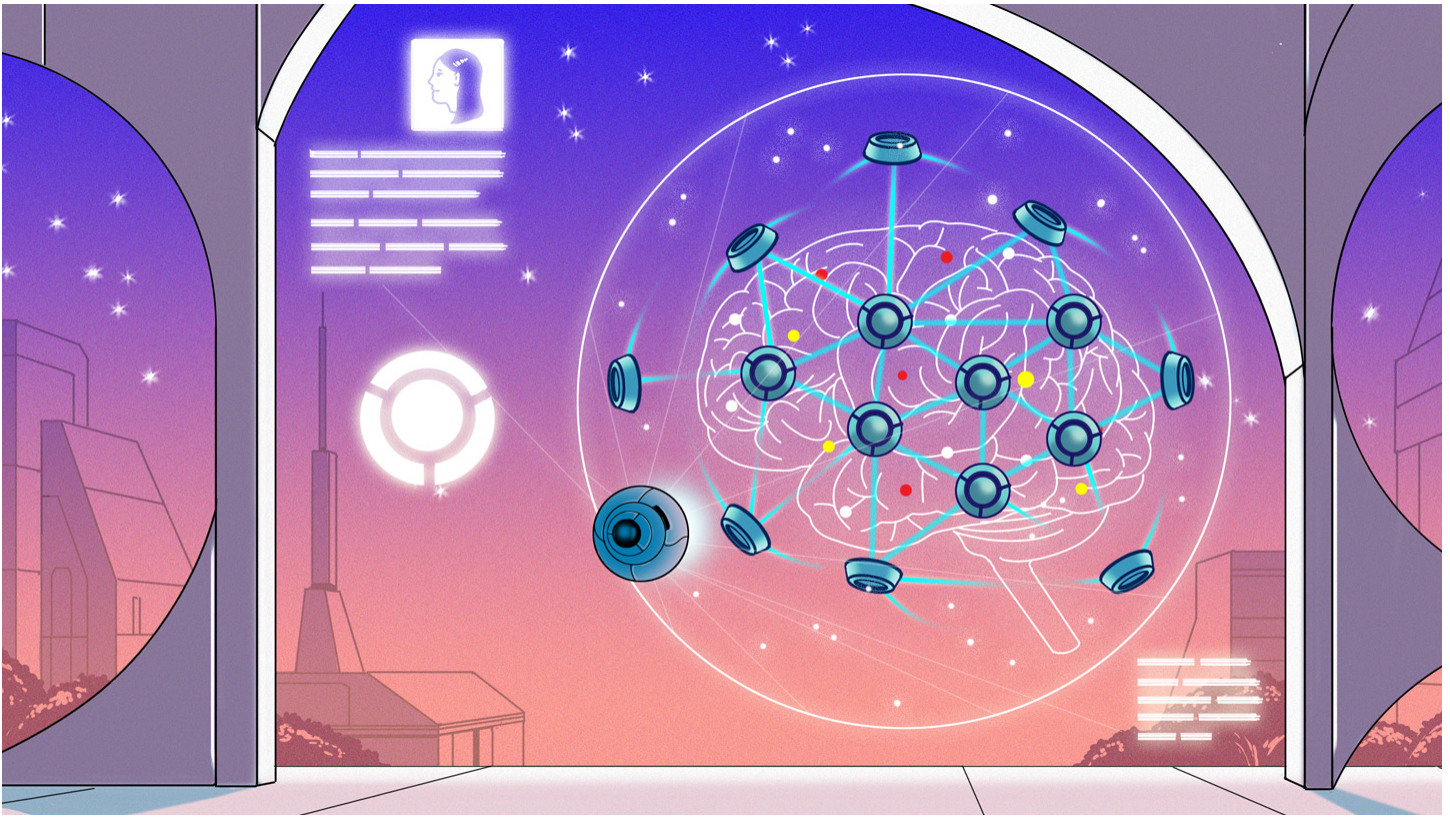


ScienceNews

EDUCATOR GUIDE



GLENN HARVEY

March 13, 2021
Our Brains, Our Futures



About this Guide

In this Guide, based on the online *Science News* article “[Three visions of the future, inspired by neuroscience’s past and present](#),” students will explore how brain science has progressed over the last century and how that progress could inform the field’s future. Then, students will discuss the ethics of advancements in neurotechnology.

This Guide includes:

Article-based Comprehension Q&A — Students will answer questions about the online *Science News* article “[Three visions of the future, inspired by neuroscience’s past and present](#),” which presents three fantastical tales of where neuroscience might take us, based on the progress made by brain researchers in the last 100 years. A version of the story, “Our brains, our futures,” can be found in the March 13, 2021 issue of *Science News*. Related standards include NGSS-DCI: HS-ETS1.

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 explore advances in neurotechnology by making connections between examples they’ve seen in popular culture and what is currently possible. Students will then think critically about positive and negative effects of advancements in this area of science. 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.

Article-based Comprehension, Q&A

Directions for teachers: Ask your students to read the introduction of the online *Science News* article [“Three visions of the future, inspired by neuroscience’s past and present,”](#) which presents three fantastical tales of where neuroscience might take us, based on the progress made by brain researchers in the last 100 years. Then, have students choose one vignette in the article to read and answer questions about. Make sure students also read the “Reality check” section that is paired with their vignette. Example answers are provided for the vignette “Science future: brain bots.” A version of the story, “Our brains, our futures,” can be found in the March 13, 2021 issue of *Science News*.

This story is part of a series that celebrates *Science News*’ upcoming 100th anniversary by highlighting some of the biggest advances in science over the last century. For more on the history and future of neuroscience, and to see the rest of the series as it appears, visit *Science News*’ Century of Science site at www.sciencenews.org/century

1. What was science’s understanding of the brain like 100 years ago? What did scientists know about the brain, and what was a mystery?

Science had a very primitive understanding of the brain a century ago. Researchers identified nerve cells as important components of the brain and nervous system, but they didn’t understand how the cells communicated or how they influenced behavior, memory and emotions.

2. When did neuroscience become an official STEM field? How has the field advanced in the decades since it was established? What obstacles remain?

Neuroscience became an established field in the 1960s. Using powerful tools developed over the last few decades, scientists have found that a single nerve cell can connect to tens of thousands of other cells and that it’s likely more than 100 different kinds of brain cells communicate using dozens of chemicals. Though scientists are collecting more data on the brain than ever before, there still isn’t a complete explanation of how it operates.

3. How are scientists working to overcome those obstacles?

Scientists are mapping the brain’s neural connections that move information from one part of the organ to another. This atlas of the brain’s communication systems, called the connectome, is helping scientists view the brain differently. The maps are now starting to be used to treat disorders such as Parkinson’s disease, obsessive-compulsive disorder and depression.

4. Why does the *Science News* article include fictional vignettes? What purpose do they serve?

The vignettes help readers imagine what neuroscience advancements are ahead based on real research that’s happening today.

5. What vignette did you choose? What technology does the vignette describe, and how is the technology used?

I chose the vignette “Science future: brain bots.” The story describes how microscopic robots called nanobots are implanted into a woman’s brain to help treat her depression.

6. List some pros and cons of the technology described in the vignette.

That neural network could pinpoint and precisely repair the woman’s brain circuitry that was misfiring and triggering depression. The technology could fix other problems, such as addiction, dementia and eating disorders. But it raised questions about what it means to be a person if the brain is influenced by robots, and who or what should have control over thoughts and emotions.

7. How realistic is the vignette? What about the vignette is fact and what is fiction?

While the nanobot treatment for depression doesn’t exist, the idea that scientists will be able to change certain brain networks to improve health is real.

8. Describe some of the real scientific research and advancements that inspired the vignette.

Research into nanoscale robots engineered to roam the body and act as doctors was a big inspiration for the vignette. Some of the advancements that served as inspiration include deep brain stimulation for treating symptoms of Parkinson’s disease and other disorders, as well as miniscule electrodes and neural nets used to track brain activity in mice.

9. What hurdles do scientists still need to overcome to reach their goals of advancing neuroscience?

Scientists are still figuring out how to reliably change brain activity and where to make the change. That location differs among disorders and among individual people.

Student Comprehension Worksheet

Directions: Read the introduction of the online *Science News* article "[Three visions of the future, inspired by neuroscience's past and present](#)," which presents three fantastical tales of where neuroscience might take us, based on the progress made by brain researchers in the last 100 years. Then, choose one vignette in the article to read and answer questions about. Make sure you also read the "Reality check" section related to your vignette. A version of the story, "Our brains, our futures," can be found in the March 13, 2021 issue of *Science News*. For more on the history and future of neuroscience, and to explore other big science advances over the last 100 years, visit *Science News'* Century of Science site at www.sciencenews.org/century

1. What was science's understanding of the brain like 100 years ago? What did scientists know about the brain, and what was a mystery?
2. When did neuroscience become an official STEM field? How has the field advanced in the decades since it was established? What obstacles remain?
3. How are scientists working to overcome those obstacles?
4. Why does the *Science News* article include fictional vignettes? What purpose do they serve?
5. What vignette did you choose? What technology does the vignette describe, and how is the technology used?
6. List some pros and cons of the technology described in the vignette.
7. How realistic is the vignette? What about the vignette is fact and what is fiction?
8. Describe some of the real scientific research and advancements that inspired the vignette.

9. What hurdles do scientists still need to overcome to reach their goals of advancing neuroscience?

Cross-curricular Discussion, Q&A

Directions for teachers:

Ask students to read the introduction of the online *Science News* article "[Three visions of the future, inspired by neuroscience's past and present](#)." Ask them to review all fictional neurotechnology vignettes in the article and choose one to focus on. Students should read the vignette and answer the first and second sets of questions, then partner with a classmate who chose a different vignette. Each pair should discuss answers to the first two sets of questions and answer the third question set together. A version of the story, "Our brains, our futures," appears in the March 13, 2021 issue of *Science News*.

As an optional extension, have students submit their answer to the final question to SNHS@societyforscience.org.

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For additional information about ethical considerations involving neurotechnology, refer to the online *Science News* article "[Can privacy coexist with technology that read and changes brain activity?](#)" A version of the story, "Inside your head," appears in the February 13, 2021 issue of *Science News*.

Want to make it a virtual lesson? Post the online *Science News* article "[Three visions of the future, inspired by neuroscience's past and present](#)," to your virtual classroom and use the questions to discuss the article with your class.

Defining neuroscience

1. What is neuroscience and when did it become generally recognized as a science?

Neuroscience is the study of the brain and nervous system. It was recognized as an official science field in the 1960s.

2. What is neurotechnology? Give an example from the article.

Neurotechnology is the set of methods and instruments that are used to collect and study neuron and neural connected pathway data from the brain or more broadly in the nervous system. Surgically implanted electrodes used to tweak brain activity are an example.

3. What role do you think neurotechnology plays in the progress of neuroscience as a field?

Neuroscience relies heavily on technology that collects, modulates and stores brain activity data. Advances in the field of neuroscience depend on advances in neurotechnology that help scientists probe the brain better or differently.

Thinking critically

1. Can you think of a movie, television show or book that exemplifies a real or fictional advance in neuroscience? Discuss what neurotechnology was used, and talk about how its use made you feel. Were there aspects of the technology that seemed exciting or interesting? What about scary or intimidating?

Student answers will vary, but students may mention examples of memories being wiped clean, implanted ideas or brain trickery to create virtual worlds from movies such as Eternal Sunshine of the Spotless Mind, Inception or The Matrix.

2. Based on currently available neurotechnology and the vignettes in the article that highlight possible future advances, how likely do you think it is that your example could become a reality if it isn't already? Explain.

Student answers will vary, but students should discuss how related or unrelated their example is from the already existing neurotechnology and the vignettes highlighted in the Science News article.

3. What are some current or potential future benefits of neurotechnology, according to the *Science News* article? List some benefits of your neurotechnology example.

Scientists can record nerve cell activity and use brain mapping to guide treatments of disorders including as Parkinson's disease, obsessive-compulsive disorder and depression. Electrodes implanted in the brain help control sporadic movements associated with seizures and Tourette's syndrome. Eventually, individuals may be able to have their brains mapped to precisely tailor treatments for various disorders. Student answers about their own example will vary.

4. What are the main ethical concerns about current and future advances in neurotechnology, according to the *Science News* article? Does your neurotechnology example raise any ethical concerns? Explain.

Privacy, autonomy and fairness are the main ethical concerns of advances in neurotechnology. Who should have access to brain data and for what purposes should it be used are major ethical concerns. If policies and regulations are not put in place, then further advances in technology may allow companies to access brain data without people's knowledge or consent. Student answers about their own example will vary.

Moving forward

1. What role should the public have in shaping how neurotechnology is created and used?

Student answers will vary, but may include thoughts about rights that individuals have to privacy, etc.

2. Brainstorm one possible solution for handling the privacy violations that might arise with advancements of neurotechnology in the future.

Student answers will vary. One solution, for example, could be suggesting the creation of guidelines or policies for scientists, engineers, governments and private companies.

3. What would you like to tell the scientists working in this field? Send your thoughts to SNHS@societyforscience.org.

Student answers will vary, but we'd love to hear back from your students!

Student Discussion Worksheet

Directions: Read the introduction of the online *Science News* article "[Three visions of the future, inspired by neuroscience's past and present](#)," and choose one of the vignettes to read. Answer the first two sets of questions alone. Then, partner with a classmate who chose a different vignette and discuss your answers to the first two question sets before answering the third question set together. A version of the story, "Our brains, our futures," appears in the March 13, 2021 issue of *Science News*.

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Defining neuroscience

1. What is neuroscience and when did it become generally recognized as a science?
2. What is neurotechnology? Give an example from the article.
3. What role do you think neurotechnology plays in the progress of neuroscience as a field?

Thinking critically

1. Can you think of a movie, television show or book that exemplifies a real or fictional advance in neuroscience? Discuss what neurotechnology was used, and talk about how its use made you feel. Were there aspects of the technology that seemed exciting or interesting? What about scary or intimidating?
2. Based on currently available neurotechnology and the vignettes in the article that highlight possible future advances, how likely do you think it is that your example could become a reality if it isn't already? Explain.
3. What are some current or potential future benefits of neurotechnology, according to the *Science News* article? List some benefits of your neurotechnology example.

4. What are the main ethical concerns about current and future advances in neurotechnology, according to the *Science News* article? Does your neurotechnology example raise any ethical concerns? Explain.

Moving forward

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