

# THE WALL STREET JOURNAL.

## Real World is Finding New Uses for Virtual Reality

While consumer sales remain low, industries from construction to medicine are using the technology to train for risky jobs

*By Betsy Morris*

June 6, 2017

Gary Steinberg, Stanford University's head of neurosurgery, has been operating on brains for more than three decades. Only in the past year has he been able to do something that he says gives him a significant advantage: preview the surgery and practice it.

Donning a virtual-reality headset, the 64-year-old works through thickets of digital blood vessels in a precise computer simulation of a patient's gray matter before he cuts into the real thing.

"I can figure out how best to approach a tumor and practice it so that when I get into the operation, it's as if I've been there before," Dr. Steinberg says. "It makes surgeries safer. Outcomes are better."

Virtual Reality has been slow to catch on with consumers, despite the high-profile launches last year of headsets from Facebook Inc.'s Oculus unit and Taiwan's HTC Corp.

But businesses are taking to it for training in industries from construction to medicine to sports. Executives say customized software that works like 360-degree videogames can help teach employees more effectively, less expensively, and often more safely than traditional methods. Wal-Mart Stores Inc., for example, last week said it would expand VR training to all of its 200 employee training centers this year, after testing it in 31 centers. It plans to make the technology an integral part of training for 140,000 employees annually, says Tom Ward, a Wal-Mart vice president.

And while they are pricey for many consumers, VR headsets have become affordable for most businesses: the upmarket HTC Vive VR system sells for about \$800.

Research firm International Data Corp. estimates total shipments of headsets for VR and augmented reality -- a related technology that superimposes digital content onto a user's view of the real world -- will grow at a compounded annual rate of 58% over the next five years. Business demand will be the main driver, with shipments of headsets for commercial uses growing 80% a year, versus 50% for headsets for consumers, says IDC.

VR training is so new that there has been limited ability to measure its effectiveness as a business tool, and it has shortcomings. Some people feel awkward putting on the headsets, and some experience motion sickness. VR doesn't lend itself to training for jobs that require manual dexterity, for example -- in the virtual world, you're rarely able to see your hands.

Still, United Rentals Inc. is a believer. The company, which rents generators, backhoes and

thousands of other types of equipment, has been testing VR training since December for new sales staff. Instead of giving lectures and showing pictures of construction sites, "we bring the job site into the classroom," says Patrick Barrett, director of training and development.

In its VR training, employees stand on the edge of a virtual construction site, with two minutes to observe and determine what equipment is missing before an avatar of a construction boss approaches and they have to begin their pitch.

"Do they see that excavation -- a hole in the ground, filled with water; do they see that opportunity to rent that customer a pump?" asks Mr. Barrett. He predicts it will shorten his weeklong training program by half, and is planning to expand the VR training beyond the new hires.

At Wal-Mart, trainees scan VR produce and deli sections to spot problems. They also get a virtual preview of a Wal-Mart on one of its busiest holiday shopping days when crowds flood the stores looking for deals.

**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**1.** What does Dr. Gary Steinberg use to practice a patient's brain surgery before actually performing it?

- A. a model of the patient's brain and real surgical tools
- B. a virtual-reality headset and computer simulation
- C. a laptop computer and computer simulation
- D. a written manual with physical descriptions of the patient

**2.** The text explains some effects of professionals and businesses using Virtual Reality for training in different industries. What is one effect of Dr. Steinberg practicing a patient's brain surgery using Virtual Reality and computer simulation before performing it?

- A. The surgery becomes safer.
- B. The surgery becomes harder.
- C. The surgery takes longer.
- D. The patient becomes sicker.

**3.** Please read these sentences from the text.

"Virtual Reality has been slow to catch on with consumers, despite the high-profile launches last year of headsets from Facebook Inc.'s Oculus unit and Taiwan's HTC Corp."

What conclusion can be drawn based on this evidence?

- A. Some people and companies expected virtual reality to be popular with consumers.
- B. Companies did not think consumers would purchase virtual reality headsets.
- C. Consumer interest in virtual reality is expected to grow in the future.
- D. Businesses were always expected to be interested in using virtual reality for training.

**4.** How do some businesses believe VR is affecting their training for employees?

- A. They believe it is making their training more enjoyable for employees.
- B. They believe it is making their training cheaper, but less effective.
- C. They believe it is making their training more useful for a wider range of employees.
- D. They believe it is improving their training in a number of ways.

5. What is the main idea of this article?

- A. Virtual Reality is being used by neurosurgeons to help preview and practice a patient's surgery before the surgery actually takes place.
- B. Construction companies and retail stores are finding Virtual Reality to be a more useful tool for training than companies in other industries.
- C. While Virtual Reality headsets are not yet popular with consumers, they are being used for job training across many different industries.
- D. While Virtual Reality headsets are being used by businesses for training, they are expected to become more popular with other consumers.

6. Please read these sentences from the text.

"VR training is so new that there has been limited ability to measure its effectiveness as a business tool, and it has **shortcomings**. Some people feel awkward putting on the headsets, and some experience motion sickness."

Based on these sentences, what does the word **shortcoming** mean?

- A. a strong advantage
- B. a negative feeling
- C. an expense
- D. a weakness or flaw

7. Choose the answer that best completes the sentence.

Business executives say virtual reality training is effective, less expensive, and often safer than traditional training methods; \_\_\_\_\_, virtual reality training does have some problems and shortcomings.

- A. therefore
- B. however
- C. additionally
- D. for example

**8.** Describe what happens during a Virtual Reality training for United Rentals, Inc., a company which rents equipment to people working on construction sites.

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**9.** How does Virtual Reality affect how the neurosurgeon Dr. Steinberg performs his job? Support your answer with details from the text.

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**10.** How might Virtual Reality training benefit people in society? Support your answer with evidence from the text.

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# Using Cellphones and Computers to Transmit Information

by Alissa Fleck



Modern technology can do some pretty incredible things. It's possible, with current technological capabilities, to transmit digital information over long distances using coding and decoding processes without losing the contents of the original information. The best part is we don't have to do anything besides send the message and wait for it to be received.

Consider, for instance, the cellular phone. It wasn't until the early 1980s that this mobile variation on the standard telephone was even available for people to use. Now, it seems like everyone has a cellphone, sending and receiving information in speedy ways invisible to the human eye.

There's so much going on below the surface of what we can see when we use our cellphones. One difference between a mobile phone and a traditional landline telephone is you can move the cellphone just about anywhere geographically and still use it to talk to other phone users. No matter

how far away you are from someone you call, you can usually still understand each other's voices over the phone, thanks to radio waves and something called a cellular network.

It took many evolutions in phone technology to get where we are today, but the current cellphone wirelessly transmits information by connecting to a cellular network. Mobile phone operators provide these cellular networks, which function with the help of cellphone towers, and then calls are made over what is known as a radio link. Through this process, information-in this case, voice input-is broken down and reassembled over the radio link, so the person on the other end instantaneously hears what is said.

In other words, as you speak into the phone, your voice is converted into an electrical signal, transmitted in the form of a radio wave by these towers, and then converted back into the sound of your voice by the phone on the receiving end. All this happens in the blink of an eye while you chat over the phone without any distortion.

The process of transmitting digital information is not exclusive to telephones. Computers are another instrument that can receive, decode and convert information, though typically this information is not a person's voice, but written content.

We may take for granted the ease with which we can pass along information with computers and the Internet, but many forces are hard at work processing information to make computers easier for us to use and communication more reliable.

The first computer showed up around 1941, but it was much more limited in its capabilities than computers now. In fact, computers are everywhere-sometimes they are so small we do not think of them as computers at all, though they serve the same function as the computers we have at home, the office or school.

Much like cellular telephones, computers were actually first used to transmit sensitive information across geographical spaces by the military at a point when government officials worried it would be possible to knock out a country's entire telephone grid.

Computer engineers began finding ways to link their computers together in order to share information among them. This linking began with just a couple of computers and grew to the millions which connect regularly today. Ultimately, that's how what we know as the Internet was developed.

Wireless computer networking is also similar to cellular phone use in that computers use the same networks our mobile phones use.

While you speak into the telephone using your voice, you typically insert data into your computer by typing on the keyboard. You may decide to share information through an email or access information on a website by typing in or visiting what is known as a hyperlink.

When you use the Internet to share and access information, you connect to the relevant network. You can send a message from your computer to another computer anywhere in the world and it will arrive almost immediately, going through many different networks in the process.

Still, the information you send does not travel in a single piece as it might through the standard mail service; instead, it is broken down into smaller digital information. As with a cellphone, the information you send is fragmented into tiny pieces and then reconstructed once it's reached its destination.

Along with your message comes other information, for instance about ordering, or how the message should be restructured to make sense to the reader. Your message will also include more basic data about where it came from and where it is supposed to go.

Computers and the Internet require many high-tech and complicated pieces to run properly, but something known as a router is a key instrument that keeps information being sent from one computer to another going along the correct pathway. The Internet also relies on telephone wires and satellite links for wireless information sharing.

It's important to note that for the Internet to work as it does, many companies have to agree to work with one another. The Internet is really a collection of networks working together toward a common goal of allowing information to be shared.



**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**1.** What are two examples of technology that send information over long distances?

- A. the human eye and computers
- B. government officials and computers
- C. cellphones and the human eye
- D. cellphones and computers

**2.** What does the author compare to cellphones in this passage?

- A. The author compares companies to cellphones.
- B. The author compares engineers to cellphones.
- C. The author compares computers to cellphones.
- D. The author compares cellular networks to cellphones.

**3.** A cellphone sends and receives information in a speedy way invisible to the human eye.

What evidence from the passage supports this statement?

- A. When a person speaks into a cellphone, his or her voice is broken down and reassembled over a radio link, so the person on the other end instantaneously hears what is said.
- B. When computers first showed up around 1941, they were used to transmit sensitive information across geographical spaces by the military because of worries government officials had.
- C. Although people may take for granted the ease with which they can pass along information through computers, many forces are at work to make computer communication more reliable.
- D. Like cellphones, computers can receive, decode, and convert information, though typically this information is written content rather than someone's voice.

4. What is one way that computer use has changed over time?

- A. Computers were first used in homes, schools, and offices to send different kinds of information, but now they are used only by the military to send sensitive information.
- B. Computers were first used by the military to send sensitive information, but now they are used in homes, schools, and offices to send different kinds of information.
- C. Computers used to send a person's voice from one place to another, but now they send only written content.
- D. Computers used to send a person's voice from one place to another, but they have been gradually replaced by landline telephones.

5. What is this passage mostly about?

- A. computers, the Internet, and how the military uses technology to protect people
- B. cellphones, landline telephones, and the reasons people have trouble hearing each other over the phone
- C. mobile phone operators, government officials, and companies that work with one another
- D. cellphones, computers, and how they send information from one place to another

6. Read the following sentence: "It's possible, with current technological capabilities, to **transmit** digital information over long distances using coding and decoding processes without losing the contents of the original information."

What does the word **transmit** mean in the sentence above?

- A. harm
- B. fold
- C. hear
- D. send

7. Choose the answer that best completes the sentence below.

Information is transmitted by different kinds of modern technology, \_\_\_\_\_ cellphones and computers.

- A. in conclusion
- B. instead
- C. especially
- D. never

8. According to the passage, what are cellphones used for?

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9. How does a cellphone transmit information using cellular networks?

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**10.** At the end of the passage, the author writes, "The Internet is really a collection of networks working together toward a common goal of allowing information to be shared." Could cellphones be described in the same way? Explain your answer using evidence from the passage.

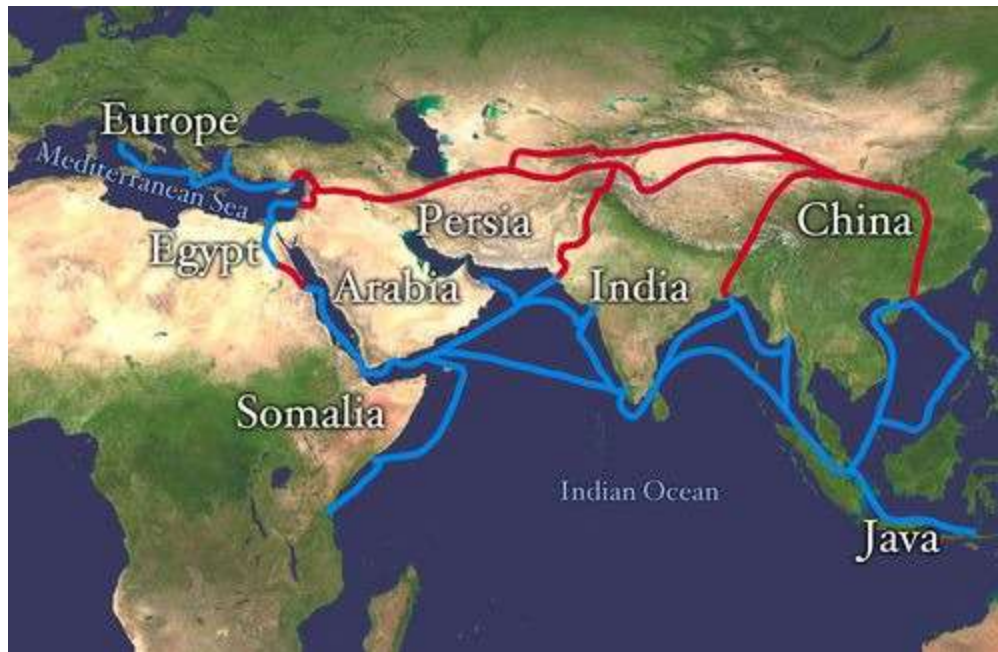
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# The Tang and Song Dynasties in China

by ReadWorks



*the Silk Road -- red: land route; blue: sea route*

China is one of the world's oldest civilizations. Historians know that Chinese history dates back to at least 2000 B.C.-nearly 4000 years before the United States became a country! However, China has not always been the country we know today. In fact, throughout its history, parts of the country were under the control of various kingdoms and warlords, and the different parts of the country were not united, but rather fought against each other for land. It wasn't until 221 B.C. that an emperor united various kingdoms to form the first Chinese empire. This began the reign of the Qin Dynasty, which only lasted until 206 B.C.

A "dynasty" is a sequence of rulers from the same family. Eras in Chinese history are named by the dynasty that ruled over the country during that period. Since China was unified, it was ruled by more than a dozen dynasties, each of which helped China grow and advance to become the country we know today. Two of the most important dynasties were the Tang Dynasty and the Song Dynasty. Under the rule of these two dynasties, China saw significant technological and commercial developments which helped the country prosper and grow. Many of these developments made an impact outside China's borders as well, helping civilizations around the world.

The Tang Dynasty started ruling in 618 A.D. Scholars generally believe the Tang Dynasty was one of the high points of Chinese civilization. One of the most influential technological innovations of the Tang Dynasty was woodblock printing. Woodblock printing is a technique for printing text, images or patterns. It involves cutting away at a block of wood until a pattern is created. The block could then be covered with ink, and applied to a paper or cloth to create the print. Woodblock printing made it possible for books to be more widely available to the general public. Literacy rates and social mobility increased, and more people from the lower classes were able to pass the examinations to gain entrance into the civil service. Woodblock printing was the most widely used form of printing in East

Asia until the 19th century, when the European mechanical printing press became more popular.

The Tang Dynasty was also a high point for China for trade with the outside world. During this period, the Chinese conducted trade by land using the Silk Road, and maritime trade at sea. The Silk Road is the name of an ancient trading route that extended from Europe, through many countries in Asia, all the way to China. It was named the Silk Road because silk was the main item traded along the route from China. While the trading route was established centuries before the Tang Dynasty, it had been closed at some point, until the Tang Dynasty reopened it. During this period, the Chinese also increased their maritime presence in the Persian Gulf and the Red Sea. Thanks to the increased trade, the Chinese gained many new technologies, cultural practices, and luxury items from the 70 (or more!) countries it traded with. Buddhism and Islam also came to China through trade with India and the Middle East, and Buddhism became an especially important and influential religion during this period. At this height of trade and culture, China also attracted thousands of people from foreign countries who wanted to live and trade in China, bringing diverse culture and wealth to the country.

The period after the fall of the Tang Dynasty was filled with chaos, and the country rapidly changed hands between several different regimes. In 960 A.D., the Song Dynasty took power. In the eyes of scholars, the Song Dynasty also ranks with the Tang Dynasty in terms of economic growth, artistic and intellectual achievement. This dynasty has even been compared to the European Renaissance!

The time under the Song Dynasty is sometimes regarded as the start of the industrial revolution in China. The economy of China during this period was one of the most prosperous and advanced in the entire world. The iron industry grew more than six fold during this period, and China continued to be an important figure in world trade, bringing iron, silk, porcelain, textiles and much more to its trading partners. However, the most important advancement during this time was the establishment of the world's first government-issued paper money. The Song rulers created factories in several cities, employing thousands of workers just to print paper money. Today, paper currency can be seen in countries all around the world, including our own!

During this period, the Chinese also made progress in weapons technology. According to scholars, the Chinese may have invented gunpowder during an earlier dynasty, but it was during the Song dynasty that it really came to prominence. The Chinese used gunpowder to create flamethrowers, grenades, cannons, firearms and land mines. By the thirteenth century, these developments had reached Europe, India and the Middle East.

There were also significant developments in mathematics, astronomy, cartography, architecture, and virtually every other field of study during this golden age of the Chinese empire. It was also during this period that the Chinese discovered a compass could be used to discern which way was north. This discovery became crucial in maritime navigation, and it is still important to us today.

The Song Dynasty struggled with Mongol invaders during its reign, and ultimately fell to invading forces in 1279 A.D.

Combined, the Tang and Song Dynasties span just a little more than 600 years. Considering how long Chinese civilization has existed, this is just a small fraction of that time. However, during these two eras, Chinese civilization made enormous technological and commercial advancements. Without many of these advancements, the world we know today might be quite different.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. According to the text, what were two of the most important dynasties in China?

- A. the Ming and Song Dynasties
- B. the Song and Qin Dynasties
- C. the Tang and Song Dynasties
- D. the Tang and Qin Dynasties

2. Which of the following events happened after the Song Dynasty took power in China in 960 A.D.?

- A. the Qin Dynasty reigned over China
- B. the development of woodblock printing
- C. the fall of the Tang Dynasty
- D. the start of the industrial revolution in China

3. Inventions created during the Song Dynasty still impact people today. What evidence from the text best supports this conclusion?

- A. "During this period, the Chinese also made progress in weapons technology. [ . . . ] The Chinese used gunpowder to create flamethrowers, grenades, cannons, firearms and land mines."
- B. "It was also during this period that the Chinese discovered a compass could be used to discern which way was north. This discovery became crucial in maritime navigation[.]"
- C. "[T]he most important advancement during this time was the establishment of the world's first government-issued paper money. Today, paper currency can be seen in countries all around the world[.]"
- D. "The iron industry grew more than six fold during this period, and China continued to be an important figure in world trade, bringing iron, silk, porcelain, textiles and much more to its trading partners."

4. What was one result of the invention of woodblock printing during the Tang Dynasty?

- A. The European mechanical printing press became more popular.
- B. Trade between China and the outside world increased.
- C. European countries began to appreciate the Tang Dynasty's power.
- D. Literacy rates and social mobility increased.

5. What is this passage mainly about?

- A. changes in Chinese leadership from 221 B.C. to 1279 A.D.
- B. the influence of the Tang and Song Dynasties on China
- C. the unification of China under the Tang Dynasty
- D. important Chinese inventions that influenced other societies

6. Read these sentences from the text.

"The Tang Dynasty was also a high point for China for trade with the outside world. During this period, the Chinese conducted trade by land using the Silk Road, and maritime trade at sea. [ . . . ] Thanks to the increased trade, the Chinese gained many new technologies, cultural practices, and luxury items from the 70 (or more!) countries it traded with."

What does the author most likely mean by the sentence, "The Tang Dynasty was also a high point for China for trade with the outside world"?

- A. China had a higher amount of trade with the outside world during the Tang Dynasty than during other periods in its history.
- B. China conducted trade at higher altitudes during the Tang Dynasty than it did during other periods in its history.
- C. China had limited trade during the Tang Dynasty compared to other periods in its history.
- D. China only traded with certain countries during the Tang Dynasty, unlike during other periods in its history.

7. Choose the answer that best completes the sentence.

During the Song Dynasty, there were significant developments in mathematics, astronomy, cartography, architecture, and virtually every other field of study during this golden age of the Chinese empire. \_\_\_\_\_, it was during this period that the Chinese discovered a compass could be used to discern which way was north.

- A. Therefore
- B. In contrast
- C. However
- D. Additionally



**8.** According to the passage, what was China's economy like under the Song Dynasty?

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**9.** The Silk Road was reopened under the Tang Dynasty. What impact did the reopening of the Silk Road have on Chinese civilization?

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**10.** How did the Tang and Song Dynasties impact China's advancement? Support your answer with at least three examples from the text.

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# Solving New York City's Hurricane Problem With Representations

by Alissa Fleck



Sketches or drawings can help people communicate to others ideas about how to solve problems, big or small. Drawings make ideas visual, so they are easier to understand than a spoken or written explanation, and using them allows for many different drafts to be presented before deciding on a final product.

When a hurricane hit New York City in 2012, the city realized it was not prepared to handle such a disaster. The hurricane damaged the city badly and left many people without homes. Sea levels were going to continue to rise, which meant potential for more hurricanes and flooding, and the government realized it had to change some things about the city to make it better able to handle future disasters.

Rather than simply begin building bigger, stronger structures, like a giant wall around the city or a gate to keep water out, people started sketching out their ideas about how to make New York a place that could better withstand hurricanes. These people were experts chosen to take on the task of re-imagining the city. By using drawings, people were able to debate these ideas, decide which ones were best and change them as they saw fit. Drawings also allowed experts in certain areas to show and explain things to people who didn't know as much as them about those subjects.

Some people focused on how to change the city's natural environment, like the grassy areas next to the ocean, to make them more hurricane-friendly. They drew and presented sketches that showed how these areas could be used to absorb seawater. They also drew in things that could be planted to grow better in the changing environment, like plants that can withstand seawater.

Others focused on important city buildings like hospitals. Hospitals in New York City were hit hard by the hurricane, and many people struggled to get the emergency care and basic medical help they needed during the disaster. The experts' drawings focused on ways to make hospital buildings stronger so that they could meet people's needs even in a crisis.

Others looked at how to improve public transportation, which is very important to keeping the city running. After the hurricane, many people in the city were stranded with no way to get around because the train system was badly affected by the storm. Transportation experts drew up ways to pump water out of train tunnels more quickly and get trains up and running sooner.

People brought their drawings together and looked at all the ways to improve the city. Some ideas had to be rejected and replaced by more useful ones. The experts presented their ideas to the public at meetings because these changes would affect everyone living in the city and they wanted the citizens to be engaged in the process.

Finally the city was able to decide on a plan it would use to start making the city stronger, and it used these sketches and representations to figure out other things, like how much it would cost the city, how many workers would be needed and how long the construction projects might take. Using the teamwork of many experts and sketch artists, the city was able to begin planning New York City's future and work toward preventing potential dangers.

**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**1.** What did people use when discussing how to protect New York City against hurricanes?

- A. drawings
- B. medical help
- C. seawater
- D. construction projects

**2.** The threat of another hurricane is a problem for New York City. What have people done to help solve this problem?

- A. People have moved to homes outside New York City.
- B. People have built sculptures of New York City.
- C. People have figured out ways to change New York City.
- D. People have spent less money on public transportation in New York City.

**3.** When a hurricane hit New York City in 2012, the city was not fully prepared to handle it.

What evidence from the passage supports this statement?

- A. Drawings can help people exchange ideas with each other about how to solve problems, big or small.
- B. Because drawings make ideas visible, they can be easier to understand than spoken or written explanations.
- C. Sea levels are expected to keep rising, which means New York City may experience one or more hurricanes in the future.
- D. Many people struggled to get medical help during the hurricane and were left without homes afterward.

4. What was one reason for using drawings when discussing improvements to New York City after the hurricane?

- A. Some people prefer hearing an idea explained by an expert than seeing a drawing of that idea by a non-expert.
- B. Drawings made it easier for many people to understand the improvements being discussed.
- C. During the hurricane, many people in New York City were stranded and could not get the medical care they needed.
- D. Some ideas that people came up with were not as good as others and had to be replaced.

5. What is this passage mainly about?

- A. the damage that a 2012 hurricane did to hospitals and the train system in New York City
- B. ideas that had to be rejected when figuring out ways to protect New York City from hurricanes
- C. how grassy areas in New York City next to the ocean could be used to absorb seawater
- D. ways to protect New York City from hurricanes and how drawings helped people discuss those ways

6. Read the following sentences: "Some people focused on how to change the city's natural environment, like the grassy areas next to the ocean, to make them more hurricane-friendly. They drew and presented **sketches** that showed how these areas could be used to absorb seawater."

What does the word **sketches** mean?

- A. ideas for making something better
- B. problems with public transportation
- C. drawings without many details
- D. meetings between experts and non-experts

7. Choose the answer that best completes the sentence below.

New York City was damaged by a hurricane; \_\_\_\_\_, the city started looking for ways to protect itself against other hurricanes.

- A. consequently
- B. however
- C. before
- D. for instance

8. Name one thing that people drew as they worked on ways to protect New York City from hurricanes.

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9. What is one example of how the drawings of ways to change New York City were shared?

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**10.** The passages states that "drawings can help people communicate to others ideas about how to solve problems, big or small." Using evidence from the passage, explain how drawings helped people communicate ideas about how to solve New York City's hurricane problem.

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# Digitized Signals Are the Future of the Black Box

by ReadWorks



## An Introduction to Digital Signals

Signals of any kind are a way to deliver a message to a destination. When digital signals transmit information, they do so by turning signals into code. This is binary code, which is very specific and easily quantified. When that code is sent via wave pulses, the transmission of the signal is very reliable.

## Why Digital Signals Work Well

What makes this so reliable is the fact that digital signals are actually quite resistant to outside noise disturbances. While other kinds of communication will almost always be transmitted along with some kind of undesirable noise (making a recording much harder to hear), digital signals can be encoded and sent without too much outside interference. One of today's commonly used devices made the switch from analog to digital signaling within the last 20 years. You might know it as the black box.

## Component One of Black Box: the CVR

Many have heard of "the black box," a device used for recording what happens during an airplane's flight. What most people don't know is that the black box is really a common term for two pieces of



recording equipment that are onboard every commercial and corporate airplane. The first is called a cockpit voice recorder, or CVR. The CVR is attached to multiple microphones located in the cockpit and it records any communication and all the sounds in the cockpit. In the case of an accident, the investigators who listen to a CVR recording can actually hear two things: first, what was said by the pilots and/or crew right before the incident; and second, the sounds in the background. Well-trained investigators can detect unusual engine noise, strange pops and other signals that help alert them to figure out what went wrong with the flight.

## Component Two of the Black Box: the FDR

The second part of the so-called black box is the flight data recorder, or FDR. This piece of equipment does not record the people onboard, but all technical aspects of a flight. Sensors all over the plane detect and send information to a flight data acquisition unit which, in turn, is hooked up to the FDR. The FDR is usually attached to the plane's tail, where it's least likely to be damaged in case of an accident. In the U.S., the Federal Aviation Administration requires FDRs to record at least 88 parameters, or aspects, of a commercial flight. As a few examples, these parameters can include the time, altitude, airspeed, direction, movement of the flaps on the wings, the flow of fuel, and use of autopilot. Then, in case something happens, investigators can use this information to recreate a simulation of the entire flight, from takeoff to the incident. In conjunction with the information from the cockpit voice recorder, they can get a picture of what happened.

## The Origins of the Black Box

Making a recording of *some* aspect of a flight began with the beginning of flight itself. The Wright brothers, who created the first airplane, actually used a device to record their propeller rotations. (Think of it as the very first FDR, except that it only recorded a single kind of data!) Some basic recording devices were invented and used during the 1930s and during World War II, but they weren't commonplace. It was two decades later that aviation recorders began to become more widespread. The modern day black box is credited as an invention by an Australian scientist, Dr. David Warren.

Warren came up with the idea that multiple aspects of all flights should be recorded while he was working at the Aeronautical Research Laboratory in Melbourne. He was helping investigate an accident by the world's first jet-powered commercial aircraft, the Comet. Without any kind of recording, the crash was a total mystery to him and his co-investigators. He demonstrated the first basic flight data recorder in 1957. It was called a "red egg" for its shape and color. The red egg was fireproof and shockproof. It could reliably record both a plane's instrument readers and the pilots' voices, using only one wire. It also included a device to then decode all this information back on the ground.

The red egg wasn't put into widespread use immediately. In 1960, however, there was another unexplained plane crash in Australia; this time in Queensland. After that, Australia became the first country in the world to mandate that the device be used on all commercial aircraft.

# The Modern Day Black Box

The black box is now used on all commercial aircraft and corporate jets. It's unclear exactly where the term came from, but it's possible it came from something a journalist told Dr. Warren about his red egg. Supposedly, he said, "this is a wonderful black box." At any rate, the phrase doesn't refer to the black box's color-the equipment is actually painted bright orange, in order to make it easier to find.

The modern device is used around the world and is highly regulated. International standards mandate that it be able to withstand high acceleration and deceleration, high and low temperature fires, deep sea pressure, submersion in seawater or other liquids, and high impact and being crushed.

## Why Digital Signaling is Important to the Black Box

Beginning in the 1990s, the technology employed by the black box was greatly improved. Newer black boxes were being built with solid state memory boards, which use memory chips to record and store information. This digital system is an improvement over the original system, magnetic tape technology, for several reasons. First off, magnetic tape needs to be pulled across an electromagnetic head. Solid state technology, however, has no moving parts making it both more reliable as an encoder of information and less likely to break. Second, the original cockpit voice recorder could only hold about a half-hour of information. It would record in a loop, recording over every half-hour, so the last half-hour of a flight was all investigators could hear. With solid state technology, the CVR can record up to two hours, which provides much more information. Furthermore, the flight data recorder can hold up to 25 hours using solid state technology.

Solid state memory boards are also better than magnetic tape technology concerning what the flight data recorder can record. While the old technology was able to record up to 100 different aspects or parameters of a flight, solid state technology records up to 700.

What has remained the same, from one technology to the next, is the way the black box is powered. Both types draw energy from two generators which are powered by the plane's engines.

The black box records and provides a huge amount of information. However, its technology helps determine how quickly investigators can analyze and use that information. In the case of an investigation, it can take weeks, even months, for investigators to download all the information from black boxes still using magnetic tape technology. And that's *before* they can even start studying and processing what happened! Using digitally equipped black boxes, however, they're able to download all the information from a flight in a matter of minutes. What a vast improvement! Black box manufacturers have made a complete switch to digital signaling from the old analog ways, and no longer make the magnetic tape recorders.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. How does the black box on an airplane record information about the flight?

- A. It videotapes the passengers.
- B. It uses microphones in the cockpit and sensors all over the plane.
- C. It uses close circuit television transmissions.
- D. Flight attendants enter information manually into a computer in the box.

2. The passage explains that the solid state technology is an improvement over the magnetic tape technology. What was one problem with black boxes using magnetic tape technology?

- A. The color of the boxes made them difficult to find after an accident.
- B. The tapes could get damaged if passengers had magnets on the plane.
- C. The tapes could break as they were stretched across a machine to be read.
- D. The tapes did not provide clear video images.

3. Solid state memory boards are more reliable than magnetic tapes for recording and transmitting flight information. Which evidence from the text supports this conclusion?

- A. Solid state technology records more data than magnetic tape technology.
- B. Solid state memory boards use memory chips to record and store information.
- C. The black box draws energy from two generators that are powered by the plane's engines.
- D. Information recorded on solid state technology can be downloaded in minutes.

4. Which of the following conclusions about flight recordings is supported by the text?

- A. The most reliable methods for recording flight data are the oldest ones.
- B. Experts began to record flight information only recently.
- C. It is critical to get the most reliable data from flight recordings when investigating airplane accidents.
- D. Digitized black boxes record flight information more effectively because they use more generators than the older ones.

5. What is the main idea of this passage?

- A. Airplanes should record information when they are in flight.
- B. The Wright Brothers created flight recorders when they invented the airplane.
- C. Digitized signals are a vast improvement over magnetic tapes in black box recorders.
- D. Colorful flight recording devices are easier to find than black ones.

6. Read the following sentences: "The modern device is used around the world and is highly regulated. International standards **mandate** that it be able to withstand high acceleration and deceleration, high and low temperature fires, deep sea pressure, submersion in seawater or other liquids, and high impact and being crushed."

As used in this passage, what does the word "**mandate**" most nearly mean?

- A. to require
- B. to reject
- C. to avoid
- D. to create

7. Choose the answer that best completes the sentence below.

Solid state technology has no moving parts; \_\_\_\_\_, it is more reliable as an encoder of information and less likely to break.

- A. however
- B. therefore
- C. but
- D. otherwise

**8.** Why are digital signals more reliable than magnetic tapes in recording and transmitting information during a flight?

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**9.** It is important to get information about a flight from many parts of the airplane. What evidence from the text supports this conclusion?

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**10.** How have improvements in black box technology impacted the investigation process of aircraft? Use information from the passage to support your answer.

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# A Room-Sized Computer in Your Digital Music Player

by ReadWorks



*SIGSALY exhibit*

It was the morning of December 7, 1941, and problems were mounting for General George Marshall. American Army code breakers had intercepted and deciphered conversations between Japanese leaders in which they announced they had given up on diplomacy with the United States. War now seemed imminent. As U.S. Army Chief of Staff, it was Marshall's role to warn every U.S. Navy post in the Pacific, including the Hawaiian base at Pearl Harbor, that they should take immediate steps to prepare for an attack.

Ever since the 1920s the United States had relied on the coded A-3 Scrambler system, operated by the American Telephone and Telegraph Company in New York, for its most secure military communications.

Marshall didn't trust the Scrambler, and his instincts were right. Years later it was discovered that the Germans had already cracked the code for the Scrambler, and were able to listen in on all conversations between American military leaders and their units using a listening station built in a former youth hostel on the Dutch coast.

To avoid having his critical message fall into Japanese hands, Marshall decided against using the Scrambler and instead sent his orders to Hawaii via telegraph code, a safer but slower system. That morning the Japanese launched a surprise air attack on the U.S. Naval base at Pearl Harbor. They sank or severely damaged 21 ships and boats and killed 2,402 people.



Marshall's orders to prepare the base's defenses did not arrive until after the last Japanese plane disappeared over the Western horizon.

The disaster at Pearl Harbor confirmed what Marshall and other military leaders already knew: they needed a secure system for communication with their troops, one that could not be cracked by enemy forces. They turned to a company called Bell Labs, which in the 1920s had developed the Vocoder, an early voice encoding machine which took analog recordings, capturing the sounds as they were naturally emitted. The Vocoder recorded people's voices and divided them by frequency into different pieces. It sent those pieces separately via radio waves to a machine on the other end, which received the different pieces and spliced them together to recreate the original sound.

The analog Vocoder became the basis of a newer, digitized version. With digital signals, the flow of sound is divided into segments, and each note is assigned its own unique binary value. Early methods of digital recording and playback had fewer values, which meant that when they were replayed, the recording sounded like a series of short segments with gaps in between. Advances in computing power allowed for more values to be added to the equation, so that conversations and other sounds could be replayed continuously and without gaps.

The new, digital version of the Vocoder was called various names, including Project X and SIGSALY. It also was called the Green Hornet. That's because the different signals were sent by cable along with a buzzing noise made to sound like random background static, further disguising the transmission. Once the signals were received and spliced back together to recreate the entire conversation, the buzzing sound remained. People thought the resulting noise sounded similar to the theme song from *The Green Hornet* radio show, which was popular at the time.

Like the Vocoder, SIGSALY broke human speech down into multiple parts. Unlike Vocoder, however, SIGSALY was a digital system. Bell Labs engineers took digital samples of analog sounds recorded at uniform intervals and converted those sounds into numeric code. Each sample was quantized to the nearest value within a series of digital steps, much as you might round 99 cents up to a dollar.

This process is called *pulse-code modulation*, and today it remains the method used by computers, MP3 players, and compact discs to translate sounds into digital form for later recreation into analog sound. The quality of that sound has to do with two properties: the sampling rate, which means the number of times per second a sample is taken; and the bit depth, which measures the number of possible values sounds can be divided into, along the audible continuum of frequencies (the more possible values, the closer each individual sound will be to the original).

By March 1943, the first SIGSALY machine was built by Western Electric and shipped to Washington, D.C., where it was installed in the Pentagon. (Rumor has it the first machine was originally planned to be installed in the basement of the White House, but President Roosevelt decided against it because he knew of British Prime Minister Winston Churchill's fondness for long, late-night phone calls.) The system was so large and generated so much heat that it required its own separate air conditioning system. Four months later, a twin system was installed in the basement of Selfridges Department Store in London, connected by cable to Churchill's war cabinet room a mile away. The two systems were connected by a cable under the Atlantic.

Though cumbersome and expensive to operate, the SIGSALY system appears to have worked well during the war. More than 3,000 high-level conversations happened over SIGSALY, covering troop movements, equipment drops and strategy, and no record has ever been found of the German or

Japanese militaries deciphering its coded messages. The system became the first transmission of speech using pulse-code modulation, and the first effective use of bandwidth compression to recreate speech. SIGSALY's room-sized terminals were eventually set up in 10 places including Hawaii, Paris, Algiers and Guam. In addition, a mobile system was built to operate on a Navy ship that would accompany General MacArthur's campaign across the Pacific Ocean, which military strategists had envisioned as the only way to beat Japan until the atomic bomb was dropped on Hiroshima in 1945. After the war ended, SIGSALY was used to coordinate the return of troops and the repositioning of units across Europe at the start of the Cold War. SIGSALY was taken out of service in 1946.

While pulse-code modulation continued to be used in coded military communications for decades, it wasn't until 1972 that the technique was used in music to manufacture digital master copies of phonograph records. The first commercial music release using pulse-code modulation didn't come until a decade later, when Billy Joel's album, *52 Street* was issued on compact disc. CDs sales, however, started to dwindle by the early 2000s when consumers began switching over to digital music files, the most common format of which is probably the MP3. MP3s possess a similar sound quality of a CD, and are recorded using the same method of digital sampling. The primary difference between them is their physical form, or lack thereof-CD's have one, whereas MP3s exist only as computer files. Because they have no physical presence, MP3s can be saved and played on a variety of devices, reducing the risk of physical damage to disks and greatly reducing the cost, weight, and space required to maintain a music collection. Because the data in MP3 files is compressed to save memory space on most devices, however, the sound quality and range is generally lower than music played during a live performance or recorded onto records and CDs.

While some audiophiles claim that digital recording and playback of music can never fully recreate the full sound of music the way that a fully analog phonograph record can, improvements in processing speed, sampling rates, and bit depth mean that today, a digital recording is almost indistinguishable from an analog one.



**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**1.** According to the text, what did the disaster at Pearl Harbor show that the U.S. military leaders needed?

- A. a way to improve the speed of the telegraph code
- B. a secure system for communication with their troops
- C. a way to prepare military bases' defenses more quickly
- D. a secure system for recording and playing music

**2.** In this text, the author describes a sequence of technological developments. In what order were these technologies created?

- A. the Vocoder, SIGSALY, CDs, MP3 music files
- B. MP3 music files, SIGSALY, CDs, the Vocoder
- C. CDs, MP3 music files, the Vocoder, SIGSALY
- D. SIGSALY, the Vocoder, CDs, MP3 music files

**3.** The method used by SIGSALY to encode messages was more effective than the method used by the Scrambler to encode messages. What evidence from the text best supports this conclusion?

- A. More than 3,000 high-level conversations happened over SIGSALY, covering troop movements, equipment drops, and military strategy.
- B. Marshall didn't trust the Scrambler for his secure military communications, so he decided to send his message to Hawaii via telegraph code.
- C. The SIGSALY system saw the first transmission of speech using pulse-code modulation and the first effective use of bandwidth compression to recreate speech.
- D. The Germans were able to crack the code for the Scrambler, while no record has ever been found of the German or Japanese militaries decoding SIGSALY's messages.

**4.** Which machine had the most direct impact on the way music is recorded and played?

- A. the telegraph
- B. SIGSALY
- C. the Scrambler
- D. the Vocoder

**5. What is the main idea of the text?**

- A. SIGSALY was the first digital voice encoding system, and it used a process called pulse-code modulation to encode human speech.
- B. Thousands of people were killed at Pearl Harbor due to the failure of the U.S. military's secure communications system.
- C. A voice encoding system made for military use was the basis for some of today's digital music systems.
- D. While CDs and MP3s both used pulse-code modulation to record and play music, they have very different physical forms.

**6. Read these sentences about the Vocoder, a voice encoding machine.**

The disaster at Pearl Harbor confirmed what Marshall and other military leaders already knew: they needed a secure system for communication with their troops, one that could not be cracked by enemy forces. They turned to a company called Bell Labs, which in the 1920s had developed the Vocoder, an early voice encoding machine which took analog recordings, capturing the sounds as they were naturally emitted. The Vocoder recorded people's voices and divided them by frequency into different pieces. It sent those pieces separately via radio waves to a machine on the other end, which received the different pieces and spliced them together to recreate the original sound.

Based on these sentences, what does "encoding" mean?

- A. recording a message so that it is perfectly preserved and understandable
- B. deleting a message so that no one can access it aside from the recipient
- C. adjusting the volume of a message so that it can be heard more clearly
- D. changing a message in some way so that it cannot be understood

**7. Choose the answer that best completes the sentence.**

The Vocoder was an analog voice encoding machine, \_\_\_\_\_ SIGSALY was a digital system.

- A. during
- B. while
- C. therefore
- D. even though

**8.** SIGSALY used a process called pulse-code modulation to translate human speech into digital form. What are two technologies that use this method today?

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**9.** How did the digital voice encoder SIGSALY make today's MP3 players possible? Support your answer with evidence from the text.

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**10.** How can technology from the past impact technology today and in the future? Support your answer with evidence from the text.

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## Alien Planets

# Space Telescope Finds Hundreds of New Worlds

They're out there in the depths of space. There are giant ones, small ones, weird ones, and most likely ones we can't even imagine.

We're talking about planets, of course. For years, astronomers have speculated that the sun is not the only star with planets circling it. Now, thanks to the Kepler space telescope, they have proof that our Milky Way galaxy could actually be teeming with planets of all sizes and types. Scientists call planets orbiting stars other than our sun extrasolar planets, or exoplanets for short.

## Kepler Spans the Sky

The Kepler space telescope was launched on March 7, 2009. It is named after Johannes Kepler, the 16th-century German astronomer who discovered the laws of planetary motion. The telescope, which orbits the sun between Earth and Mars, is the most advanced and sensitive optical telescope ever constructed. It is so light sensitive that, if it were pointed back toward Earth at night, it would be able to detect when one person in a small town turned off a single porch light.

Kepler's mission, however, is not to detect porch lights. The spacecraft has one mission only—exoplanet hunting. For nearly two years, it has been peering at approximately 100,000 stars in a portion of the Milky Way. On February 2, NASA, the U.S. space agency, released its findings from Kepler's sky search conducted between May and September 2009. The telescope had discovered 1,235 possible exoplanets orbiting 997 stars. The find includes 68 about the size of Earth and 54 planets in what scientists call the Goldilocks zone—the zone around a star that permits liquid surface water, considered an essential condition to produce life.



AP Images

*This artist's rendition shows the Kepler space telescope on the hunt for planets.*

# How to Find an Exoplanet

As sensitive as it is, Kepler cannot see the planets themselves. The stars it is looking at are from a few hundred to a few thousand light-years away. A light-year is the distance that light, traveling at 186,000 miles per second, covers in a year. That distance comes to approximately 5.9 trillion miles.

Kepler uses what scientists call the transit technique. The telescope is able to measure the very slight drop in starlight that occurs when an orbiting object passes in front of a star. Once Kepler registers an object passing around a star (usually after three passes), teams of scientists on Earth begin to focus on the object and try to analyze it.

Ground-based telescopes at the W. M. Keck Observatory in Hawaii, for example, are used to determine a possible planet's mass. Astronomers do that by measuring a star's wobbles-the tiny back-and-forth movements caused by the pull of a planet's gravity. Once size and mass are determined, as well as the type of star an exoplanet orbits, astronomers can make an educated guess as to what the planet is composed of. Sometimes the planet can be rocky, such as Earth, or gaseous, similar to Jupiter or Saturn. Or it may be some other type of exoplanet altogether.

## Hot Jupiters and Rogue Planets

It takes time and a lot of work for astronomers to verify that what Kepler notices is, indeed, an exoplanet, and what kind of planet it might be. That is why it has taken two years to confirm many of Kepler's discoveries.

So far, Kepler has led to the discovery of a number of different types of exoplanets:

- hot Jupiters-large planets like Jupiter mainly made up of gas; they orbit their stars as closely as Mercury orbits our sun;
- super-Neptunes-gas planets similar to Neptune that also orbit close to their stars;
- rogue planets-planet-sized objects that have been ejected from their star systems and are no longer bound to their stars by gravity.



Detlev Van Ravenswaay/Photo Researchers, Inc.

*This is an artist's rendition of a hot Jupiter, an exoplanet made mostly of gas.*

# Kepler-10b

In January, 2011, NASA scientists announced that they had discovered, for the first time, an Earth-like rocky exoplanet rather than a gas giant. The exoplanet, which they named Kepler-10b, orbits a sun-like star 560 light-years from Earth. Unfortunately, Kepler-10b is unlikely to support life, as it is 60 times closer to its star than Earth is to the sun. It is also 1.6 times denser than Earth—roughly the density of an "iron dumbbell," says astronomer Natalie Batalha, the leader of the Kepler team. Some believe that Kepler-10b may have originated much farther from its star and moved inward. If the planet supported life in the past, say astronomers, there is no way it could now. Still, Kepler-10b will go down in the history books as the most Earth-like exoplanet ever discovered—so far.

## Continuing the Search

Many astronomers think that it is only a matter of time before Kepler locates Earth's twin revolving around a star that may even be close to us. The space telescope has surveyed only a tiny fraction of the stars in the Milky Way. Once an Earth-like exoplanet is discovered, however, finding out whether it has all the ingredients for life will be a new hurdle. It will require costly new telescopes, including one capable of scanning such planets for evidence of oxygen, water, and carbon dioxide. Such a huge scientific mission will be expensive, but many scientists believe the exploration should continue at any cost.

"We are at a very special moment in the history of mankind," Cornell University astronomer Martha Haynes told The Associated Press.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. To which planet do scientists compare Kepler-10b?

- A. Earth
- B. Jupiter
- C. Neptune
- D. Mars

2. The Kepler space telescope was launched on March 7, 2009. What is an effect of this occurrence?

- A. Johannes Kepler has recently been interviewed by several television stations.
- B. Earth's twin has been located revolving around a star in the Milky Way.
- C. Astronauts are traveling to several super-Neptunes to conduct research.
- D. Scientists have discovered hundreds of exoplanets in the Milky Way.

3. What can you conclude after reading the passage?

- A. Many astronomers agree that exoplanets aren't worth studying.
- B. In the near future, astronauts will be able to visit Kepler-10b.
- C. Most exoplanets have oxygen, water, and carbon dioxide.
- D. Scientists will continue to search for Earth-like exoplanets.

4. Read this sentence from the passage:

"For years, astronomers have speculated that the sun is not the only star with planets circling it."

In this sentence, the word **speculated** means

- A. competed with members in the same group
- B. persuaded others to believe false information
- C. formed a belief without hard evidence
- D. stopped a mission that was unsuccessful

5. The primary purpose of this passage is

- A. to describe the mission of the Kepler space telescope
- B. to explain why so many different types of exoplanets exist
- C. to list the features of stars in the Goldilocks zone
- D. to discuss NASA's plans for the future of astronomy

6. What are exoplanets?

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7. The author writes that Kepler-10b is "unlikely to support life because it is 60 times closer to its star than Earth is to the sun." Why might the author draw this conclusion?

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8. The question below is an incomplete sentence. Choose the word that best completes the sentence.

Astronomers determine an exoplanet's size and mass \_\_\_\_\_ making an educated guess as to what the planet is composed of.

- A. because
- B. before
- C. however
- D. although



# News Debate: Phone Patrol

## ***Should the police be allowed to dig through people's cell phones?***

Police officers in California have a new way to fight crime. If they arrest someone who is carrying a cell phone, officers can dig through the phone's content, including text messages, voice mails, e-mails, calendars, and photos.

In a 5-2 ruling, the California Supreme Court stated in December 2011 that police officers are allowed to "open and examine what they find" on an arrested person, without a warrant. A warrant is permission from a judge based on reasonable suspicion.



Fuse/Getty Images

The decision came about as a result of a 2007 case, *People v. Diaz*. Sheriffs in California's Ventura County arrested Gregory Diaz, saying they saw him participate in a drug deal. The sheriffs took Diaz's cell phone from his pocket and scrolled through the text messages. They found one linking Diaz to the sale. Diaz was convicted. Later, however, he appealed the charges. He said that phone snooping violated the Fourth Amendment, which protects against unreasonable searches and seizures.

The California Supreme Court's verdict upheld Diaz's conviction. The court stated that, based on past rulings from the U.S. Supreme Court, police can indeed look through anything "immediately associated with a person."

The two judges who voted against the verdict argued that cell phone searches are an invasion of privacy. They noted that smart phones can contain a wide variety of information about a person.

Here are the arguments from people on both ends of the call.

### **Protection Over Privacy**

The police need help keeping the streets safe, say supporters of cell phone searches. Officers in Shafter, Calif., note that the policy has already been helpful. "We were able to establish who [the arrested people] were in contact with. It helped us to find who may also be involved in that crime," Detective Chris Grider told Bakersfield's 23ABC.

Some people also believe that the policy will deter people from committing crimes. "The police now have better means to find out if you're guilty," California resident Chris Eddy told San Diego 6 News.

Furthermore, supporters of the ruling say it does not violate the Fourth Amendment. If you've already been arrested with reasonable evidence, they say, then it is fair for the police to search through anything on you.

### Abuse of Power

Stop snooping through smart phones, argue opponents of the new ruling. "People could have ... pictures in there, like of their girlfriends, that they don't want somebody else to see, and it would be an invasion of privacy not only for them, but the other person also," California resident Valinten Perez told 23ABC.



ICP/Alamy

San Diego resident Jim Tharayil added that he thinks the policy could be abused. He told San Diego 6 News that he can imagine police officers "using something else to pull you over and then using this to look through your cell phone."

Justice Kathryn M. Werdegar, one of the judges who opposed the decision, says that police officers should have to obtain a warrant. It is unfair of police officers to "rummage at leisure through the wealth of personal and business information that can be carried on a mobile phone ... merely because the device was taken from an arrestee's person," she says.

*Update: The Supreme Court ruled in June 2014 that cell phones can no longer be searched without a warrant. This ruling came after this text was first published.*

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. Which amendment protects against unreasonable searches and seizures?

- A. the First Amendment
- B. the Second Amendment
- C. the Third Amendment
- D. the Fourth Amendment

2. The passage shows two sides of this debate: Should the police be allowed to dig through people's cell phones? According to the passage, all of these people are against the police being allowed to dig through people's cell phones EXCEPT

- A. Detective Chris Grider
- B. Justice Kathryn M. Werdegarr
- C. Valinten Perez
- D. Gregory Diaz

3. What can you most likely conclude about Gregory Diaz after reading the passage?

- A. He was probably sentenced to jail.
- B. He wasn't actually guilty of a crime.
- C. He was related to one of the judges.
- D. He used to work as a police officer.

4. Read these sentences from the passage:

"Diaz was convicted. Later, however, he appealed the charges."

In this sentence, the word **convicted** means

- A. reported angry
- B. acted alone
- C. looked after
- D. found guilty

5. The author's purpose for writing this passage was all of the following EXCEPT

- A. to present evidence for both sides of the argument
- B. to let the reader come to his or her own conclusions
- C. to provide facts about the 2007 case *People v. Diaz*
- D. to offer convincing proof that one side is clearly right

6. Why did sheriffs arrest Gregory Diaz?

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7. Why is the *People v. Diaz* case important? How do you know? Give specific examples from the text to support your answer.

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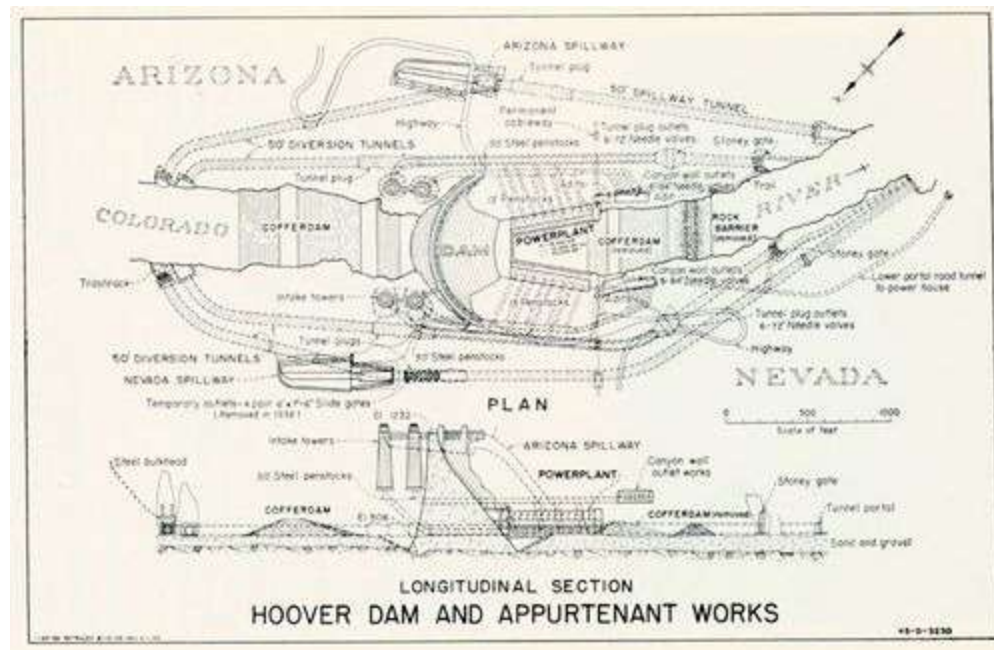
8. The question below is an incomplete sentence. Choose the word that best completes the sentence.

Gregory Diaz appealed the charges, \_\_\_\_\_ the California Supreme Court upheld his conviction.

- A. for
- B. or
- C. as
- D. but

# Everyday Energy

by Edward I. Maxwell



The pitcher gets into her set. Her glove and pitching hand come together by her chin, and she then lowers them to her belt. She looks at the catcher and nods. She brings her front leg up and pauses, standing perfectly balanced on her back leg. Then, in an instant, she steps forward with her front leg. Her whole body lurches toward home plate and her pitching arm swings out after it like a whip. At the furthest point, when a whip would crack, she lets the ball fly toward the catcher's mitt. The batter steps forward with her front leg and rotates her torso, swinging the bat with her eyes fixed on the incoming fastball.

"STRIKE THREE! BATTER'S OUT!"

Moments like these happen all across the physical world, whether on the molecular or cosmic level. Potential energy is the energy, chemical or physical, stored within an object, atom or molecule. Think about a car at the top of a roller-coaster, pausing just before it plunges into the next turn. A log resting in a fireplace just before it is about to be lit, is a treasure trove of potential energy. As the log burns, the connections between carbon atoms that make up the wood are being broken down, and the potential energy stored within those connections is being released as heat and light. As a comet approaches a planet or star, it slows, momentarily affected by the larger body's gravity. The potential energy builds and then reaches a breaking point, as the comet accelerates around the larger body and is slingshotted out the other side.

Sports showcase countless examples every day of potential energy being converted into kinetic energy. Kinetic energy is the energy of movement. When an archer draws and holds her arrow, her bow is brimming with stored potential energy. When she releases the bowstring, all the potential energy is quickly converted into kinetic energy, which is transferred to the arrow that takes flight. The

transfer of kinetic energy from the bow to the arrow is not a perfectly efficient process. What this means is that some of the energy does not make it to the arrow. Instead, the energy might be absorbed by the archer's arm, causing it to jerk to the side when the bow twangs. The most important thing to remember is that although the transfer of energy between objects may be inefficient, the energy still exists. It has simply been transferred along a different pathway. Therefore, the total sum of energy is still conserved.

The conversion of stored potential energy into kinetic energy can also be harnessed to power homes, factories and entire cities. The most notable example is the Hoover Dam. The Hoover Dam is an arch-gravity dam by design. This design name is the first clue as to how exactly the dam harnesses energy. Located in the Black Canyon of the Colorado River, the Hoover Dam formed, and now holds back, Lake Mead-the largest reservoir in the United States. The dam was built toward the beginning of the Great Depression. Constructed between 1931 and 1936, the dam had been the subject of planning and design sessions since 1900. Deliberations included discussions of potential catastrophes, should the dam fail or the lake grow beyond expectations.

Gravity acts as a force upon Lake Mead. Held at bay by the Hoover Dam, the waters of Lake Mead and the Colorado River gain greater potential energy with each passing moment. The Arizona and Nevada spillways are two means by which the waters of Lake Mead can escape the dam. As the lake water tumbles over the walls into a spillway, potential energy is instantly converted into kinetic energy. The channels through which the water normally escapes every day are the four intake towers. These towers funnel the water through sluices, or passageways, to the powerhouse and hydroelectric generators. When the water reaches the intake towers and is allowed to flow down through the sluices, all the stored potential energy created by the force of gravity acting upon the water is converted into kinetic energy, just as when water flows over the wall into a spillway.

By harnessing the converted potential energy of Lake Mead, the Hoover Dam provides power to California, Nevada and Arizona. Well over a dozen turbines are housed within the power plant at the base of the dam. Electricity production varies annually depending on how much water is required downriver from the dam and the water levels of Lake Mead. The greatest amount of energy was produced during 1984; a year after floods brought the lake to its highest levels. As of 2009 the American Southwest has entered a prolonged period of seasonal droughts. As a result, compared to its peak periods of energy production, the Hoover Dam has been recently generating much less energy.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. A rollercoaster car at the top of the hill, an archer preparing to release an arrow, and a lake that sits above a dam are all examples of what kind of energy?

- A. potential energy
- B. kinetic energy
- C. gravitational energy
- D. consumption of energy

2. What does the author describe in the passage?

- A. the history of human energy use in the United States
- B. the ways in which potential energy is converted to kinetic energy
- C. the best reasons to build new dams in the American Southwest
- D. the consequences of drought for people who rely on dams

3. The conversion of stored potential energy into kinetic energy can also be harnessed to power homes, factories and entire cities. Which example from the text supports this conclusion?

- A. the softball pitcher
- B. the slingshotting comet
- C. the archer
- D. the Hoover Dam

4. Which of the following conclusions is supported by the text?

- A. Nuclear power is the most efficient kind of energy for powering cities.
- B. Professional athletes should study the science of energy to play better.
- C. Dams power cities by converting stored potential energy into kinetic energy.
- D. Drought is a serious problem for farmers in the American Southwest.

5. What is this passage mainly about?

- A. The movement of comets through our solar system.
- B. The scientific forces behind our favorite roller-coasters.
- C. The unusual properties of water molecules in rivers.
- D. The conversion of potential energy into kinetic energy.



6. Read the following sentences: "The Arizona and Nevada spillways are two means by which the waters of Lake Mead can escape the dam. As the lake water tumbles over the walls into a **spillway**, potential energy is instantly converted into kinetic energy."

As used in the passage, what does the word "**spillway**" mean?

- A. A place where water flows over the top of a dam, creating energy.
- B. A place where water accidentally spills, causing problems for engineers.
- C. A place where water flows underground, into tunnels.
- D. A place where water flows into nearby farms, watering crops.

7. Choose the answer that best completes the sentence below.

"The conversion of stored potential energy into kinetic energy can be harnessed to power homes, factories and entire cities. \_\_\_\_\_, the Hoover Dam provides power to California, Nevada and Arizona.

- A. Even though
- B. Initially
- C. For instance
- D. However

8. How does the Hoover Dam provide power to California, Nevada and Arizona?

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**9.** What two factors determine the energy production of the Hoover Dam?

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**10.** Explain why the prolonged period of drought (a time where there is little rain, and little water flowing into rivers and lakes) would cause the Hoover Dam to generate much less energy since 2009. Use evidence from the text to support your answer.

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# Forecasting Severe Weather to Communities Helps them Prepare

by Alissa Fleck



Severe weather does not happen in one place all the time, but when it happens, it's important to be prepared for it. Knowing the weather risks of where you live and how to plan for them are key to staying safe in any kind of storm.

While tornadoes can hit any part of the United States at any time of year, there are parts of the country-and certain seasons-in which tornadoes are much more common than others. Tornadoes primarily hit the U.S. in an L-shaped area from Iowa to Colorado to Texas. Oklahoma has the highest impact zone. Most tornadoes take place in this region in the month of May.

It's very helpful for weather scientists, emergency responders and community members to be aware of this so-called "Tornado Alley" in keeping people safe. While it may be difficult to protect buildings and other structures, maintaining public awareness helps humans protect themselves and their families in instances of severe weather. Protecting human lives is the most important thing. The

National Weather Service provides timely warnings, and local TV and radio stations broadcast these warnings so that people in the tornado's path can seek shelter in time. Towns also set off warning sirens that indicate there is potential for a tornado.

People who live in areas with high tornado frequency are also familiar with how to prepare for these events. One way people might prepare for a tornado is to seek protection in a basement or storm shelter where heavy winds are less likely to blow around dangerous objects, which could hurt someone. Often during storms people get hurt by flying debris rather than the storm itself. People who don't have basements or have disabilities preventing them from moving with ease are sometimes encouraged to lie down in a bathtub and cover their heads. These are just some of the ways people stay safe when a tornado is on the way.

Hurricanes, on the other hand, tend to strike coastal regions. You would not see a hurricane hit the Tornado Alley, for instance, because there are no oceans nearby. Florida is one state in the U.S. that gets hit by a large number of hurricanes. Meteorologists can usually predict hurricanes several days in advance. If it's safe to stay at home during a hurricane, people are advised to cover their windows with shutters and stock up on food, water, medication, batteries and other items they might need. As with tornadoes and other severe weather, people should expect to lose power to their homes for potentially several days or more. Even when the hurricane has passed, there can still be dangerous flooding in the streets for which people should also be prepared.

Sometimes government emergency services will decide it's not safe for people in the hurricane's path to stay in their homes, and they will be told to evacuate in advance. When people evacuate their homes, they move to a safer region until the storm passes and they can return home.

**Name:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**1.** What is one type of severe weather discussed in this passage?

- A. earthquakes
- B. tornadoes
- C. tidal waves
- D. heat waves

**2.** What does this passage compare and contrast with tornadoes?

- A. This passage compares and contrasts basements with tornadoes.
- B. This passage compares and contrasts emergency services with tornadoes.
- C. This passage compares and contrasts Oklahoma with tornadoes.
- D. This passage compares and contrasts hurricanes with tornadoes.

**3.** Read this sentence: "While it may be difficult to protect buildings and other structures, maintaining public awareness helps humans protect themselves and their families in instances of severe weather."

What evidence from the passage supports this statement?

- A. "While tornadoes can hit any part of the United States at any time of year, there are parts of the country-and certain seasons-in which tornadoes are much more common than others."
- B. "The National Weather Service provides timely warnings, and local TV and radio stations broadcast these warnings so that people in the tornado's path can seek shelter in time."
- C. "You would not see a hurricane hit the Tornado Alley, for instance, because there are no oceans nearby."
- D. "Severe weather does not happen in one place all the time, but when it happens, it's important to be prepared for it."

**4.** Which state would a tornado be most likely to strike in May?

- A. Oklahoma
- B. New York
- C. California
- D. Florida

5. What is this passage mostly about?

- A. the National Weather Service
- B. flooding caused by hurricanes
- C. preparing for tornadoes and hurricanes
- D. Colorado, Iowa, Texas, Oklahoma, and Florida

6. Read the following sentences: "As with tornadoes and other **severe** weather, people should expect to lose power to their homes for potentially several days or more."

What does the word **severe** mean in the sentence above?

- A. simple
- B. winter
- C. very bad
- D. very calm

7. Choose the answer that best completes the sentence below.

People should prepare for severe weather, \_\_\_\_\_ tornadoes and hurricanes.

- A. such as
- B. however
- C. meanwhile
- D. third

8. According to the passage, what is one way that people prepare for a tornado?

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**9.** According to the passage, what is one way that people prepare for a hurricane?

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**10.** What are some similarities between preparing for a tornado and preparing for a hurricane? Support your answer with evidence from the passage.

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