach to answering the questions is to create a Venn diagram or chart showing the information that is shared between the two articles and the information unique to each of the articles.

1. Find the most recent article in the archives that closely relates to one of the 10 year-end articles. Briefly describe the article, and give the citation for the article you found (ask your teacher about which citation style to use).

2. What information is the same in the archive article and the year-end article? Explain.

3. What information is different between the two articles? Explain what information is only in one article or the other and what new research or information has been added or changed in the year-end article when compared with the earlier article.

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Cross-Curricular Discussion: Q&A

Directions: In order to fully appreciate the Top 10 science stories of the year, students have to have some scientific background knowledge. Use this section to help students gain a better understanding of the key vocabulary and concepts in the *SN* Top 10. To help students better understand some of the vocabulary in these 10 articles, lead a classroom discussion based on the questions that follow.

Alternatively, as an extension of the article-based observation questions, students could work in groups to define and explain key scientific words or phrases from the articles using the questions below as a starting point. Ask students to think beyond the questions below to explain what concepts and key vocabulary must be known in order to understand the article's content. Working as a group, define the vocabulary in terms of how it relates to the article. Identify scientific topic areas that connect to the article.

Have the groups prepare to present this information to the rest of the class in a creative way. Allow each group to choose how to display and present the information to their classmates — suggest a poster, infographic or another visual that relates all the terms to the central topic. Alternatively, suggest that groups can write a two-minute commercial, skit or story about the article to present to classmates. After each class presentation, let students ask each other questions.

1) Cosmic mysteries unlocked in neutron star collision

Physics and Astronomy: What is a neutron star?

The inward gravitational pull on the mass of a star is normally balanced by the outward pressure generated by fusing hydrogen into helium, which produces energy. After a star has consumed most of its hydrogen and other raw materials, it can no longer generate that outward pressure, and some of its mass is pulled into its core. A star about as large as our sun or smaller will eventually collapse into a white dwarf, the core that remains after the star has blown off its outer layers. A star several times more massive than our sun will collapse until eventually its core is too heavy to withstand its own gravitational force, resulting in an explosion called a supernova. After a supernova, an ultradense, neutron-rich core of a dead star, or a neutron star, remains. Stars much more massive than the sun can collapse even further to form black holes.

Physics and Astronomy: What are gravitational waves?

The dimensions of space and time join into a fabric of the universe called spacetime. In two dimensions, spacetime can be thought of as a rubber sheet. Mass and energy warp spacetime, creating gravitational fields. Acceleration of large masses can create gravitational waves, ripples in the rubber sheet that travel outward at the speed of light.

2) CRISPR gene editing moves into humans, spurs debate

Biological Sciences: What is CRISPR/Cas9?

CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats)/Cas9 is a technique for genetically engineering cells or organisms. It has been adapted from a natural system in bacteria that targets and cuts up DNA from invading viruses. For genetic engineering, the Cas9 DNA-cutting enzyme is paired with a guide RNA sequence that corresponds to the desired target DNA sequence. When Cas9 and the guide RNA are introduced into a cell, they can seek out the target DNA and cut it. The cell may repair the DNA with other cellular DNA that it already has, or newly introduced DNA. Using the CRISPR/Cas9 technique, it is possible to delete, add or replace genetic material in a cell.

Biological Sciences: What is genetic discrimination?

Genetic discrimination would be denying people certain rights or opportunities based on their genes. Genetic discrimination can already occur, for example if a health plan will not cover a patient because the insurer knows the patient has a disease-causing mutation. If genetically altering human cells is taken to extremes, there is a danger that society could split into people whose parents had the money and opportunity to correct or even improve their genes, and those whose parents did not.

3) Larsen C ice break invites groundbreaking research

Earth Sciences: What are the Antarctic ice shelves?

Most of Antarctica is ice on top of a solid continent. However, the surface of the ocean adjacent to the continent is frozen, and those regions are called ice shelves since the solid ice protrudes like a shelf over the liquid water. Antarctic ice shelves have different names depending on their locations, and collectively cover approximately 1.5 million square kilometers.

4) Fossils join genetic evidence to revise human origin story

Biological Sciences: What are hominids?

Hominids are humans and their ancestors or relatives in the family of great apes, known as Hominidae. This family includes not only humans but also chimpanzees and gorillas, among others. Human-like hominids split off from other apes in Africa, most recently from a shared ancestor with chimpanzees around 6 million years ago. The genus Homo *includes modern humans,* Homo sapiens*, as well as a number of earlier species and subspecies that have been identified from fossil evidence.*

5) Seven Earth-sized planets orbit the same ultracool star

Physics and Astronomy: What are exoplanets?

Exoplanets are planets around stars other than our own sun. Because other stars are so far away — and because planets are typically much smaller than stars, do not emit light on their own and do not have much gravity to tug on things — exoplanets had been very difficult to detect until recently. Some exoplanets are detected when they cross in front of their star, causing the star's light as seen from Earth to dim. Other exoplanets have been detected based on the slight gravitational tugs they exert on their star, which causes the star to wobble slightly.

Physics and Astronomy: What is a dwarf star?

A dwarf star is a faint, small star, often a burned-out former star that has used up most of its fuel and collapsed. Other dwarf stars simply had too little matter to become regular stars in the first place. The more mass a star has, the more inward gravitational pull there is, the more pressure and heat are created at the

center and the more fusion reactions and energy are produced. A very small star will only produce a small amount of energy, so only planets orbiting very close to it would receive much warmth. On the other hand, smaller stars last much longer than larger stars, since they use up their available fuel more slowly.

Physics and Astronomy: What is a stellar flare?

Stellar flares result from electromagnetic instabilities, in which charged particles at the surface of the star are ejected by changes in the star's magnetic field. Those charged particles travel through space and can bombard any planets orbiting the star. Earth's magnetic field shields us from most charged particles emitted by solar flares. Charged particles that follow the magnetic field lines to the North and South poles create the northern and southern lights when they hit the atmosphere. Mars lost its magnetic field long ago, and then its atmosphere was gradually eroded by charged particles from the sun. Planets orbiting near a star prone to flares might have their atmospheres stripped away, killing any life on the surface — or preventing it from taking hold in the first place.

6) Quantum communication goes global

Physics and Astronomy: What is quantum entanglement?

Some particles link up as an ethereal pair — across great distances, their characteristics remain interconnected so, for example, the direction of spin of one may be linked to the spin of another. Yet according to quantum physics, particles might have any spin until an observer makes a measurement and determines the direction. If two entangled particles are separated without being measured, and then one particle's spin is measured, the other's can be predicted, even though it may now be far away. Einstein called this quantum link "spooky action at a distance."

Physics and Astronomy: What is quantum teleportation?

Quantum teleportation does not transmit matter from one place to another, but only information. If a sender and receiver each have a pair of entangled particles, for example, the sender can allow his or her entangled particle to interact with another particle he or she wants to "teleport." The sender can measure the property of interest, which destroys the information stored in that particle. But by sending that measurement to the receiver, the receiver can use the second of the entangled particles and the measurement to replicate the information in the new "teleported" particle.

7) Climate change may silently steal nutrients from crops

Earth Sciences: What is the atmospheric CO_2 level?

There is a small but important amount of CO_2 in the atmosphere. CO_2 is taken up by plants, and produced by animals and decaying plants. Due to the combustion of fossil fuels, the atmospheric CO_2 level has increased from approximately 300 parts per million (ppm) to over 400 ppm over the last century. The concentration is rising rapidly and some estimates suggest it could pass 1,000 ppm this century.

Earth Sciences: What is climate change?

Carbon dioxide (and other gases such as methane) act like a greenhouse in the atmosphere. Sunlight of shorter wavelengths enters through the atmosphere, is absorbed by the surface and reemitted as thermal radiation of longer wavelengths. Greenhouse gases prevent this longer radiation from passing back through the atmosphere to return to space, so the Earth gets warmer. As Earth warms, oceans rise from the melting

of polar ice and the thermal expansion of liquid water. Other effects of the warming include potentially more intense storm seasons and altered patterns of precipitation.

8) FDA approves gene therapy for two rare blood cancers

Biological Sciences: What is a T cell?

A T cell or T lymphocyte is a type of white blood cell in the immune system. The surface of a T cell is covered with receptors, which sense antigens or surface features on other cells. T cell receptors look for major histocompatibility (MHC) proteins on other cells, a sort of bar code that identifies where the cell is from. T cell receptors also look for pieces of internal cellular proteins that a cell coughs up to its cell surface. If a T cell finds a cell with the wrong MHC bar code or with no MHC bar code, it assumes that cell is an invader (or a transplant), and the T cell initiates an immune response. Likewise, if a T cell finds a cell with pieces of abnormal or unexpected proteins on its surface, it assumes the cell is cancerous or virus-infected and also initiates an immune response. Two major categories of T cells are helper T cells, which respond by producing chemical molecules that egg on other immune cells, and cytotoxic T cells, which respond by trying to kill abnormal cells.

Biological Sciences: What makes a cell a cancer cell?

Unlike normal cells, cancer cells continually divide to produce more copies of themselves — proliferating uncontrollably. Successful cancer cells typically: (1) Acquire mutations in their signaling pathways that keep cell division turned on. (2) Acquire mutations that knock out tumor suppressor genes, whose proteins would cause an abnormal cell to either fix its DNA or self-destruct. (3) Use tricks to evade T cells that could detect and kill the cancerous cells.

Biological Sciences: What is a chimeric antigen receptor?

An antigen is a molecule or substance that can trigger an immune response within the body. An antigen receptor is a sensor on the surface of a cell that detects specific antigens. A chimera is unrelated pieces assembled into a whole, like the chimera in Greek mythology. A chimeric antigen receptor is a genetically engineered receptor that contains different pieces; a common example combines pieces of a T cell with an antibody that specifically binds to a protein found on the surface of certain cancer cells. T cells that have been engineered with such a chimeric antigen receptor will recognize and respond to those cancer cells.

9) CTE may be common among pro football players

Biological Sciences: What is tau protein?

Tau proteins are normally associated with cytoskeletal microtubules, which provide internal structure to healthy neurons. In several neurodegenerative diseases such as chronic traumatic encephalopathy, Alzheimer's disease and Parkinson's disease, tau proteins tend to clump together. The clumps can damage or kill neurons.

Biological Sciences: What is chronic traumatic encephalopathy?

Chronic traumatic encephalopathy or CTE is a neurodegenerative disease known to affect people who have had repetitive head trauma, including concussions. It has received a lot of media attention in American football players, but it can occur in other athletes prone to head injuries (such as boxers or hockey players), as well as soldiers who have had multiple head injuries. Brains of people with CTE often have clumps of tau proteins, and the disease is associated with memory loss, uncontrolled emotions, depression and dementia.

10) Zika is not gone for good

Biological Sciences: What is Zika virus?

Zika virus is a member of the flavivirus family, which also includes dengue hemorrhagic fever, West Nile virus and yellow fever. Like those other infections, the Zika virus is spread from person to person by mosquitoes. Zika can also be spread by direct sexual contact. Until recently, Zika was believed to generally cause fairly mild symptoms before going away. However, in 2015 and 2016 it became apparent that Zika infection in pregnant women could sometimes cause a baby to be born with an abnormally small head or with other signs of brain damage.

Biological Sciences: What is a viral reservoir?

A reservoir is a source of something: water reservoirs for drinking water or thermal reservoirs for heat. A viral reservoir is a source of viruses, often referring to a place where a virus can hide out before causing future outbreaks in humans. Since viruses need host cells to replicate and survive, animals are good viral reservoirs. Different viruses prefer different types of animals. Primates such as monkeys or apes can be a dangerous reservoir since they are relatively similar to humans, so viruses can more easily hop from monkeys or apes to humans. Bats are another dangerous reservoir of human diseases; even though bats are less closely related to humans, they live in dense colonies and can fly great distances to spread infections.

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Cross-Curricular Discussion: Q

Directions: In order to fully appreciate the Top 10 science stories of this year, you've got to have some scientific background knowledge! Use this section to gain a better understanding of the key vocabulary and concepts in the *SN* Top 10. The following list of discussion questions is provided to help you take notes, brainstorm ideas and test your thinking in order to be more actively engaged in the class discussion.

You may be prompted by your teacher to work in your group on one specific article. Your group should explain what concepts and key vocabulary you have to know in order to understand the article's content. Define the vocabulary in terms of how it relates to the article. Identify scientific topic areas that connect to the article. Then prepare to present this information to the rest of the class. Be creative! You could create a poster, infographic or another visual that relates all the terms to the central topic. Alternatively, you might write a two-minute commercial, skit or story about the article to present to your classmates.

1) Cosmic mysteries unlocked in neutron star collision

Physics and Astronomy: What is a neutron star?

Physics and Astronomy: What are gravitational waves?

2) CRISPR gene editing moves into humans, spurs debate

Biological Sciences: What is CRISPR/Cas9?

Biological Sciences: What is genetic discrimination?

3) Larsen C ice break invites groundbreaking research

Earth Sciences: What are the Antarctic ice shelves?

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Physics and Astronomy: What is a stellar flare?

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Biological Sciences: What is a T cell?

Biological Sciences: What makes a cell a cancer cell?

Biological Sciences: What is a chimeric antigen receptor?

9) CTE may be common among pro football players

Biological Sciences: What is tau protein?

Biological Sciences: What is chronic traumatic encephalopathy?

10) Zika is not gone for good

Biological Sciences: What is Zika virus?

Biological Sciences: What is a viral reservoir?

SN EDUCATOR GUIDE

December 23, 2017 & January 6, 2018

SN 2017 Year in Review

Activity Guide for Teachers: Top 10 Countdown

Purpose: To review 2017's top science stories or class content from the entire first semester.

Procedural overview:

Activity 1: Match it up! Students can work in groups of three to play an organism matching game after reading the "Life finds a way" page for homework. Organisms highlighted include flamingos, tardigrades (one shown below) and the bearded dragon lizard. Groups may create their own game that classmates can play based on other information from the issue.

3DSTOCK/SHUTTERSTOCK

Activity 2: Top 10 semester in review Have students start a semester review by creating their own Top 10 list of science experiences from the semester. Have students describe what was learned in each experience, explain the concept covered and give an application of the learned concept. Students may present their Top 10 science experiences in a timeline or infographic format.

Approximate class time: 1-2 classes.

Activity 1: Match it up!

Have students read the "Life finds a way" page for homework before coming to class. Download, print and prepare the **Match it up!** game for groups of three students. The PDF for the game can be found at this link.

Cut out the squares containing the names and photos of the organisms. Also cut out the squares containing clues about each organism. Shuffle the clues and name cards together, and place them in one stack face down. Each group of three students should get one stack of 20 cards. Follow the instructions below.

Instructions:
1) Shuffle the cards and then set them out face down into five rows of four cards.
2) The first player turns over any two cards. If the two cards match — the name card matches the corresponding clue — the player picks up and keeps the pair and then goes again. If the cards don't match, turn them back over in their original positions. A player's turn ends when he or she doesn't make a match.
3) Once all the cards have been picked up, the player with the most matching pairs is the winner.

Variations:

- To decrease the difficulty of the game, keep the clue cards and name cards separate throughout the game. Shuffle clue cards separately from name cards, and place each set face down in its own pile. Each group of three students should get one stack of name cards and one stack of clue cards. Place all name cards face down in two rows of five cards, and place all clue cards face down in a separate rectangle of two rows of five cards. When it is a player's turn, one clue card should be turned over and one name card should be turned over to see if they match.

If time permits, allow groups to create another game based on information from this issue. Here are some examples of games students could create, or have them come up with their own ideas:

- A board game based on rolling dice to work your way toward solar system destinations visited by the robotic probes listed on the "Mission debriefing" page.
- A Jeopardy!-style game based on facts from the 10 articles.
- A Monopoly-style game where you compete to gather technologies from this issue to rule the world.
- A bingo game based on vocabulary from the Top 10 articles.

After groups have finished creating a game, have them swap games with another group. Once the group finishes a game, allow time for groups to give each other feedback for game improvement.

Activity 2: Top 10 semester in review

Have students work in groups to review the key concepts of the semester by looking back over *Science News* readings, textbook chapters, notes, labs and other related assignments. Based on that information, have groups or individuals create their own Top 10 list of science experiences from the semester. For each of the 10 experiences, students should explain what they learned, explain the concept covered and give an application of the learned concept. To get an even larger in-class review session, have students share their Top 10 with their classmates by creating and presenting an infographic or timeline.

SN EDUCATOR GUIDE

December 23, 2017 & January 6, 2018

SN 2017 Year in Review

Activity Guide for Students: Top 10 Countdown

Purpose: To review 2017's top science stories or class content from the entire first semester.

Procedural overview:

> **Activity 1: Match it up!** After reading the "Life finds a way" page, in a group of three play an organism memory matching game. Then create your own game that your classmates can play based on other information from the issue.
>
> **Activity 2: Top 10 semester in review** Start a semester review by creating your own Top 10 list of science experiences from the semester. Describe what was learned in each experience, explain the concept covered and give an application of the learned concept. Be prepared to present your Top 10 science experiences in a timeline or infographic format.

Activity 1: Match it up!

Instructions:
1) Obtain cards from your teacher.
2) Shuffle the cards and then set them out face down into five rows of four cards.
3) The first player turns over any two cards. If the two cards match — the name card matches the corresponding clue — the player picks up and keeps the pair and then goes again. If the cards don't match, turn them back over in their original positions. A player's turn ends when he or she doesn't make a match.
4) Once all the cards have been picked up, the player with the most matching pairs is the winner.

Variations:

- To decrease the difficulty of the game, keep the clue cards and name cards separate throughout the game. Shuffle clue cards separately from name cards, and place each set face down in its own pile. Each group of three students should get one stack of name cards and one stack of clue cards. Place all name cards face down in two rows of five cards, and place all clue cards face down in a separate rectangle of two rows of five cards. One clue card should be turned over and one name card should be turned over to see if they match.

If time permits, create another game based on information from this issue. Here are some examples of games you could create, or come up with your own ideas:

- A board game based on rolling dice to work your way toward solar system destinations visited by the robotic probes listed on the "Mission debriefing" page.
- A Jeopardy!-style game based on facts from the 10 articles.
- A Monopoly-style game where you compete to gather technologies from this issue to rule the world.
- A bingo game based on vocabulary from the Top 10 articles.

After you have finished creating a game, swap games with another group. Give each other feedback for game improvement.

Activity 2: Top 10 semester in review

Work in groups to review what you have learned this semester. Look back over your *Science News* readings, textbook chapters, notes, labs and other related assignments. Based on that information, create your own Top 10 list of science experiences you had this semester. For each of the 10 experiences, what did you learn? Explain the concept and give an application of it. Create an infographic or timeline of your Top 10, then present it to the rest of the class.

SN EDUCATOR GUIDE

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SN 2017 Year in Review

Other Related Articles

***Science News* article(s) related to *SN* Top 10:**

1. What detecting gravitational waves means for the expansion of the universe
2. CRISPR/Cas9 can reverse multiple diseases in mice
3. When the Larsen C ice shelf broke, it exposed a hidden world
4. Ancient boy's DNA pushes back date of earliest humans
5. Seven Earth-sized planets orbit nearby supercool star
6. Quantum video chat links scientists on two different continents
7. Changing climate could worsen foods' nutrition
8. FDA approves gene therapy to treat a rare cancer
9. Most football players who donated their brains to science had traumatic injury
10. Zika hasn't been in the news much, but that doesn't mean it's gone

***Science News for Students* readers' top picks:**

1. Concerns explode over new health risks of vaping
Readability score: 7.6
2. What killed the dinosaurs?
Readability score: 8.1
3. New solar system found to have 7 Earth-size planets
Readability score: 6.9
4. Explainer: What is dopamine?
Readability score: 7.6
5. Are fidget spinners tools or toys?
Readability score: 6.9
6. Why onions make us cry
Readability score: 7.5
7. Video games level up life skills
Readability score: 7.9
8. Evening screen time can sabotage sleep
Readability score: 6.0
9. What do animals do during a solar eclipse?
Readability score: 8.0
10. Is weather control a dream or nightmare?
Readability score: 7.2

***Science News for Students* editors' top picks:**

1. What scientists hope to learn from Great American Eclipse
Readability score: 7.5
2. Five portraits of Hurricane Irma's record-breaking fury

Readability score: 7.2
3. Antarctic ice shelf sheds Delaware-sized iceberg
Readability score: 7.7
4. The Internet of Things wants to link all facets of our world
Readability score: 7.6
5. Astronomers finally find the cosmic source of gold and silver
Readability score: 8.1
6. Think you're not biased? Think again
Readability score: 7.8
7. What killed the dinosaurs?
Readability score: 8.1
8. Bones have stealth role in muscle appetite and health
Readability score: 7.6
9. Cassini spacecraft takes its final bow
Readability score: 6.9
10. Is Zealandia a continent?
Readability score: 8.3

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