

THE EXPERIMENTALIST

An Encyclopedia of Science and Technology for Young People

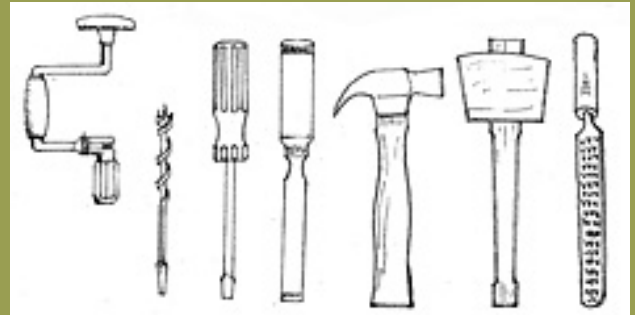
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Editorial

Many children in Mozambique build things: toys, musical instruments, small trucks that can 'drive', catapults, cages, traps, and so on. Some are simple, but some are complicated. These constructions show how children are creative and innovative.



Technology: A source of Magnets

Construction: Carpentry Tools and how to make a Saw and a Bench

Community: Making Water drinkable using the Sum

World Technology: Mines and Rats



A quite sophisticated toy made by children

Doing these things can be the first stage to becoming an engineer or scientist. It is important for young people to build "toys" that work, and develop technology. There are many examples in the world of a poor child who rose to a high level. Mozambique needs young people who learn to be engineers and technologists.

It is one of the intentions of our 'Experimentalist' to help young people do technical experiments, to understand them and then progress to a career in science and technology.

A source of Magnets

Fifty percent of the magnets produced in the world are actually used in hard disk drives of computers (HDD) each unit normally having two magnets.



Removing the magnets from an old hard drive is very easy - usually just one (Phillips) screwdriver is required. See the Internet to watch a YouTube video on how to extract a magnet from the hard disk.

See: <http://www.youtube.com/watch?v=RWGNNWAv4U>.

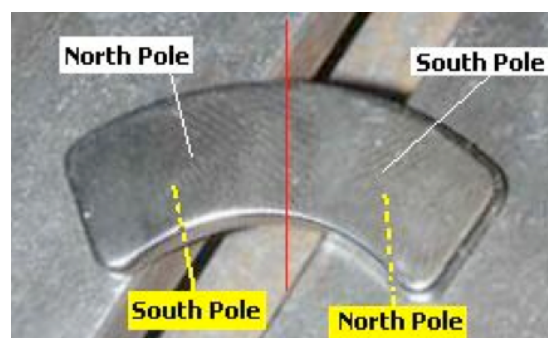
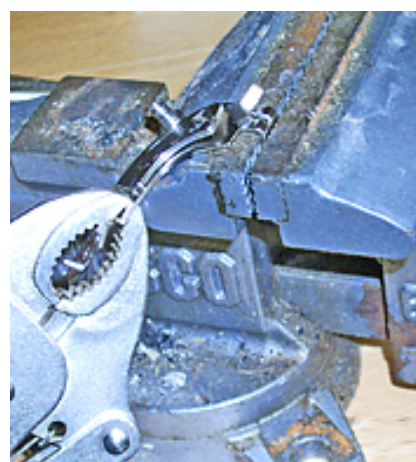
Do not use very modern hard disks - they have smaller and weaker magnets. Use hard disks from an old computer.

When you take a magnet from a hard disk it will still be attached to a steel plate that must be removed. The easiest way is to place a corner of the steel plate in a vise and bend the other corner of the plate using locking pliers.

The magnets used in hard disks are very strong, made of an alloy of neodymium element

Usually a magnet has a north pole on one side and a south pole on the other side. But a hard drive magnets act like two magnets glued side by side. On one side there is a north pole on the left side and a south pole on the right, on the other side there is a south pole on the left and a north pole on the right.

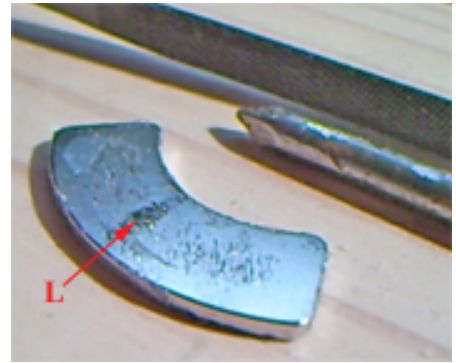
This is shown in the picture with the white labels pointing to the upper face of the magnet, and the yellow labels pointing to the under face (hidden) of the magnet. >>



The polarity seen from the side.

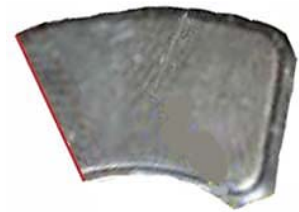


To find out where the division is between the two magnets, file a nail to produce iron filings and then spread them on the magnet. Thus, the filings indicate the line of division.



The simplest method of cutting the magnet is to use a hammer and chisel.

The magnet cut and ready to use>



The power of magnets can be increased by gluing them together (as shown in the photo). Three bonded magnets, for example, should have between 2 and 3 times the magnetic force of only one magnet.



Beware of neodymium magnets!

Neodymium magnets are extremely strong, and must be handled carefully to avoid injury to yourself and damage to the magnets. Fingers and other body parts can be severely pinched between two attracting magnets. Neodymium magnets are brittle and may break or crack if allowed to knock together. Eye protection should be worn when handling these magnets, as magnets can throw broken pieces at great speeds. >>



The strong magnetic fields of neodymium magnets can also damage magnetic media such as floppy disks, credit cards, cassette tapes, videotapes or other devices. They can also damage televisions, VCRs, computer monitors and others. Never place neodymium magnets near electronic appliances.

Children should not be allowed to handle neodymium magnets.

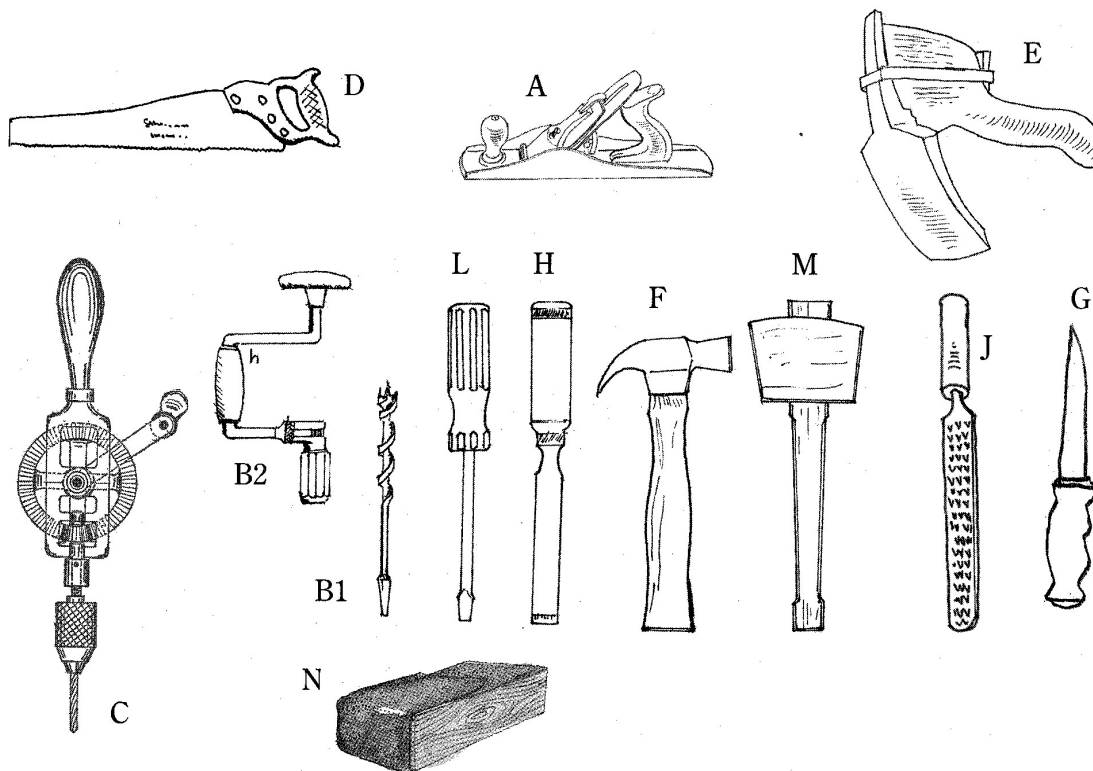
Never allow neodymium magnets near a person with a heart pacemaker or similar medical care. The strong magnetic fields of the magnet can affect the operation of such devices.

Neodymium magnets are brittle and prone to chipping and cracking.

Neodymium magnets lose their magnetic properties above 80 ° C.

Carpenter's Tools

There are many tools for working with wood. The most common are:



Plain (A): is a form of adze, within a support. It serves to smooth the wood surface and produces a better quality than the adze. Figure 2.1 shows the proper way to handle a plane. >>



Broca (B1) is a metal spiral (which may have various forms) that is for making circular holes. It rotates with the bow drill (B2). You use this drill for larger holes up to 2 cm in diameter. >>

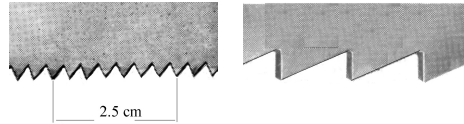
<< The tool that rotates the drill bits is small. (C). This drill is used for smaller holes up to 8mm in diameter.





Saw (D): Serves to make direct cuts in wood.

Hand saws are divided into two main categories, "cross" and "rip". The cross-cutting saws are for cutting across the fibres and have fine teeth.

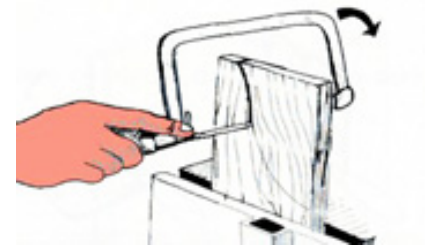


Rip saws have larger teeth and are for cutting along the fibres.

Adze (E) is used to reduce the thickness of a board.



A serra de contornar This saw is used to cut the timber along a curved line. The frame allows you to change the angle of the saw to follow the curve. It can be used to cut wood planks.



Hammer (F) serves to hammer nails and chisels and to adjust pieces of wood during their assembly. The hammer with "ears" is used to remove nails.

Knife (G): is used to cut small pieces of wood, sharpen pencils and carve small models.



Chisel (H): is a long, narrow tool, sharp at the end. You hit it with a hammer or mallet to make incisions in the wood (especially in joints) or to carve.

Grossa (J): a type of file used to shape wood.

Mallet (M): A hammer made of wood used to hit chisels.

Sandpaper (N) serves to smooth the wood to a finish.





Grinding Stone (N) is one of the most important tools and serves to sharpen knives, adzes, planer blades, chisels, etc..

Carpenter's square: This should be used to make sure the corners of the work are rectangular.

Tape measure: One of the most essential tools. The measurements must be exact.

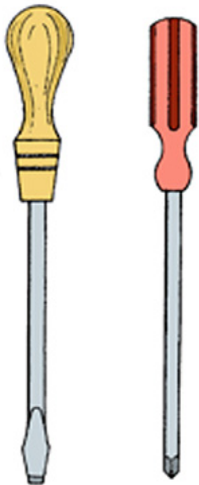
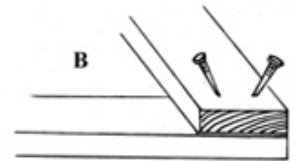
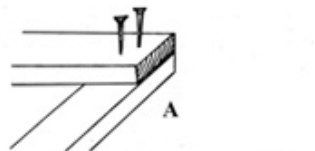


Take care!

Tools can be dangerous because they have sharp edges. You should be careful when you use them. When you make a cut with a knife or other cutting instrument, you should always cut in the opposite direction to your body. Thus, if the knife or cutting instrument fails, there is no risk of cutting yourself.

Joints and nails

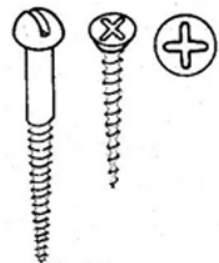
Carpenters use nails only for heavy work because they do not hold the wood very well. (But they are more secure if you hammer them in at different angles. The figure A shows the weaker way and Fig B shows the best way.



Screws and screwdrivers

Screws are better than nails because the thread holds the pieces of wood tighter together. You must make a hole slightly smaller than the screw before inserting it. The screws either have **split** heads or 'star' heads and there are screwdrivers of various sizes appropriate for each.

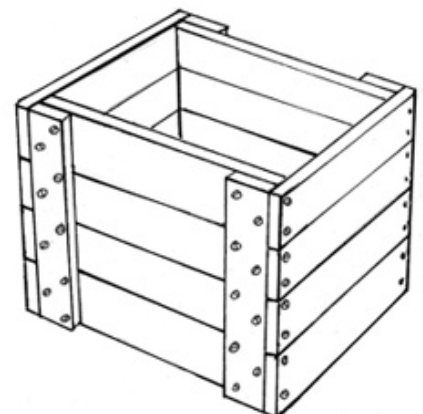
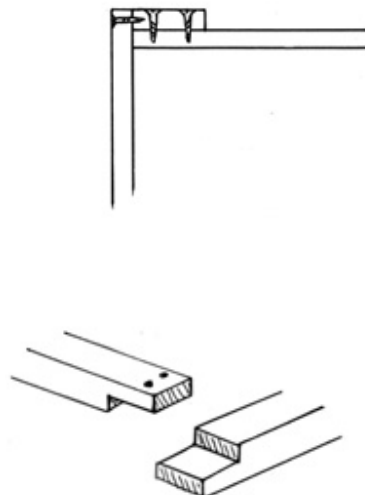
Do not use a screwdriver to do anything else except putting in screws, or you could damage it and then it will never work well for tightening screws.



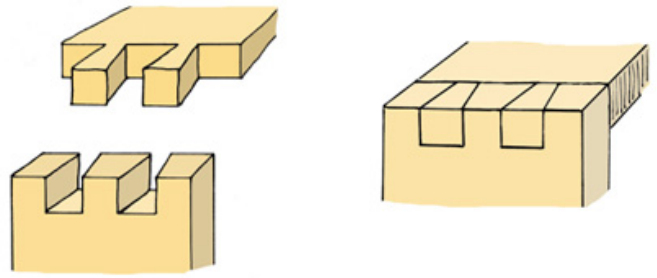
Wood joints

Here are some common joints. First a butt joint and a box made of butt joints. The figures show how this is done. To make a simple box, you can use nails instead of screws.

The figure shows a simple overlap joint. It is fixed with glue and screws or nails.



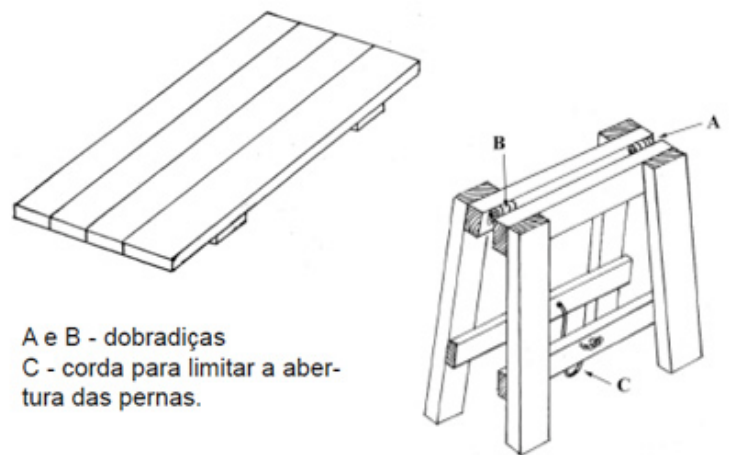
The figure shows a dovetail joint that is made using a hack saw and chisel, and then glued together. This is a very strong joint.



A bench or table

To work with wood a strong bench is needed.

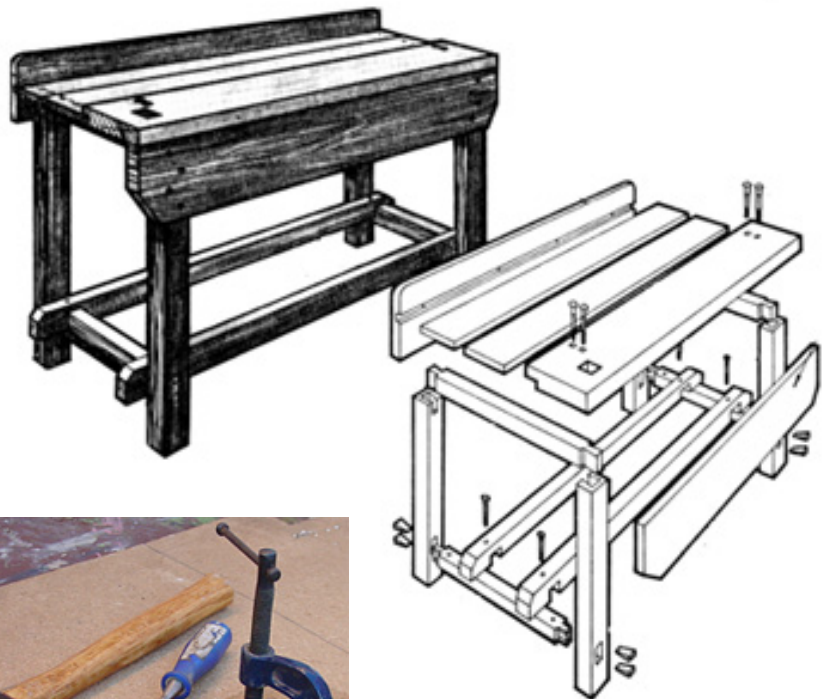
Two sawhorses can support a board to serve as a table for sawing.



Wood vice. The vice is necessary to grip the wood to be worked - drilled or sawn.



The clamp is used to keep the wood in a fixed position on the bench to work on. >>



How to make a saw

You can make a simple saw for cutting metal. It's as good as a commercial saw and cuts both metal and wood.

First, you should get a hacksaw blade.

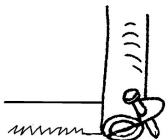
A hacksaw >>

Now you need an armature. This can be made of wood, but bamboo is easier and stronger.

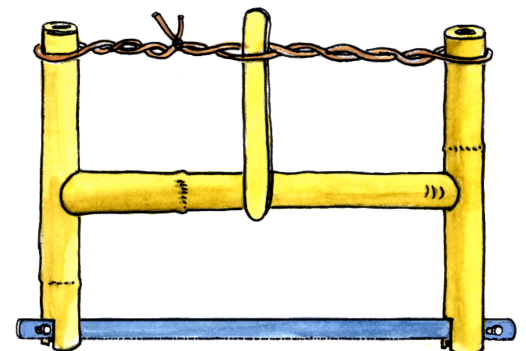
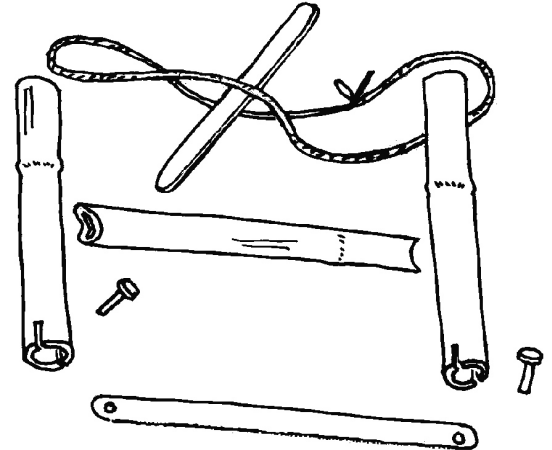
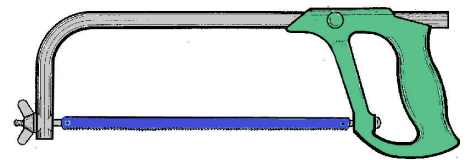
Look at the photo of the blade and check the direction that the teeth should point to. They point forward so that they can 'attack' the metal.

The construction of the armature is shown in the diagram >>

When you twist the piece of wood, this twists the cord which becomes a bit shorter and pulls in the sides of the saw. This really pulls the saw blade and tightens it. It should be as tight as the strings of a guitar, so that it make a high musical note when plucked.



<< The small diagram shows how the blade enters the slots on the sides of the armature and is secured with a piece of a nail.



The photo shows a young man with the metal cutting saw.

Domestic Gas

The gas used in domestic stoves is a mixture of methane and propane supplied in steel cylinders. The same gas is used in cigarette lighters.

Within the cylinders, most of the gas exists as a liquid. When the gas leaves the stove, a part of the liquid evaporates. If you shake a bottle, you can feel the liquid moving inside. If you turn a gas cylinder upside down, the liquid would come out instead of gas.

The quantities of gas (in kg) are indicated on the bottle. >>



How to make a balance to tell which is the fullest bottle

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The figure shows a balance to weigh a gas cylinder. It's like a bow and arrow. With this, you can measure which bottle contains more gas in the store before buying. Also you can tell when your bottle is nearly empty.

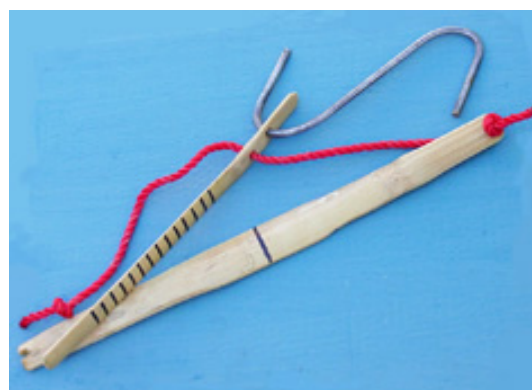
To make the balance, you need a strip of bamboo. This is the 'bow'. Choose a piece that is not too thick and strong (because it does not bend enough). But it should not be too thin and weak (or it will bend or break).

With a knife, make small slots at the ends of the 'bow'. Prepare a bamboo to serve as a "arrow". Drill two holes near one end, one for a cord and one for a hook. Then prepare a strong cord, a little longer than the bow. Pass the string through one

of the holes, as shown in the figures. Make knots at the ends of the cord so as to stretch the rope between the slots.

Fold 30 cm of strong wire in the form of an 'S' and put it in the other hole in the "arrow".

You should experiment with various sizes of bow (width and thickness) in order to ensure that the arrow moves enough but not too much.



With a pencil, make lines on the arrow to indicate the weights of 'full bottle' and 'empty' (after experimenting with several bottles in the store).

The balance is not very accurate but serves well to help you decide which is the fullest bottle before buying.

You can build a more sensitive scale (with the bow thinner and longer) to weigh potatoes, fish, etc.. not to be misled when buying in the market.



Modern digital scales to weigh the bags of passengers at an airport.

Making drinking water, using the sun

According to UNICEF, 4 million children in the developing world die from diseases caused mainly by contaminated water. The sources of water here in Mozambique are often infected with germs that cause diseases such as diarrhea, cholera and hepatitis.

A method to kill these microbes and make water drinkable is to boil the water. But this is difficult because of the cost of firewood and charcoal. But there is another method that costs nothing ...

In this article, we present a simple method, available to all the world and easily understandable, which disinfects water and makes it healthy to drink.



This method uses the sun's rays to kill all microbes. If you use it, you and your children avoid water-borne diseases. This method should be taught to students in schools, and they should take the practice home.

The sun

The sun emits heat (that you feel), light (that you see) and 'Ultraviolet', which you do not feel nor see. Maybe you have seen it in a nightclub, the white shirts of the people shine in the darkness when the lights go out. This is caused by ultraviolet lamps. It is this ultraviolet that kills microbes in water.

Method:

The first step is: leave the water in a clean covered bucket (or any container) for 12 hours for the heavier particles (sand, etc.) settle at the bottom. This process is the first water cleaning process.

Now you need a bottle of clear glass or plastic - for example an empty cooking oil bottle. (It may be yellow but better is a fully transparent bottle, such as those containing mineral water.) Equally effective is a transparent plastic bag.

First, rinse the bottle and its cap. Remove the label so as not to impede the sun's rays.

In the morning, fill the bottle with water. Put the bottle on its side in the sunshine. If possible, put it on the roof or on top of a wall in the sun. Do not put in the shade.

Allow the bottle to stay in the sun until the end of the day, for at least five hours. If there is no sun, you have to leave the bottle out for two days.



In the evening, if it has been in the sun most of the day, the sun will have killed most of the micro-organisms in water. This water has no diseases and can be drunk.

If you store water in another container that is not the bottle you used, this container has to be washed with clean water.

You must have enough bottles to treat water for the whole family.

Mines and Rats

Mozambique is still littered with landmines from the civil war that ended in 1992. An estimated 20 people step on landmines every month in Mozambique. In addition to destroying the lives of about 60 percent of those who tread on them, landmines eat dirt that could be used for agriculture.

Finding humans willing to enter into a minefield and detect where bombs are is difficult. However, in Mozambique, rats are trained to do this risky job.

Rats have a keen nose for detecting land mines. They sniff out mines, indicate where they are and identify all the mines in the field.

It is a cruel thing, as most animal defenders might think. But, although the species used, the Giant Gambians, is known for its large size, the rats are still too light to activate the mines.



Equipped with a sort of collar designed specifically to guide them, two rats could analyze 100 square meters per day.

When they find the mines, they are rewarded with bananas.

They are being trained to detect landmines in Mozambique and Tanzania.

They are small and the weight is not enough to detonate mines.

A team with two rats can sweep over an area of



200 square meters in two hours, a human being would take a day to do the same.



They can directly assess 160 samples of the area suspected of containing anti-personnel mines in just 20 minutes, an exercise that man needs a day to do.

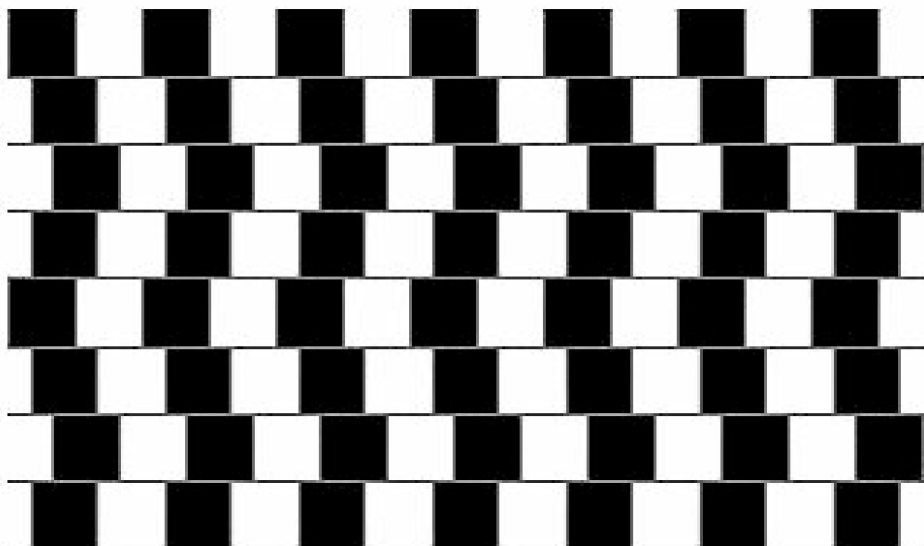
The photos show the demining teams in Mozambique, and deactivated mines.



Deactivated mines



Seventeen rats trained to detect explosive devices have been used in 2007 to remove landmines in Inhambane, southern Mozambique, a



Curiosity

The lines are parallel or not?