

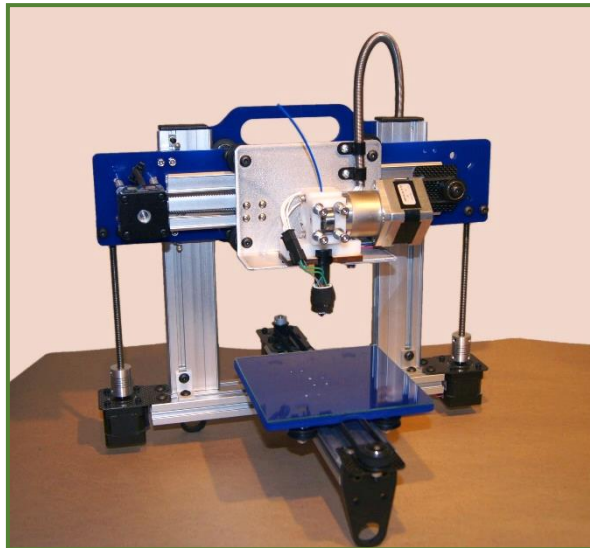
## Print your world!

This week's Pop-up Science is about 3D printing!

A 3D printer is a device that can create a touchable object from a digital computer model. In individual layers, an object is "printed" from bottom to top.

With a 3D printer, you can easily create any object on your computer and then print it out. There are almost no limits to creativity.

This is how a 3D printer looks like:



Picture by Bart Dring, <https://commons.wikimedia.org/>

And here are examples that can be printed:



<https://www.thingiverse.com/>; © 2020 MakerBot Industries, LLC

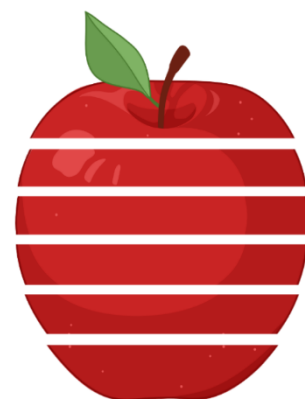
**A. Read the following text. Underline the most important pieces of information.**

3D-printed objects have been used in the industry for years. Companies use 3D printers when, for example, very few items need to be produced, such as spare parts. 3D printers are also used when you want to try out a new idea for a shape. Such an experimental model is called a prototype. 3D printers are also useful when you need to produce something new quickly, for example, protective equipment against corona.

A 3D printer can print a three-dimensional object by applying molten plastic over many layers from bottom to top. Hot plastic is forced through a nozzle. This nozzle moves left and right and back and forth. Material is printed only where it is needed. This is similar to an inkjet printer. The ink is only printed where letters or pictures should be.

The 3D printer presses the hot plastic out of the nozzle and prints the bottom layer. This then cools down quickly and thus keeps its shape without flowing away. The printer then prints the next layer on top of it. Then another layer and then another. This is repeated until the object is finished from bottom to top. It is almost like putting icing on a cake. The more layers you put on the cake, the thicker the icing gets! This is exactly how the 3D printer manages to create a three-dimensional object.

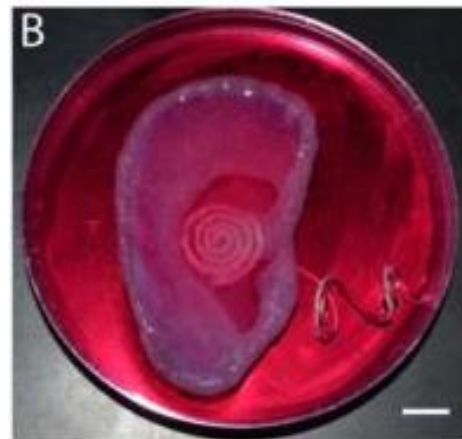
A 3D printer needs to know what to print. To do this, it needs a digital computer model. The model is created with a special computer program. When the model is finished, another computer program is needed, called slicer. This program then splits the model into many thin layers. To the printer, it looks like the apple you cut up in your participatory experiment on Monday.



Each layer is then printed individually from bottom to top. Together they make up the complete computer model, which can be touched after printing. Not only objects made of plastic can be printed, but also objects made of ceramics, glass, metal, and even biological tissue!

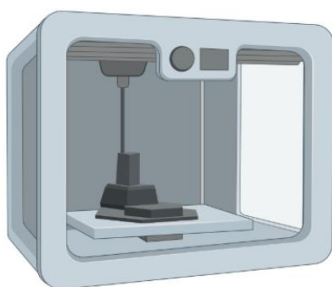
Very special 3D printers can print gels in which living cells are enclosed. The cells in the gel survive and can organize themselves into a functional tissue. When printing living cells, the temperature during printing needs to be kept carefully so that cells do not die. Research is already quite advanced in this area and muscles, cartilage, skin or parts of the liver or kidney can be printed! However, these are currently only used for drug discovery research and are not implanted in humans yet.

Here you can see a 3D-printed ear! Here, the structure of the ear was first printed with a special gel. Then, living cells in the red liquid were poured over it. After some time, the cells settled in the gel. These cells could survive and grow. However, such an ear has never been transplanted to a human being yet.



3D Printed Bionic Ears, Mannoor MS et al., Nano Letters, 2013, 13, 6, 2634–2639, Copyright © 2013 American Chemical Society

That got you curious? You want to see a 3D printer in real life?



<https://app.biorender.com/>

In the techLAB of the Technical Museum Vienna or in other so-called Maker Spaces you can print your own projects in 3D! You can find more information about this at <https://www.technischesmuseum.at>. For now, you can experiment with whipped egg white!

**B. Try to answer the following questions.**

**Tick the correct answers.**

1. A 3D printer is a device that can create a touchable object from a digital computer model.

true  false

2. Until now, people can only 3D print very few objects, unfortunately.

true  false

3. A prototype is ...

- ... another word for a 3D printed ear
- ... a computer program that breaks down a computer model into many thin layers.
- ... another word for an experimental model.

4. What was 3D printing compared to in text? Complete the text.

A 3D printer first prints the bottom layer of the model. Then it prints the next layer and the next. It is as if you would put

\_\_\_\_\_ on a \_\_\_\_\_.



5. What is the name of the computer program that breaks down the computer model into individual layers after it has been created digitally? This program allows the 3D printer to print layer by layer. At the end of the process the printer creates an object that can be touched!

prototype  slicer  nozzle

### C. Word search

Can you find all the hidden words in our word search this time?

3DPRINTER

CELLS

OBJECT

COMPUTERMODEL

CERAMIC

SLICER

CREATIVITY

GLASS

NOZZLE

PROTOTYPE

METAL

PLASTIC

Circle each word! Have fun!

V	E	D	L	S	R	K	F	P	A	R	O	P	O	I	K	N	R	H	M
H	E	F	K	M	K	M	F	O	E	B	G	B	R	L	G	M	Y	P	R
P	L	O	O	P	J	E	V	L	X	E	Z	Y	J	W	S	P	N	U	U
V	J	J	O	P	L	T	R	X	C	N	M	T	I	E	E	R	W	E	X
W	R	P	E	B	A	A	P	V	S	O	B	I	E	A	C	O	N	A	H
W	B	X	L	Y	O	L	S	X	Z	N	S	V	G	E	X	T	F	F	M
A	Y	J	T	W	Q	K	J	T	P	E	N	I	P	X	O	O	R	E	H
P	I	F	H	Q	N	S	L	R	I	G	O	T	O	U	S	T	U	I	F
E	A	Z	V	W	I	W	L	P	O	C	Z	A	X	C	S	Y	R	W	V
T	K	V	U	A	E	N	E	I	V	V	Z	E	C	E	A	P	V	G	M
M	J	B	E	B	V	N	Y	T	C	V	L	R	S	L	L	E	C	Q	D
H	V	C	F	B	J	Q	R	D	W	E	E	C	M	D	G	E	L	B	X
C	T	C	R	E	N	R	S	H	L	B	R	Q	I	N	V	N	D	N	S
L	U	F	V	X	X	K	O	I	G	H	D	C	I	X	Z	C	K	V	G
I	T	X	E	H	C	O	M	P	U	T	E	R	M	O	D	E	L	A	S
N	T	K	R	V	D	I	G	N	X	E	J	A	F	I	J	R	H	Z	H
L	K	Y	R	T	T	C	Y	N	V	M	O	J	I	B	M	A	I	G	S
U	L	Z	L	A	G	I	S	M	U	A	A	U	B	H	O	M	I	P	Z
A	R	E	T	N	I	R	P	D	3	R	W	Z	E	E	M	I	X	F	D
T	L	A	P	D	B	G	I	Q	X	C	I	K	E	S	X	C	D	F	M