SN EDUCATOR GUIDE

Dec. 24, 2016 & Jan. 7, 2017

Making Waves

About this Issue

Science News' latest issue looks back at impactful research "making waves" in 2016. The No. 1 story of the year, "Gravitational waves offer new view of dynamic cosmos" (Page 17), recounts the direct detection of gravitational waves, reported for the first time in 2016. Albert Einstein's theory of general relativity had predicted the waves a century earlier. The article also describes how observing gravitational waves could tell us more about collisions between black holes, explosions of stars and other cosmic events that create the waves. A special infographic, "The future of cars" (Page 34), examines the challenges in developing and embracing self-driving cars. How will humans share the roads with robotic vehicles that don't have the instincts and ethics that help us make decisions? Cognitive scientists and robotic engineers are joining forces to overcome problems with sensory perception, spatial awareness, safety and cybersecurity. The infographic text touches on robotics, physiology and psychology, cyber vulnerability and social and ethical considerations. Students can focus on the details of each article or explore cross-curricular connections to other major science topics such as wave interference or automated technology. For additional gravitational wave information and curriculum-related content, see the *Science News* article "Physicists detect gravitational waves," in the March 5, 2016 issue, and the accompanying Educator Guide.

Connections to Curricula

- Qualitative observations
- Theory of general relativity
- Waves and vibration
- Optics and lasers
- Ethics
- Spatial organization
- Brain physiology
- Sociology and human interactions
- Robotics
- Cybersecurity

What's in this Guide?

- Article-Based Observation on Self-Driving Cars: These questions focus on reading and content comprehension by drawing on information found in the article "The future of cars." Questions focus on autonomous vehicles and the nature of research that will support their widespread use.
- Article-Based Observation on Gravitational Waves: These questions develop an understanding for the concept of gravitational waves by focusing on gravitational waves, gravitational wave detectors and how observing gravitational waves can improve our understanding of the universe. The questions are based on an article from this issue, "Gravitational waves offer new view of dynamic cosmos," and the related article from the March 5, 2016 issue, "Physicists detect gravitational waves."
- Quest Through the Archives: With Internet access and your school's digital access to *Science News*, your students can use this short section to explore applications of artificial intelligence and the potential issues with its use, as reported by *Science News* since 1922.

- Cross-Curricular Discussion: These questions and extension prompts connect to the article "Gravitational waves offer new view of dynamic cosmos" and encourage students to think about many types of waves and wave detectors. The section is divided roughly by science subdiscipline for educators who would like to focus on one particular topic area. The extension prompts are either more topic specific or more conceptually advanced. **Biological Sciences** questions cover detection of various types of waves by humans and other animals. **Physical Sciences** questions concern general properties of waves, differences between sound and electromagnetic waves and the nature of gravitational waves. **Earth-Space Sciences** questions encourage students to think about events in space that can produce gravitational waves. **Engineering and Experimental Design** questions focus on how to design wave detectors and how to interpret collected data correctly.
- Activities: This section includes two experimental activities that students can perform. The first activity on **Wave Generation** involves generating and observing waves in a clear pan of water, with analogies to gravitational waves and to the light waves used in gravitational wave detectors. The second activity on **Wave Detection** asks students to design, build, test and optimize their own light-based detector for waves (a very simple optical seismometer), and explores how this detector relates to much more sophisticated gravitational wave detectors.

Standards Alignment

Next Generation Science	Common Core
Energy: HS-PS3-2, HS-PS3-5	ELA Standards: Reading Informational Text (RI): 1, 2, 4, 7
Waves and their Applications in Technologies for Information Transfer: HS-PS4-1, HS-PS4-5	ELA Standards: Writing (W): 1, 2, 8, 9
Earth's Place in the Universe: HS-ESS1-2	ELA Standards: Speaking and Listening (SL): 1, 2, 3, 4
Engineering Design: HS-ETS1-1, HS-ETS1-3	ELA Standards: Reading for Literacy in Science and Technical Subjects (RST): 1, 2, 3, 4, 9
	ELA Standards: Writing Literacy in History/Social Studies and Science and Technical Subjects (WHST): 1, 2, 4, 7, 9