Scratch Jr tactile

Fabrication Guide

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Sistema THEAD (Barcelona, Spain)

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www.ScratchJrTactile.org

Imagine, create and share!

We would welcome comments and suggestions to improve this guide or translate it into other languages.

Upcoming updates:

The Scratch Jr Tactile kit and educational materials are constantly evolving as we work on continuous improvements. For this reason, the guide will be improved and modified. All updates, both to the guide and the archive, are available at the following link:

www.scratchjrtactile.org/create

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1. Introduction

In this guide you'll find everything you need to build your own Scratch Jr Tactile kit. The guide is divided into two parts: a first part with a complete list of the required materials and a second part with step-by-step instructions that you can follow.

What is Scratch Jr Tactile?

Scratch Jr Tactile is a kit inspired by the principles and philosophy of creativity. This inclusive educational resource is designed specifically for the youngest children, allowing them to play and learn while developing essential skills for today's society. These skills include digital skills, critical thinking, problem solving and teamwork, all of which are essential in the 21st century.

Although this resource is aimed at the very young, it has amazing potential. Older students can use this kit for classroom projects to design new items and explore advanced features using technology. This includes using technologies such as 3D printing, laser cutting and artificial intelligence. Through these experiences, they will not only develop digital skills but also gain knowledge relevant to the real world, such as product design, prototyping, teamwork and creating solutions to meet the needs of a diverse society.

In this way, Scratch Jr Tactile opens the door so that no one is left behind, providing opportunities for people of all ages and ability levels to learn and create, preparing them for a digital and dynamic future.

Make It, Design It, Learn It, Have Fun and... GIVE IT AWAY!

One of the best features of Scratch Jr Tactile is that... You can make it yourself! Creating Scratch Jr Tactile is a great Maker and STEAM project for the classroom, both for educators and students ages 10 and up. You will learn design and digital fabrication skills.

In this guide, we will accompany you step by step in the creation process. However, if you wish, you have the flexibility to modify the designs or use other materials at your disposal.

Once you've finished making the kit, you can make an inspiring gesture of solidarity. Find a preschool, primary or special education school, whether near or far, and give them the kit so that their students can fully enjoy it.

Who Created It?

Scratch Jr Tactile has been developed by **Sistema THEAD** with the collaboration of **Scratch Foundation of MIT Media Lab** and many more organizations, educational centers and people you will find in www.scratchjrtactile.org/about

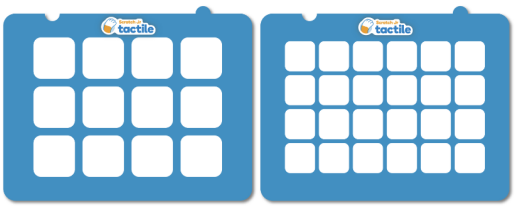
Warning: This kit contains small parts that are not recommended for children under 3 years of age.

Open Designs

All designs are free to access and modify. You can download all the necessary files in the following link:

www.scratchjrtactile.org/create

The formats used are the most common ones:

Boards • Format 2D vectorial .**SVG**	
Blocs • Format 2D vectorial .**SVG** • Format .**STL** three-dimensional	
Characters • Format .**STL** three-dimensional	

Recommended Design Software

You can use the program that best suits your needs to modify, customize or create new designs. However, if you want to use it in the classroom, we recommend using these free and easily accessible programs:

2D DESIGN

Inkscape

- Allows the editing of 2D designs (in vector format).
- Files are usually in .SVG format.
- You need to download and install it on your device.
- It's free and OpenSource.

https://inkscape.org

3D DESIGN

TinkerCAD

- It's 100% online. We recommend using a personal or educator account.
- All Scratch Jr Tactile characters have been created and are editable using TinkerCAD.
- It allows you to "remix" other people's designs.

www.tinkercad.com

SketchUp

- It's 100% online.
- It is a 3D design program that offers more advanced features, although it is more complex to learn.
- It has many free features and a version for educational use.

www.sketchup.com/plans-and-pricing/sketchup-free

Familiarize Yourself With the Core Design and Manufacturing Values of Scratch Jr Tactile

In the process of designing and manufacturing this kit, we carefully considered the following criteria, which we recommend following to ensure the best features in several areas:

- **VALUE 1 - Similarity with the app:** We designed Scratch Jr Tactile based on ScratchJr, with the aim of facilitating the transfer of knowledge acquired in the application, without the use of screens. We've selected the most popular and relevant blocks that would make the most sense in a tangible world. Also there are customizable blocks that will allow you to use more blocks from the app or to invent new actions.

- **VALUE 2 - Accessibility and universal design:** We have adapted the blocks so that they are easily recognizable by touch. The color contrast, sizes and thicknesses have been adjusted to increase accessibility. We have prioritized designs that can benefit the largest number of people with disabilities, promoting their inclusion and participation in learning through play. The blocks and the whole kit must be able to be used for people with various disabilities: visual, cognitive, motor... and also for all children, regardless of their abilities or conditions. We must not forget the visual and aesthetic aspect, as this makes it attractive to the majority of boys and girls.

- **VALUE 3 - Safety for child use:** We have ensured that the paints used comply with the UNE-EN 71-3 standard for children's toys. We have guaranteed that the objects have rounded corners and are not sharp, are durable and do not break easily, and that there are no small parts that can be accidentally ingested. We have also excluded the use of flammable materials.
  Warning: It is very important to follow the safety rules if you want children to use the kit.

- **VALUE 4 - Environmental sustainability:** As part of our commitment to the environment, we advise the use of ecological paints whenever possible. In addition, the kit has been designed to minimize the use of plastics and other slow-degrading materials. We propose the use of DM boards with PEFC certification, which provides a verified and independent guarantee that products with the PEFC label contain certified forest material from sustainably managed forests. In addition, we recommend the use of PLA coils for 3D printing, a biodegradable material made from natural organic compounds and is recyclable.

- **VALUE 5 - Durability:** We conceived the design with a long-term vision, with the intention of supporting continued use in the educational environment. To achieve this, we recommend using DM (fiberboard) boards instead of more fragile materials such as plywood.

With these considerations in mind, we aspire to create a kit that is not only educational and entertaining, but also safe, durable and respectful of our natural environment.

2. List of Tools and Materials

Thanks to digital fabrication technologies, we can now transform virtual designs into physical items, relatively quickly and affordably. The digital fabrication tools we recommend are widely used and can be found in Makerspaces, institutes, schools, innovative companies, collaborative spaces and even in the homes of hobbyists.

Laser cutting machine	Impressora 3D
	
It cuts sheets of cardboard, wood or methacrylate (less than 5-8 mm) using a powerful laser. You can also use it to make engravings. It cuts surfaces in a matter of minutes. The most common cut size is between 30 x 50 cm and 60 x 80 cm.	It prints objects in 3D using plastic-like material. The most common are filament (FDM) or resin (SLA). PLA filament is biodegradable, resistant and easy to use. The most common printing surface is 21 x 21 cm, or smaller.

Below, we present the complete list of **materials** needed to create a **COMPLETE KIT**.

Materials for the laser cutting boards

Material	quantity	What	Examples
FOR THE BOARDS:			
3mm thick DM board	**1**	**33 x 50 cm approx.**	link
Blue paint	**1**	**250 ml**	link
Satin varnish (optional)	**1**	**250 ml**	link
FOR BOARD BASES:			
3mm thick white DM board	**1**	**33 x 50 cm approx.**	link
b1) Round Velcros	**6**	**10mm rounds approx.**	link
Or			
b2) Round magnets with a diameter of 8 mm	**12**	**1mm thick**	link
	12	**2mm thick**	link
b2) Extra strong glue (in gel)	**1**	**1 small tub**	link
One: - Small roll of flake - Paint tray - Humid rag	**1** **1** **1**	**11 cm approx.**	link link

Materials for coding blocks with laser cut

Material	quantity	What	Examples
3mm thick DM wood board (middle layer)	**1**	**45 x 50 cm**	link
3mm thick DM wood board (bottom layer)	**1**	**45 x 50 cm**	link
4mm thick DM wooden board, **white** (icons)	**1**	**20 x 40 cm**	link
4mm black methacrylate	**1**	**5 x 10 cm**	link
Blue, green, purple, yellow, gray/black, red, orange paint.	**8 colors**	**125 ml or less of each color**	link
Satin varnish (optional)	**1**	**250 ml or less**	link
White glue	**1**	**250 ml or less**	link
Superglue	**1**	**1 tube**	link
Tools: - Small flock foam roller - Paint tray - Small/medium brush - White glue brush (optional) - Humid rag	 **1** **1** **1** **1** **1**	**10 cm approx.**	 link link link link

Materials for coding blocks with 3D printing

Material	quantity	What	Examples
PLA filament spools - Blue - Red - Yellow - Green - Purple - Orange	**1 of each color**	**approx. 200 gr of PLA filament is enough to make a complete kit**	link
Option 1: Color changes with PLA - White - Dark gray or black - Green	**1 of each color**	**approx. 30 grams of filament**	link
Option 2: Paint the icons - Paint for miniatures: white, black	**Several**	**125 ml or less of each color**	link
Tools: - Small brushes			link

Materials for characters with 3D printing

Material	quantity	What	recommendation
PLA filament spools - White - Or various colors (orange, light blue, white, green, black...)	**1**	**150 gr of PLA filament is enough to make a basic kit**	link
Paint for the miniatures: white, black, green... Or any color that you want.	**Several**	**125 ml or less of each color**	link
Tools: - Small brushes for miniatures - Humid rag	**1 set of brushes** **1**		link

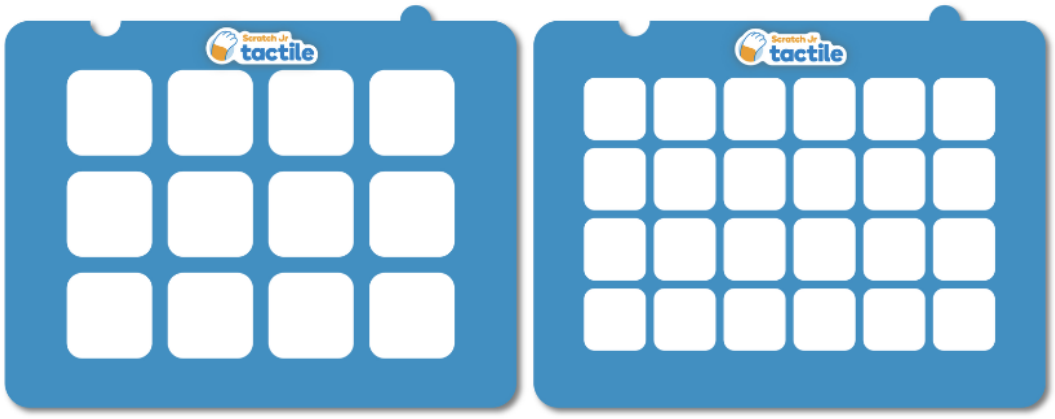
The Time Has Come...

To Start Creating

Continue with the creating guide:

"MAKER"

3. Make the Boards



To ensure accessibility for all students, it is recommended that the boards are 100% tangible, especially for students with severe visual or motor impairment. This means that the boards must be thick enough to be perceived by touch.

The boards were designed for use on paper and are compatible with the two most common paper formats:

- **A4 size** (more common in Europe and other regions)
- **US Letter paper size** (more common in America and other regions)

We suggest using DM boards of 3 mm of thickness.

- Technical characteristics:
  - 1 board 3x4 - 33 x 25.8 cm
  - 1 board 4x6 - 33 x 25.8 cm
  - 2 bases for the boards 33 x 25.8 cm.

The current design consists of two parts: the board (the upper part) and the base (the lower part). If you prefer, it is sufficient to make only the board, as the base is not necessary to be able to play. However, the base has the advantage of improving the stability of the paper sheets, which makes it easier for people with different types of disabilities to use them independently.

Part A - Boards

There are two levels of difficulty:

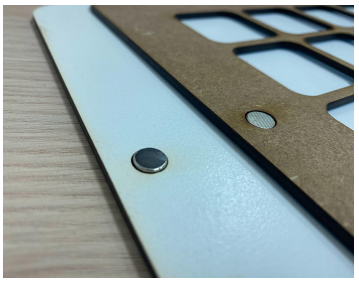
3x4

4x6

Part B - Board base (optional)

This base can be attached using velcro or magnets.

If you decide to create the base, first select the connection mode. If you do it with magnets (see section B2). You can use the dashboard file without any modification to get this result:



If, on the other hand, you choose to connect with Velcro (see section B1), remember to remove the engraving of the magnets that you will find in the archive.

Part A) Boards

Materials for one kit:

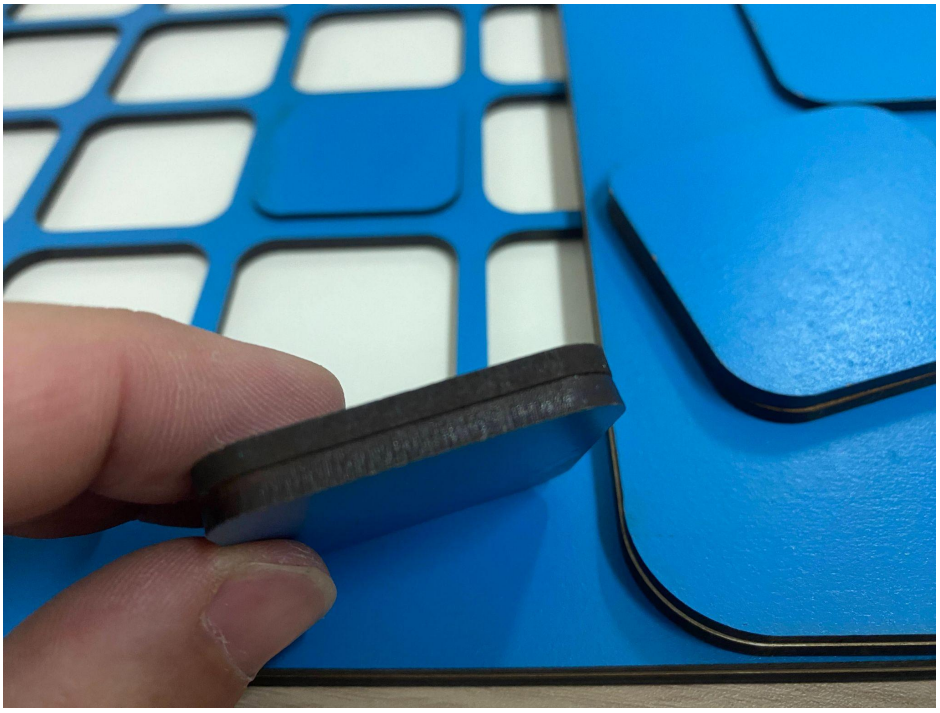
3mm DM wood board (minimum size of the kit is 33 x 50 cm) Each board in the kit is 33 x 25.8cm.	
Blue paint certified for use in toys	
Transparent varnish certified for use in toys	
Small flock foam roller	
Paint tray	

Process:

- **STEP 1:** Paint one side of the board and wait until it is completely dry.
- **STEP 2:** Apply a coat of varnish to the same side of the board you painted and wait again until it is dry.
- **STEP 3:** Download the board's file with the cutting pattern for your laser cutting machine.

- **STEP 4:** Place the board in the laser cutting machine, painted side down, and start cutting.
- **STEP 5:** Use a damp cloth to wipe off any smoke residue on the board.

IMPORTANT: Don't forget to collect the cut-out square pieces, because you can use them as obstacles during the game.



Part B1) Board Base With Velcro (Optional)

Materials for one kit:

3mm white DM wood board (Minimum size of the kit is 33 x 50 cm) Each board in the kit is 33 x 25.8cm.	
Adhesive round Velcros	

Process:

- **STEP 1:** Download the 2D file of the boards to use them on your laser cutting machine and remove the engraving from the magnets
- **STEP 2:** Place the DM board in the laser cutting machine with the white side facing up and start the cutting process.
- **STEP 3:** Use a damp cloth to wipe off any smoke residue on the board.
- **STEP 4:** Attach two Velcro fasteners to the ends of the two long sides and one Velcro fastener to the ends of the two short sides.

Part B2) Board Base With Magnets (Optional)

Materials for one kit:

3mm white DM board (Minimum size of 40 x 55 cm for a board.)	
Magnet (8mm in diameter)	
Superglue Preferably the gel type.	

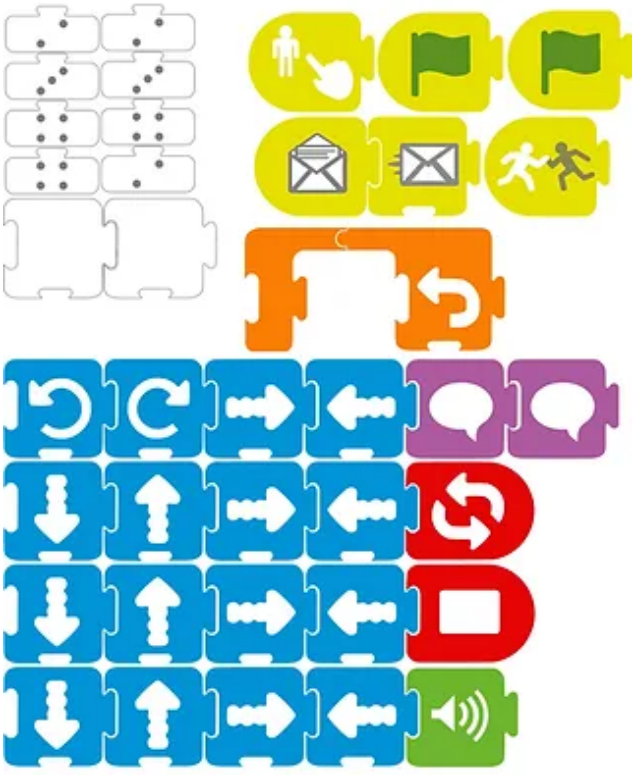
Process:

- **STEP 1:** Download the board's file with the cutting pattern for your laser cutting machine.
- **STEP 2:** Insert the DM board white side up into the laser cutting machine and start the laser cutting process.
- **STEP 3:** Use a damp cloth to wipe off any smoke residue on the board.
- **STEP 4**: Glue the magnets into the circles on both sides of the boards using the superglue. Place the 1 mm magnets on the board and the 2 mm magnets on the base.

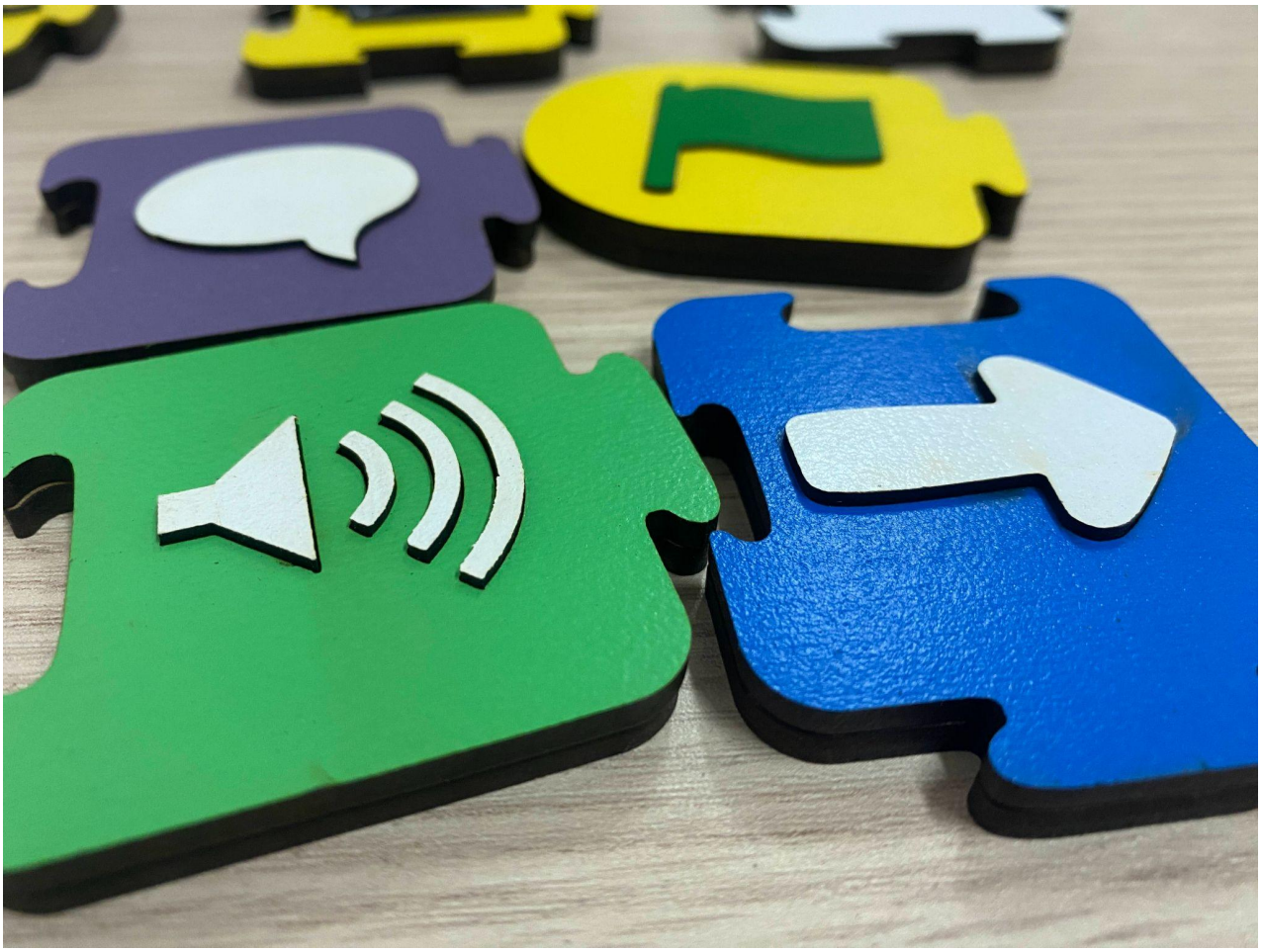
4. Make the Coding Blocks

To ensure accessibility for all students, it is recommended that the blocks are provided with tangible icons. Therefore, the icons must protrude 1 mm from the surface of the blocks. They should also have high-contrast colors and not be too bright.

The coding blocks can be created in two different ways. The first way is to use a laser cutting machine, while the second way is to use a 3D printer. Below you will find the description of both methods.



Blocks With Laser Cut



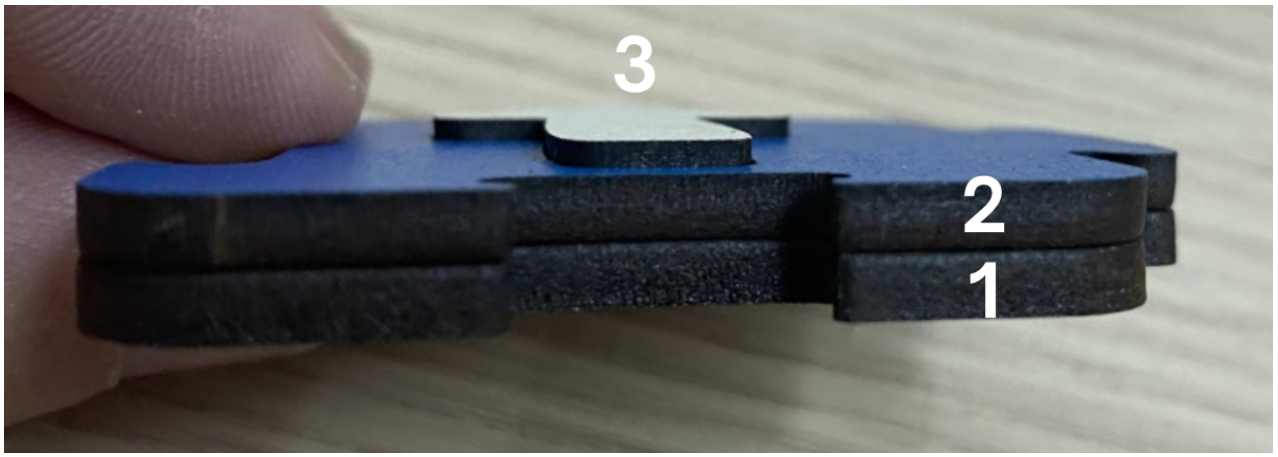
Materials for one kit:

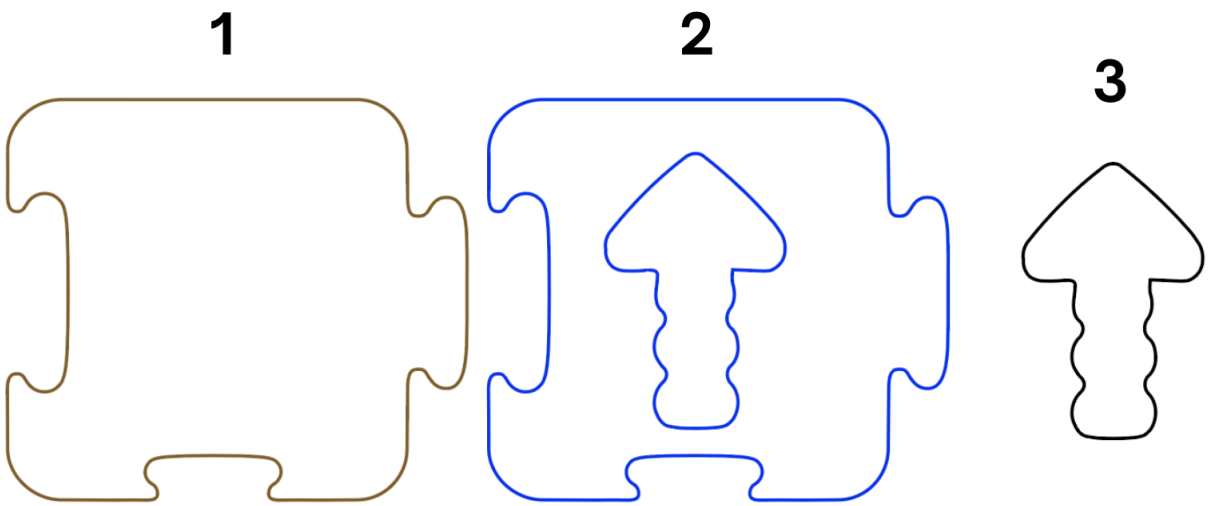
A 3mm DM board (Minimum size of 70 x 50 cm)	
A 4mm DM board (Minimum size of 20 x 30 cm for the icons)	

A 4mm black methacrylate (Measures approx. 10 x 5 cm)	
Paints certified for use in toys.	
Transparent varnish certified for use in toys.	
Small flock foam roller	
Paint tray	
Extra strong glue Preferably the gel type.	

For the icons to be tactile, they must protrude about 1 mm from the surface of the block. It is recommended to make the blocks with 3 layers:

- **Layer 1:** the base of the 3mm pad (not painted)
- **Layer 2:** the block with the hole for the 3mm icon (painted)
- **Layer 3:** the 4mm icon (white)

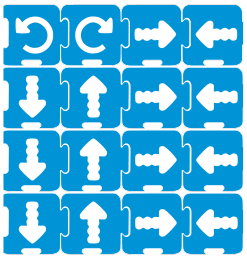
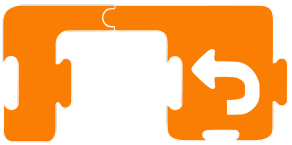
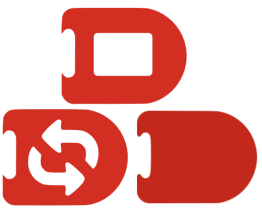


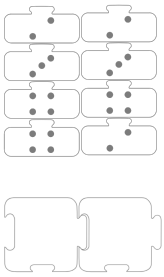


This ensures great durability.

Process:

- **STEP 1:** First download the SVG block file that you can use with your laser cutting machine (to download, click on the link ww.scratchjrtactile.org/ca/create)
- **STEP 2:** Paint some 3mm DM boards in the different colors of the blocks with the flock roller (the total painted area is approx. 35 x 40cm).

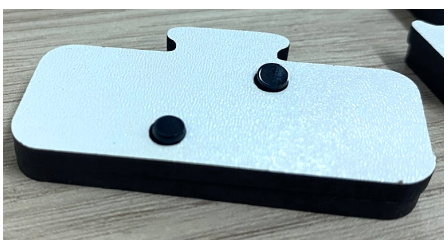
TYPES OF BLOCKS	COLOR	IMAGE
Event blocks	Yellow	
Movement blocks	Blue	
Sound blocks	Green	
Appearance blocks	Purple	
Repetition	Orange	
Completion blocks	Red	

Counters and customizable blocks	White	

Notice that some blocks have a green or gray icon instead of white.

- **STEP 3:** Apply a coat of varnish to the painted boards. This makes it easier to clean the smoke after cutting and protects it.
- **STEP 4:** Modify the SVG file to keep the icons you need each time. Once you have created the file, insert a DM board into your laser cutting machine and start the cutting process.
    - Cut the bases (1) without color, 3mm.
    - Cut the central layer (2), the 3mm colored blocks.
    - Cut the icons (3), with DM of 4mm.
    - Cut the black dots with 4mm black methacrylate.
- **STEP 5:** Use a damp cloth to clean the smoke residue from the parts.
- **STEP 6:** Connect the lower parts to the upper parts and the icons with white glue. To increase adhesion, you can apply pressure with clothespins for about 5 minutes.
- **STEP 7:** The tips of the counter blocks are made of methacrylate to ensure better durability. Connect them with extra strong glue.

You can also paint the pieces after cutting them, but painting them beforehand will give the finished blocks a more uniform look. Expected result:

Blocks Using 3D Printer

Materials for one kit:

PLA filament (200 gr of filament is enough to make one complete kit) <u>Option 1: Color changes with PLA</u> Spools of PLA filament in various colors (blue, red, yellow, green, purple, orange)	 
<u>Option 2: Paint the icons or blocks</u> **Paints certified for use in toys.** (white, green, dark gray) **Small brushes**	 

There are two ways to get the blocks in color with 3D printing.

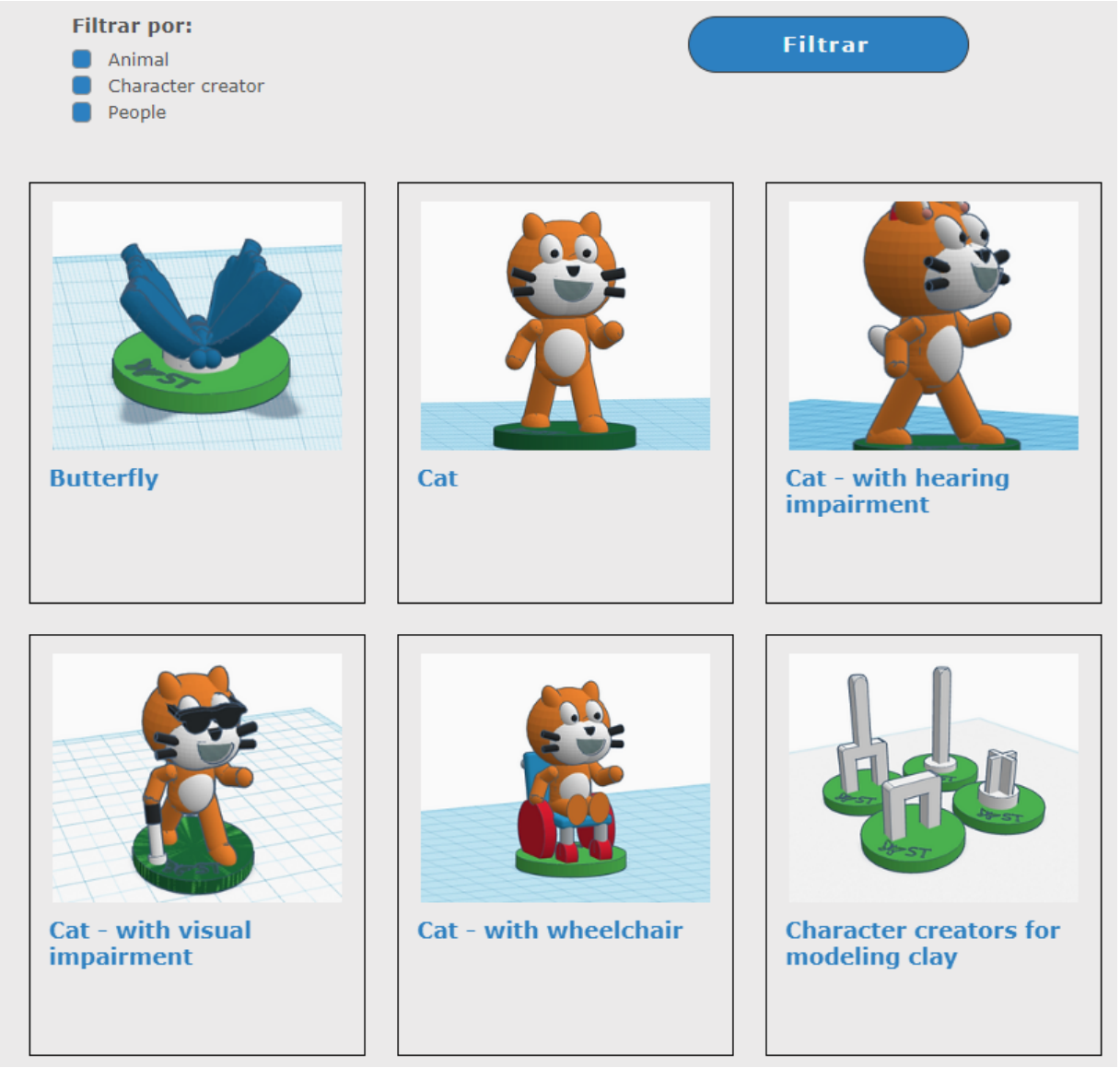
- **Option 1: Color changes with PLA**
  - With most 3D printers, you can stop printing at a certain layer, change the filament and continue printing with a different color.
  - If your printer allows this, it usually uses the M600 command in the .gcode file or it can be configured with your laminating software.
  - From a height of 6 mm, carry out a filament change to print the blocks directly in multiple colors.
  - For this you need PLA filament for the icons: mostly white, but also dark gray or black and green.
- **Option 2: Paint the icons or blocks**
  - You can print all the blocks in the same color and then paint them.
  - Another option is to print the blocks in the corresponding colors and then paint the icons with white, dark gray or green.

Process:

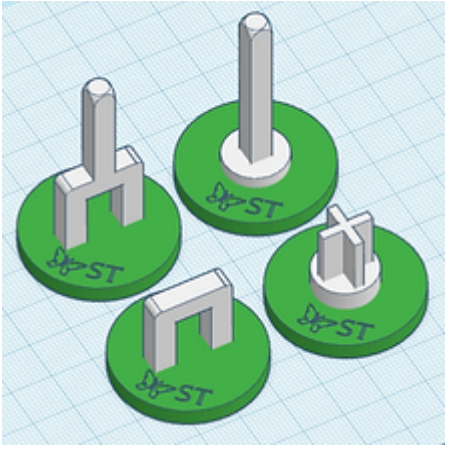
- **STEP 1:** Start by going to www.scratchjrtactile.org/create and opening the 3D file of the blocks in TinkerCAD.
- **STEP 2:** Prepare and select the blocks you want to print. Then export them to download the file in .STL format, the common format for 3D printers.
- **STEP 3:** Convert the file to .gcode format using your favorite slicer software. If you are using PLA, it is better not to heat the printer bed; instead, you can use lacquer to bond the pieces during the printing process.
- **STEP 4:** Load filament and calibrate your 3D printer to ensure an accurate print.
- **STEP 5:** Start the printing process and watch the start of the process carefully.
- **STEP 6:** Carefully remove the pieces from the printer bed.
- **STEP 7:** Paint the pieces with the appropriate color and let them dry.

5. Make the Characters

It is recommended to make the characters three-dimensional and use high-contrast colors to ensure accessibility for all students, including those with severe visual impairments or visual disorders.



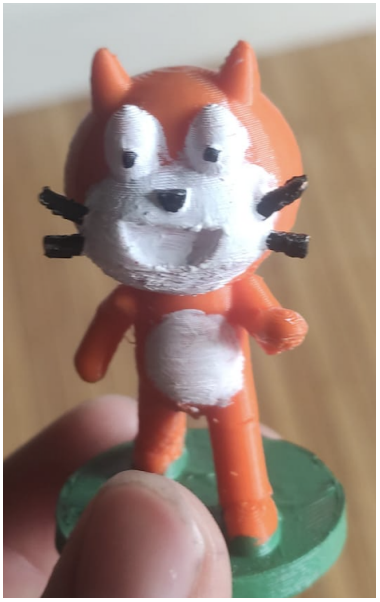
Alternatively, you can also use toys, figures, animals or even natural elements such as stones or leaves to represent the characters in the game.



You will also find the 4 “character creator supports”, so you can easily create them with play dough or clay.

- **STEP 1:** Go to www.scratchjrtactile.org/characters and download the TinkerCAD file in .STL format.
- **STEP 2:** Convert the file to .gcode with your laminating program. Check that the supports are being generated correctly.
- **STEP 3:** Insert the PLA filament into the 3D printer and then calibrate it. You can use lacquer to ensure good adhesion to the base.
- **STEP 4:** Start printing.
- **STEP 5:** Use suitable tools to carefully remove the figure from the printer bed.
- **STEP 6:** If necessary, remove the supports or file the surfaces to improve the finish.

- **STEP 7:** Paint them with the appropriate color and let them dry.

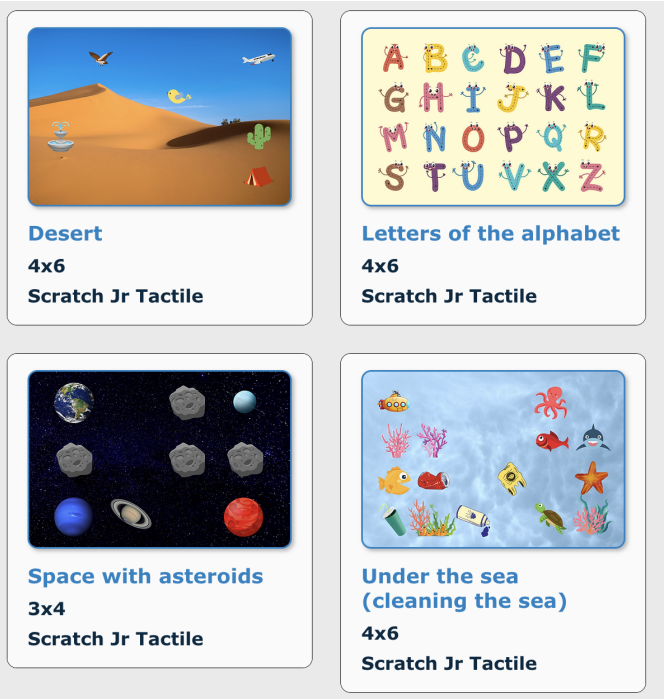


It is important to follow the safety instructions for both the 3D printer and the laser cutter and handle the finished parts with care to avoid damage.

6. Other Elements

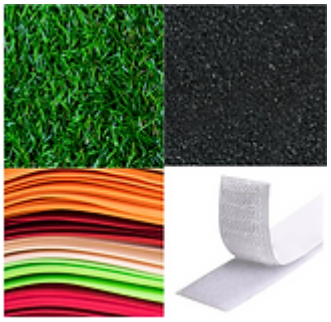
Background

Create backgrounds by drawing or painting by hand. You can also download, design, print and share backgrounds at the following link: www.scratchjrtactile.org/backgrounds.
Remember that the boards are adapted for use with A4 paper and US letter.



Tactile Elements

Incorporate tactile elements with different textures to cut and paste or natural objects to create a variety of activities that are not only fun but also more accessible for people who are blind or visually impaired.



Whether you have students with a visual impairment in your class or not, elements from the environment or recycled materials are very useful to create new tactile experiences and activities.

Eye Mask

You can use the eye mask to carry out activities with your pupils without visual impairment to raise awareness of visual impairment.

They can start each activity by covering their eyes and trying to recognize the different blocks and characters.

Are you able to create or program your project without seeing?
In this way, you can put your students in the perspective of a visually impaired person and help them develop empathy for the difficulties these people face.

Congratulations, you've reached the end of the guide.

Thanks for being part of the community of

Scratch Jr Tactile !!!

For more information and resources, vist:

www.scratchjrtactile.org

To access classroom teaching material in virtual book format:

SCRATCH JR TACTILE DAY ESP

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