

XENOTRANSPLANTATION AND PIG ORGAN TRANSPLANTS GRADE 8 AND UP READING

Improve students'
literacy skills

Science Applicability

Sub Plan

SCROLL
to take a look inside!

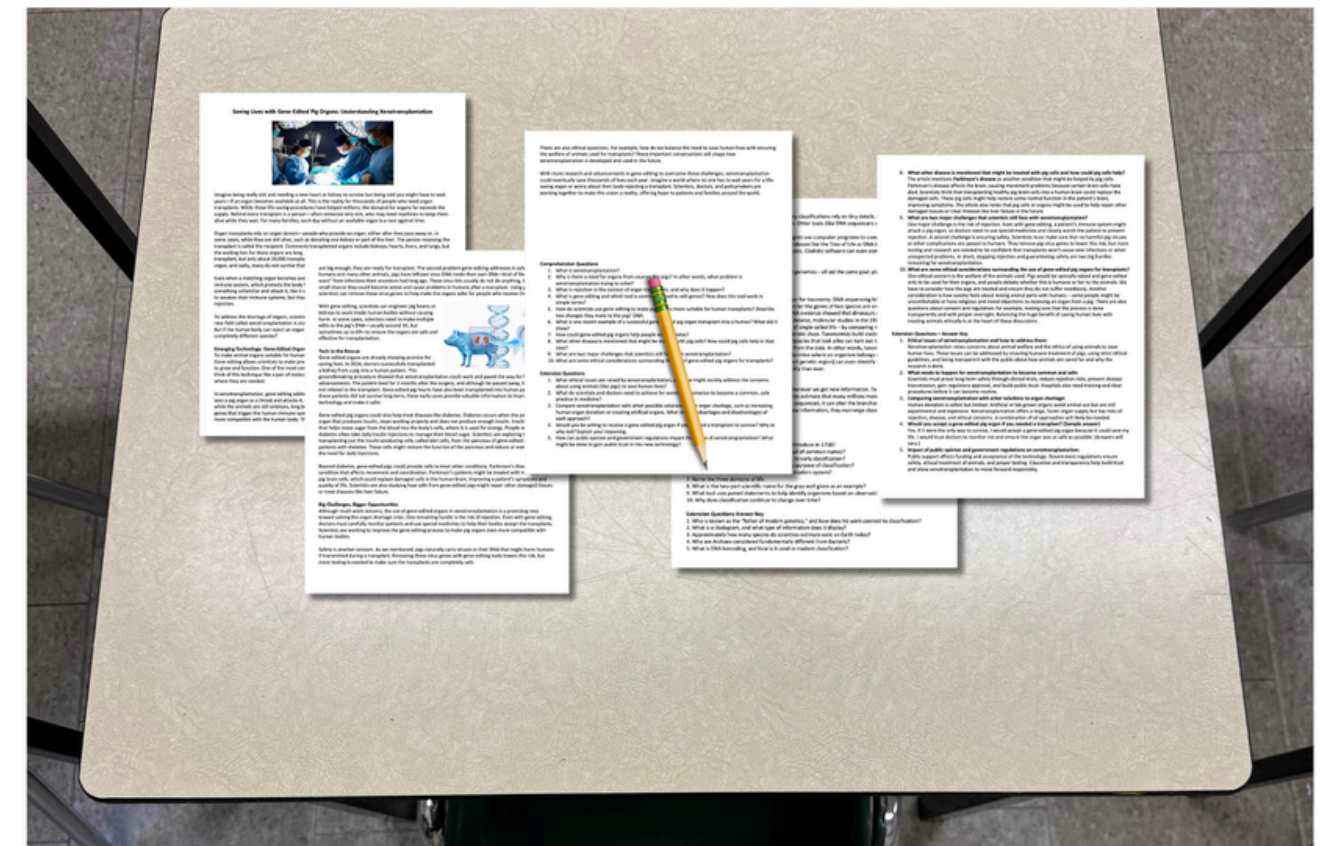


THE PROBLEMS YOU FACE

- Limited time to teach scientific literacy and strengthen students' reading and analysis skills.
- Need meaningful extension activities to engage fast-moving learners.
- Difficulty creating effective last-minute sub plans that still support student learning.

CLASSROOM READY

- Questions and Answer Key
- **No Prep, Ready-to-Use:** Print or assign digitally with Google Docs, Microsoft Word, and PDF formats for flexible classroom use
- **Includes Varied Question Types:** Knowledge, thinking, connecting, application, and open-ended questions.



What Will Your Students Learn?

READING COMPREHENSION ARTICLE & QUESTION BUNDLE

Article with
Comprehension
Questions

Grade 8 and Up

Print & Digital

- Organ Shortage
- Xenotransplantation
- Gene Editing
- CRISPR Technology
- Pig Organs
- Immune Rejection
- Ethical Concerns
- Future Medicine

Comprehension Questions

1. What is xenotransplantation?
2. Why is there a need for organs from sources like pigs? In other words, what problem is xenotransplantation trying to solve?
3. What is rejection in the context of organ transplants, and why does it happen?
4. What is gene editing and which tool is commonly used to edit genes? How does this tool work in simple terms?
5. How do scientists use gene editing to make pig organs more suitable for human transplants? What are the two challenges they face?
6. What is the 'xenotransplantation' process?
7. How do scientists use gene editing to make pig organs more suitable for human transplants?
8. What is the 'xenotransplantation' process?
9. What is the 'xenotransplantation' process?
10. What is the 'xenotransplantation' process?

Extension Questions

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Saving Lives with Gene-Edited Pig Organs: Understanding Xenotransplantation



Imagine being really sick and needing a new heart or kidney to survive but being told you might have to wait years—if an organ becomes available at all. This is the reality for thousands of people who need organ transplants. While these life-saving procedures have helped millions, the demand for organs far exceeds the supply. Behind every transplant is a person—often someone very sick, who may need machines to keep them alive while they wait. For many families, each day without an available organ is a race against time.

Organ transplants rely on organ donors—people who provide an organ, either after they pass away or, in some cases, while they are still alive, such as donating one kidney or part of the liver. The person receiving the transplant is called the recipient. Commonly transplanted organs include kidneys, hearts, livers, and lungs, but the waiting lists for these organs are long. In the United States, over 100,000 people are waiting for an organ transplant, but only about 30,000 transplants will happen this year. Some patients may wait years for an organ, and sadly, many do not survive that long.

Even when a matching organ becomes available, there is another big challenge: rejection. The recipient's immune system, which protects the body from dangerous invaders, may see the transplanted organ as something unfamiliar and attack it, like it would a virus or bacteria. To prevent this, patients take medications to weaken their immune systems, but these drugs have side effects and are not always effective at stopping rejection.

To address the shortage of organs, scientists are exploring a surprising source: animals—specifically pigs. A new field called xenotransplantation is studying how organs from animals could be used to save human lives. But if the human body can reject an organ from another person, how could it possibly accept one from a completely different species?

Emerging Technology: Gene-Edited Organs

To make a pig organ more suitable for human transplants, scientists are using a powerful tool called CRISPR-Cas9 to edit the pig's DNA.

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Your Reading

Saving Lives with Gene-Edited Pig Organs: Understanding Xenotransplantation



Imagine being really sick and needing a new heart or kidney to survive but being told you might years—if an organ becomes available at all. This is the reality for thousands of people who need transplants. While these life-saving procedures have helped millions, the demand for organs far exceeds supply. Behind every transplant is a person—often someone very sick, who may need machine support to stay alive while they wait. For many families, each day without an available organ is a race against time.

Organ transplants rely on organ donors—people who provide an organ, either after they pass away or while they are still alive, such as donating one kidney or part of the liver. The recipient of the transplant is called the recipient. Commonly transplanted organs include kidneys, hearts, and livers. The waiting lists for these organs are long. In the United States, over 100,000 people are on the waiting list, but only about 30,000 transplants will happen this year. Some patients may wait years for an organ, and sadly, many do not survive that long.

Even when a matching organ becomes available, there is another big challenge: rejection. The immune system, which protects the body from dangerous invaders, may see the transplanted organ as something unfamiliar and attack it, like it would a virus or bacteria. To prevent this, doctors use drugs to weaken the immune system, but these drugs have side effects and are not always effective.

To address the shortage of organs, scientists are exploring a surprising source: animals. A new field called xenotransplantation is studying how organs from animals could be used to save human lives. But if the human body can reject an organ from another person, how could it possibly accept an organ from a completely different species?

Emerging Technology: Gene-Edited Organs

To make animal organs suitable for human transplants, scientists are using a powerful tool called gene editing. Gene editing allows scientists to make precise changes to an animal's DNA—the instructions that tell the body how to grow and function. One of the most commonly used tools for gene editing is called CRISPR. Think of this technique like a pair of molecular scissors that can cut and paste specific bits of DNA where they are needed.

In xenotransplantation, gene editing addresses two big problems. First, the human immune system sees a pig organ as a threat and attacks it, causing rejection. To prevent this, scientists edit the DNA of the animals while they are still embryos, long before they are born. These changes include "turning off" genes that trigger the human immune system and adding human genes to the pig's DNA to make the pig's organs more compatible with the human body. The pig organs grow with these edits already in place.

Pig organs are big enough, they are ready for transplant. The second problem gene editing addresses is that humans and many other animals, pigs have leftover virus DNA inside their own DNA—kind of "scars" from infections their ancestors had long ago. These virus bits usually do not do anything, but they can sometimes become active and cause problems in humans after a transplant. Using gene editing, scientists can remove these virus genes to help make the organs safer for people who receive them.

With gene editing, scientists can engineer pig hearts or kidneys to work inside human bodies without causing harm. In some cases, scientists need to make multiple edits to the pig's DNA—usually around 10, but sometimes up to 69—to ensure the organs are safe and effective for transplantation.

Tech to the Rescue

Gene-edited organs are already showing promise for saving lives. In 2024, doctors successfully transplanted a kidney from a pig into a human patient. This groundbreaking procedure showed that xenotransplantation could work and paved the way for future advancements. The patient lived for 2 months after the surgery, and although he passed away, the transplant was successful. Gene-edited pig hearts have also been transplanted into human patients. These early cases provide valuable information to improve the technology and make it safer.

Gene-edited pig organs could also help treat diseases like diabetes. Diabetes occurs when the pancreas, which produces insulin, stops working properly and does not produce enough insulin. Insulin helps move sugar from the blood into the body's cells, where it is used for energy. People with diabetes often take daily insulin injections to manage their blood sugar. Scientists are exploring transplanting just the insulin-producing cells, called islet cells, from the pancreas of gene-edited pigs into human patients with diabetes. These cells might restore the function of the pancreas and reduce or eliminate the need for daily injections.

Beyond diabetes, gene-edited pigs could provide cells to treat other conditions. Parkinson's disease is a condition that affects movement and coordination. Parkinson's patients might be treated with transplants of pig brain cells, which could replace damaged cells in the human brain, improving a patient's quality of life. Scientists are also studying how cells from gene-edited pigs might repair other parts of the body or treat diseases like liver failure.

Big Challenges, Bigger Opportunities

Although much work remains, the use of gene-edited organs in xenotransplantation is a promising step toward solving the organ shortage crisis. One remaining hurdle is the risk of rejection. Even with gene editing, doctors must carefully monitor patients and use special medicines to help their bodies accept the transplanted organ. Scientists are working to improve the gene-editing process to make pig organs even more compatible with human bodies.

Safety is another concern. As we mentioned, pigs naturally carry viruses in their DNA that might be transmitted during a transplant. Removing these virus genes with gene-editing tools lowers the risk, but more testing is needed to make sure the transplants are completely safe.

There are also ethical questions. For example, how do we balance the need to save human lives with ensuring the welfare of animals used for transplants? These important conversations will shape how xenotransplantation is developed and used in the future.

With more research and advancements in gene editing to overcome these challenges, xenotransplantation could eventually save thousands of lives each year. Imagine a world where no one has to wait years for an organ or worry about their body rejecting a transplant. Scientists, doctors, and policymakers are working together to make this vision a reality, offering hope to patients and families around the world.

Comprehension Questions

1. What is xenotransplantation?
2. Why is there a need for organs from sources like pigs? In other words, what problem is xenotransplantation trying to solve?
3. What is rejection in the context of organ transplants, and why does it happen?
4. What is gene editing and which tool is commonly used to edit genes? How does this tool work?
5. How do scientists use gene editing to make pig organs more suitable for human transplants?
6. What is one recent example of a successful gene-edited pig organ transplant into a human?
7. How could gene-edited pig organs help people with diabetes?
8. What other disease is mentioned that might be treated with pig cells? How could pig cells help?
9. What are two major challenges that scientists still face with xenotransplantation?
10. What are some ethical considerations surrounding the use of gene-edited pig organs for transplants?

Extension Questions

1. What ethical issues are raised by xenotransplantation, and how might society address them?
2. What do scientists and doctors need to achieve for xenotransplantation to become a common practice in medicine?
3. Compare xenotransplantation with other possible solutions to the organ shortage, such as organ donation or creating artificial organs. What are the advantages and disadvantages of each approach?
4. Would you be willing to receive a gene-edited pig organ if you needed a transplant? Why or why not? Explain your reasoning.
5. How can public opinion and government regulations impact the future of xenotransplantation? What might be done to gain public trust in this new technology?

Comprehension Questions – Answer Key

1. **What is xenotransplantation?**
Xenotransplantation is the transplantation of organs or cells from one species into another species. In this article's context, it specifically means using animal organs (especially from pigs) and putting them into human patients to save lives.
2. **Why is there a need for organs from sources like pigs?**
There is a serious shortage of human organs for transplant, which means many patients die while waiting for a donor. Xenotransplantation is trying to solve this organ shortage by providing an additional source of organs. By using organs from pigs, doctors hope to give people life-saving transplants when human donor organs are not available.
3. **What is rejection in the context of organ transplants, and why does it happen?**
Rejection is when the recipient's immune system attacks a transplanted organ as if it were a harmful invader. It happens because the immune system recognizes the new organ's cells as "foreign" (not the body's own). The immune system then tries to destroy the transplanted organ, which can cause the organ to fail. Even if the donor is another human, rejection can occur; the risk is even greater when the organ comes from a different species.
4. **What is gene editing and which tool is commonly used to edit genes? How does this tool work?**
Gene editing is a technology that allows scientists to change an organism's DNA in specific ways. A common gene-editing tool is CRISPR-Cas9. This tool works like a pair of molecular scissors that can cut DNA at a precise spot. Scientists can use CRISPR-Cas9 to remove or add pieces of DNA. In simple terms, it lets scientists "edit" the genetic instructions by cutting the DNA and then letting it repair in a way that changes the sequence. This is very useful for making specific changes, such as disabling certain genes or inserting new ones.
5. **How do scientists use gene editing to make pig organs more suitable for human transplants?**
Scientists modify the pig's DNA to reduce the chance of rejection and improve safety. One major change is "turning off" or removing certain pig genes that would cause a strong immune reaction in a human. They also add human genes to the pig's genome to help the pig organ function better in a human body. Another important change is removing virus genes that are naturally present in pig DNA, so that there's less risk of a pig virus harming the human recipient. By making these genetic changes, the pig's organs become more compatible with humans and less likely to be rejected or cause illness.
6. **What is one recent example of a successful gene-edited pig organ transplant into a human? What did it show?**
One example is the transplant of a gene-edited pig kidney into a human patient in 2024. In that case, the patient lived for about two months with the pig kidney working in his body. The patient's death after two months was due to unrelated causes, not because the organ failed. This demonstrated that a pig organ can function for a significant time in a human and that xenotransplantation is possible. Gene-edited pig hearts have also been tried in patients, showing that pig organs can start working in a person, although those patients did not survive long-term. These early experiments proved that xenotransplantation can work at least temporarily and provided lessons to help scientists improve the process.
7. **How could gene-edited pig organs help people with diabetes?**
Scientists are looking at transplanting insulin-producing cells from gene-edited pigs into people with diabetes. In type 1 diabetes, the patient's pancreas doesn't make enough insulin. By taking islet cells (the cells that make insulin) from a pig's pancreas and transplanting them into a diabetic patient, the pig cells could produce insulin inside the person's body. This could control the person's blood sugar and possibly reduce or even remove the need for daily insulin shots.

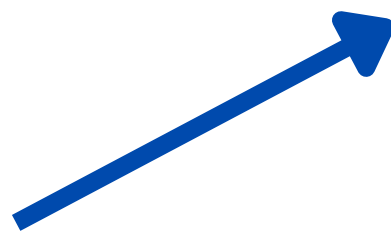
8. **What other disease is mentioned that might be treated with pig cells and how could pig cells help?**
The article mentions Parkinson's disease as another condition that might be helped by pig cells. Parkinson's disease affects the brain, causing movement problems because certain brain cells have died. Scientists think that transplanting healthy pig brain cells into a human brain could replace the damaged cells. These pig cells might help restore some normal function in the patient's brain, improving symptoms. The article also notes that pig cells or organs might be used to help repair other damaged tissues or treat illnesses like liver failure in the future.
9. **What are two major challenges that scientists still face with xenotransplantation?**
One major challenge is the risk of rejection. Even with gene editing, a patient's immune system might attack a pig organ, so doctors need to use special medicines and closely watch the patient to prevent rejection. A second challenge is ensuring safety. Scientists must make sure that no harmful pig viruses or other complications are passed to humans. They remove pig virus genes to lower this risk, but more testing and research are needed to be confident that transplants won't cause new infections or other unexpected problems. In short, stopping rejection and guaranteeing safety are two big hurdles remaining for xenotransplantation.
10. **What are some ethical considerations surrounding the use of gene-edited pig organs for transplants?**
One ethical concern is the welfare of the animals used. Pigs would be specially raised and gene-edited only to be used for their organs, and people debate whether this is humane or fair to the animals. We have to consider how the pigs are treated and ensure they do not suffer needlessly. Another consideration is how society feels about mixing animal parts with humans—some people might be uncomfortable or have religious and moral objections to receiving an organ from a pig. There are also questions about consent and regulation: for example, making sure that the process is done transparently and with proper oversight. Balancing the huge benefit of saving human lives with treating animals ethically is at the heart of these discussions.

Extension Questions – Answer Key

1. **Ethical issues of xenotransplantation and how to address them:**
Xenotransplantation raises concerns about animal welfare and the ethics of using animals to save human lives. These issues can be addressed by ensuring humane treatment of pigs, using strict ethical guidelines, and being transparent with the public about how animals are cared for and why the research is done.
2. **What needs to happen for xenotransplantation to become common and safe:**
Scientists must prove long-term safety through clinical trials, reduce rejection risks, prevent disease transmission, gain regulatory approval, and build public trust. Hospitals also need training and clear procedures before it can become routine.
3. **Comparing xenotransplantation with other solutions to organ shortage:**
Human donation is safest but limited. Artificial or lab-grown organs avoid animal use but are still experimental and expensive. Xenotransplantation offers a large, faster organ supply but has risks of rejection, disease, and ethical concerns. A combination of all approaches will likely be needed.
4. **Would you accept a gene-edited pig organ if you needed a transplant? (Sample answer)**
Yes. If it were the only way to survive, I would accept a gene-edited pig organ because it could save my life. I would trust doctors to monitor me and ensure the organ was as safe as possible. (Answers will vary.)
5. **Impact of public opinion and government regulations on xenotransplantation:**
Public support affects funding and acceptance of the technology. Government regulations ensure safety, ethical treatment of animals, and proper testing. Education and transparency help build trust and allow xenotransplantation to move forward responsibly.

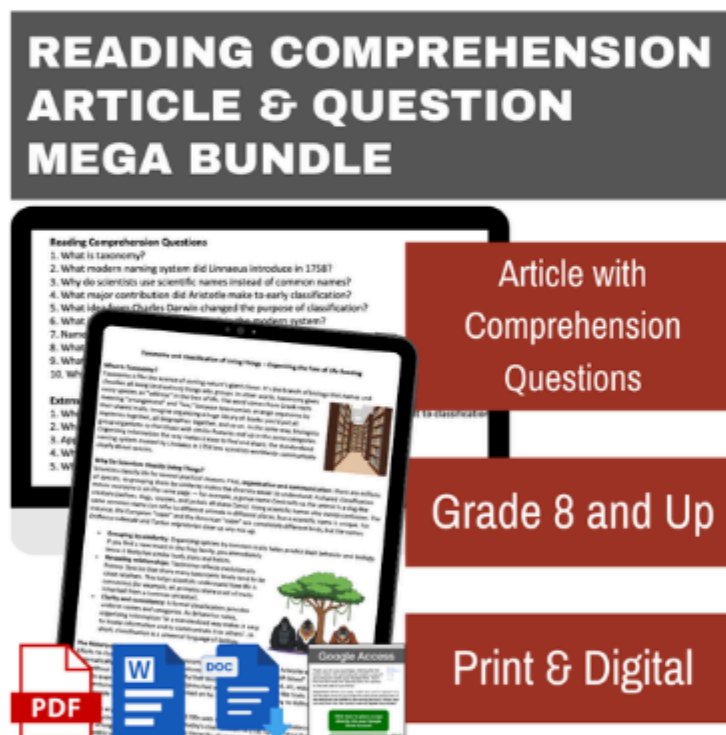
Answer Key Included

Comprehension and Extension Questions



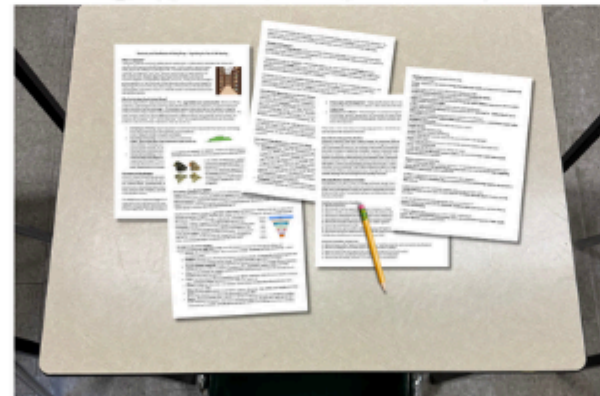
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CLASSROOM READY

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★★★★★ Extremely satisfied - It is a good supplemental activity either for review and at the same time introducing some concept. I also use this for sub plan. It is well presented, organized and interesting.

★★★★★ Extremely satisfied - This a great resource. I used this for a sub plan. It was fun and engaging for my students.

Grade 8 and Up Scientific Reading Comprehension Article Mega Bundle

ALL my current and future grade 8 and up readings, covering the following subject areas:

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