

The Molecule Movie

Article

PART 1

SAN JOSE, California. Technology company IBM says that it has made the tiniest stop-motion movie ever. The one-minute video consists of individual carbon monoxide molecules. They repeatedly rearrange. They show a boy dancing, bouncing on a trampoline, and riding a skateboard.

The movie is titled "A Boy and His Atom." It isn't at all like most movies. It was made on a super-small scale. Each frame measures 45 by 25 nanometers. (There are 25 million nanometers in an inch and 10 million nanometers in a centimeter.) But the frames are hugely magnified. The look of the video is primitive by some standards. It's similar to early video games. This is particularly apparent when the boy bounces a ball off the side of a frame. This is accompanied by simple music and sound effects.

"A Boy and His Atom" isn't the first film to show atoms in motion. But this is said to be the first time anything so small has been used to tell a story.

"This movie is a fun way to share the atomic-scale world," Andreas Heinrich said. He is IBM's principal scientist for the project. "The reason we made this was not to [give] a scientific message directly, but to engage with students, to prompt them to ask questions."

Jamie Panas of *Guinness World Records* said that Guinness certified the movie as the "Smallest Stop-Motion Film."

This isn't a conventional movie. So it couldn't be made using typical methods. IBM used a remotely operated 2-ton (1.8-metric ton) scanning tunneling microscope (STM) at its lab in San Jose, California. The microscope magnifies a surface more than 100 million times its original size, so atoms on the surface are visible. It operates at 450 degrees below 0 Fahrenheit (268 degrees below 0 Celsius).

The cold "makes life simpler for us," Heinrich said. "The atoms hold still. They would move around on their own at room temperature."

Scientists used the STM to control a tiny, super-sharp needle on a copper surface. At a distance of just 1 nanometer, the needle physically attracted the carbon monoxide molecules and pulled them to an exact location on the surface. The dots that make up the figure in the movie are the oxygen atoms in the molecules. The scientists took 242 still images that make up the movie's 242 frames.

Working on a tiny scale may be the way of the future, as the volume of data in the world increases. Heinrich said that the methods used to make the movie are similar to what IBM is doing to make data storage smaller.

"As data creation and [use] continue to get bigger, data storage needs to get smaller, all the way down to the atomic level," he said.

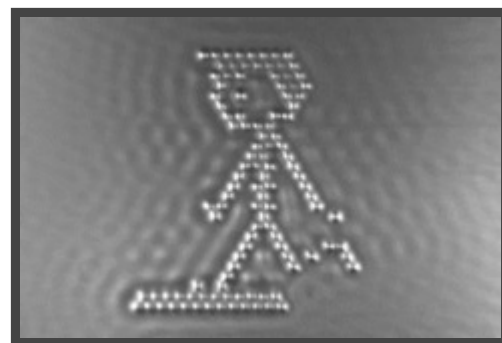


Photo credit and all related images:
AP/IBM

In this image from a video created by IBM, a boy made of oxygen atoms rides a skateboard. He's in a scene from the world's tiniest stop-motion movie.

The Associated Press contributed to this story.

PART 2

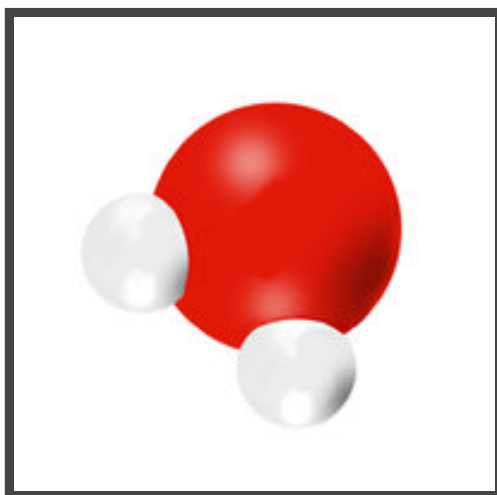
Dig Deeper

Atoms are the smallest particles of an element. Atoms are so small that you cannot see them through an ordinary microscope. In fact, millions of them could fit in the period at the end of this sentence. But IBM scientists knew that they could see and make images of atoms. They have a scanning tunneling microscope (STM).

The needle of the STM has a very sharp tip. It is only one atom wide. The tip is brought close to the surface of a material. The tip is given an electric charge. Then the needle is moved around just above the surface. This creates an image of the surface. The image appears as a group of bumps. The bumps are atoms.

Scientists can also use the tip of the STM needle to move atoms on a surface. This is how the IBM scientists created their movie. They pushed individual atoms into place on a very smooth metal (copper) surface.

A molecule is made when 2 or more atoms bond together, or combine. The force that holds the atoms together is called a chemical bond. A molecule can be made of atoms that are different. It can also be made of atoms that are alike. Think about a molecule of water. It is a combination of different atoms. It is made of 2 hydrogen atoms and 1 oxygen atom (also written as H₂O).



Credit: Houghton Mifflin Company

Each water molecule contains 2 hydrogen atoms (shown in white) and 1 oxygen atom (shown in red).

A molecule is the smallest amount of a substance that is still thought of as that substance. Think about trying to divide water to find its smallest part. In time, you would reach 1 molecule of water. What if you divide this molecule into atoms? It is no longer water. Instead, it is atoms of hydrogen and oxygen. It is two different substances.

Dictionary

certify (*verb*) to confirm or approve

primitive (*adjective*) an early kind; from long ago

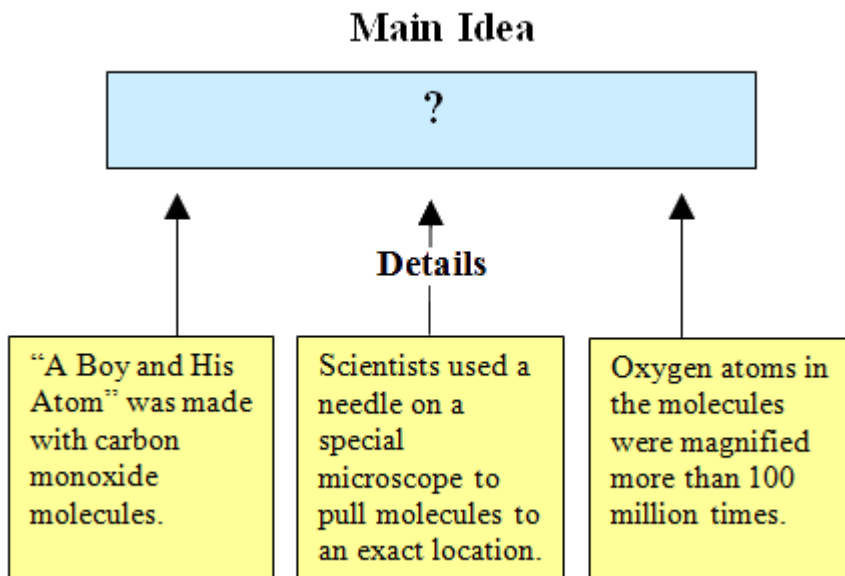
scanning tunneling microscope (*noun*) a device that makes three-dimensional images of atoms on surfaces

substance (*noun*) matter; elements, compounds, and mixtures

Activity

PART 1

Question 1



Based on the article, which best replaces the question mark in the diagram above?

- (A) IBM says that the new movie it made is similar in some ways to early video games.
- (B) IBM's principal scientist for a stop-motion movie project is Andreas Heinrich.
- (C) IBM's principal scientist for a project says that data storage needs to get smaller.
- (D) IBM says it has made the tiniest stop-motion movie ever, a one-minute video.

Question 2

Which statement from the article best supports the opinion that there is value to the work involved in making "A Boy and His Atom" beyond engaging students?

- (A) IBM used a remotely operated 2-ton (1.8-metric ton) scanning tunneling microscope (STM) at its lab in San Jose, California.
- (B) "As data creation and [use] continue to get bigger, data storage needs to get smaller, all the way down to the atomic level," [Heinrich] said.
- (C) "A Boy and His Atom" isn't the first film to show atoms in motion.
- (D) "The reason we made this was not to [give] a scientific message directly, but...to prompt them to ask questions."

Question 3

Which is the closest **antonym** for the word *primitive*, as it's used in the article?

- (A) Quaint
- (B) Modern
- (C) Natural
- (D) Basic

Question 4

The reader can tell from the article that _____.

- (A) Scientists believe that making the molecule movie using a scanning tunneling microscope has significance beyond engaging students.
- (B) Scientists probably invested a lot more time than money in the creation of the one-minute molecule video.
- (C) Scientists hope that making the molecule movie will prompt students to become curious about the development of early video games.
- (D) Scientists will probably remove the scanning tunneling microscope from its current location in San Jose, California.

Question 5

In the article, scientist Andreas Heinrich said:

"This movie is a fun way to share the atomic-scale world. The reason we made this was not to [give] a scientific message directly, but to engage with students, to prompt them to ask questions."

The author probably included this quote to _____.

- (A) Explain to the reader one of the reasons why IBM decided to create its small-scale movie
- (B) Explain to the reader how IBM acquired a remotely operated 2-ton (1.8-metric ton) STM
- (C) Explain to the reader where to find other movies that show atoms in motion
- (D) Explain to the reader why Andreas Heinrich chose to work as a scientist at IBM

Question 6

The article states:

The look of the video is primitive by some standards. It's similar to early video games. This is particularly *apparent* when the boy bounces a ball off the side of a frame. This is accompanied by simple music and sound effects.

Which would be the closest **synonym** for the word *apparent*, as it is used above?

- (A) Necessary
- (B) Obvious
- (C) Productive
- (D) Magnificent

Question 7

Which is the best summary of the article?

- Ⓐ IBM says that it has made the tiniest stop-motion movie ever using moving molecules.
- Ⓑ IBM says that it has made a movie showing a boy dancing and riding a skateboard.
- Ⓒ IBM says that scientists used a scanning tunneling microscope to control a tiny, super-sharp needle on a surface.
- Ⓓ IBM says that scientists use cold temperatures to make atoms hold still when they are using a scanning tunneling microscope.

Question 8

Which information is **not** in the article?

- Ⓐ The size of each picture frame that was used to make a movie on a super-small scale
- Ⓑ The methods that the scientists at IBM used to create a movie showing moving atoms
- Ⓒ Whether or not "A Boy and His Atom" is the first film to show atoms in motion
- Ⓓ The amount of time that it took scientists to create a movie called "A Boy and His Atom"