
Tinkering: Addressing the Adults

Tinkering Activity Plans





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TRACES

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The photos included in this document in the Tinkering activity plan section are from the activities carried out in collaboration between the partner institutions and the local partners.

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Introduction

Project context

These activity plans are based on work taking place through the Erasmus-funded “Tinkering EU: Addressing the adults” project¹. This project aims to target adult learners with a focus on inclusive and equitable ‘Adult Learning and Education’ (ALE). It is reaching out to adults who may not currently identify with STEM learning, who have relatively low levels of confidence with STEM and who are less likely to choose to participate in science-related social, cultural or training opportunities. In this way, the project is targeting adults who are likely to have low levels of ‘science capital’ (Archer, Dawson, DeWitt, Godec, et al. 2015; Archer, Dawson, DeWitt, Seakins, et al. 2015), that is, people who may feel a disconnect with STEM and who may have little or no personal experiences, relationship, or interest with it. The project emerges from the following challenges facing contemporary global society:

- ▶ Widespread disengagement with science for many people across Europe
- ▶ An increasing generational skills and competencies-gap in relation to technology and science
- ▶ Increasing demand for highly developed 21st century skills for individuals to participate effectively in civic and social life.
- ▶ Low levels of science capital amongst communities underserved and underrepresented by the informal STEM learning sector

Co-design

A process of co-design has underpinned the development phase of the project. The partner institutions have collaborated with local partners already connected with and working in the community with the project’s target adult groups. Through partnership work between these institutions, cross-sector learning has been nurtured. The community sector organisations brought deep insights around the experiences, values, needs, motivations and wishes of the target groups

while the science learning organisations brought expertise relating to Tinkering as a means of engaging diverse audiences with STEM learning. The project has brought together these different organisations to help support, extend, and enhance their existing community engagement practice through exchange of knowledge and expertise. The science learning institutions and community partners have worked closely with each other to explore ideas, themes and processes, in order to develop and deliver high-quality learning opportunities that have been tailored to the needs, interests, values and wishes of the target group(s):

Copernicus partnered with the Foundation **W securu Matki** (Mother’s Heart) while developing the Tinkering activities *Building cardboard furniture* and *Home garden*.

- Foundation W securu Matki (Mother’s Heart) is a non-profit organization/social inclusion charity which supports adults and families facing social or economic difficulty through educational and cultural activities, healthcare and health promotion and social assistance.

MUST partners with **Caritas Ambrosiana** while adapting the Tinkering activities *Light Play* and *Chain reaction*.

Caritas Ambrosiana is a philanthropic organisation associated with the Catholic Church in Milan. It operates through and coordinates a network of local associations, carries out a range of initiatives to support people with social, health, community and welfare needs. In the project MUST is working with two local associations embedded in the network of Caritas, which are both active in local/community contexts:

- **Progetto Periferie e Parrocchie** aims to create and implement strategies to develop active citizenship in the periphery, exploiting the social function of the parish and its educators.
- **QuBi Villapizzone** implements social actions with positive fallout for the citizens of Villapizzone (suburban

¹ Tinkering EU: Addressing the Adults. (2019-1-NL01-KA204-060251), funded with support from the Erasmus+ Programme of the European Union. www.museoscienza.it/tinkering-eu3/

area northwest of Milan), with a specific focus on families and youngsters, trying to meet the needs of the younger generations and their families and the civic heed of the suburb as well.

NEMO Science Museum partnered with **Vrouwen Vooruit**, **Stichting Studiezalen** and **Tinkersjop** while developing the Tinkering activities *Interweaving and Send a message*.

- **Stichting Vrouwen Vooruit** is a non-profit organization, they aim to reach and support women (especially immigrant) from Amsterdam West and the surrounding area to participate (more) in society, so that they can (continue to) take steps forward in their emancipation, integration and development process.
- **Stichting Studiezalen** is a non-profit organization in Amsterdam. They seek to reach children, youngsters and adults and help them forward through a combination of Life Coaching, homework support and talent development, they offer a tailor-made approach.
- **Tinkersjop** is an organisation in Curaçao working with families, schools and adults to get them acquainted with STEM and give them the opportunity to develop knowledge and skills.

ScienceCenter-Network partnered with **Peregrina** and **PROSA** while developing the Tinkering activity *Dyeing with natural materials* and adjusting the activity *Wishcards*.

- **Peregrina** is a counselling centre for migrant women aged 16 and older. They offer advice and information in legal as well as social matters and help with all questions concerning careers and education. Peregrina offers German language courses for levels A1+ to B1 as well as basic education courses.
- **PROSA** offers basic and compulsory schooling courses for young refugees aged 15 and over. In addition to the courses, counselling by social workers and tutoring support by volunteers is offered.

TRACES partnered with **Service Pénitentiaire d'Insertion et de Probation** (SPIP) du Val de Marne and **Espace Dynamique d'Insertion Césame** while developing the Tinkering activities *Popping Balloons and Tinkering with Sound* and adjusting the activity *Dismantling and merging electronic toys*.

- **Service Pénitentiaire d'Insertion et de Probation** (SPIP) du Val de Marne is a public service that is in charge of giving access to culture and training to inmates in the Val de Marne French region. The targeted group are detainees from the Melun detention center, all men, in long-term detention, average age 45 years.
- **Espace Dynamique d'Insertion Césame**. It is a place of training, experimenting and exploring for youngsters (16-25 years old) in an underserved neighbourhood in Paris to help them build a better professional and social future. The targeted group are young adults that dropped out of studies and professional world in research for a new professional project.

Upskilling Pathway Agenda

An overarching aim of the project is to support the current European agenda of widening participation in adult education and lifelong learning. During the development phase of the project, the partner institutions have reflected on the co-design process they undertook and how it connects with the EC Upskilling Pathway Agenda.

The EC Upskilling Pathway Agenda is a three-step framework to help widen access and participation in relation to quality learning opportunities for adults with low levels of skills:

- **Step 1 – Skills assessment** to enable adults to identify their existing skills and any needs for upskilling. It may take the form of a “skills audit”: a statement of the individual’s skills that can be the basis for planning a tailored offer of learning.
- **Step 2 – A learning offer** of education and training meeting the needs identified by the skills assessment. The offer should aim to boost literacy, numeracy

or digital skills or allow progress towards higher qualifications aligned to labour market needs.

- **Step 3 – Validation and recognition** in which the adult learner has the opportunity to have the skills they have acquired validated and recognised.

In this project, the co-design process has incorporated the key elements of the first two steps of the Upskilling Pathways Agenda. Through a series of meetings, workshops and small-scale training events, the partner institutions and the community partners have been able to identify knowledge and skill development areas for the adult learners. This informed the type of Tinkering activity chosen and how it could be tweaked or redesigned to support learning and development in those areas.

Example case: *Traces* collaborating with *Service Pénitenciaire d’Insertion et de Probation du val de Marne (SPIP77)*

We held meetings, online and in person, to co-design the activity with the team at SPIP77. During these meetings, we took the time to listen and absorb the ideas of the community partners. We consciously answered and asked questions as opposed to suggesting ideas for workshop activities. The result was that we were much more confident that we would be offering a relevant activity for the target audience which met with their interests as well as developed skills which the SPIP77 team knew would be useful. The SPIP77 team became very familiar with the detail of the workshop because of their deep involvement in its design. They were therefore able to talk about the activity more clearly with the prison inmates who subsequently had clear expectations of what they were going to do and achieve in terms of their learning.

“The SPIP77 staff could afford to take risks in imagining and suggesting activities for their clients as they were confident our TRACES team would know how to adapt their ideas. They loved working and designing in this frame as, usually, they do not have the time and opportunity to be this creative.”

Example case: *NEMO* collaborating with *Stichting Vrouwen Vooruit*

Staff at Stichting Vrouwen Vooruit were positive about the two-way communication in which they felt taken seriously. Through the co-design process they became familiar with the Tinkering methodology. They understood that it focusses on the learning path of the participant (rather than on what the facilitator wants to achieve), as well as on valuing the knowledge and experiences of the participants. This really resonated with their vision of how they work with their clients. They liked the fact that Tinkering would address the same skills they aim to develop in their regular talking-based programs (self-esteem, language skills, perseverance etc.). But they also valued the fact that the Tinkering workshops were hands-on and addressed STEM, so their clients developed skills in a different context and in new ways.

“I do not think we would have developed a tinkering activity about weaving had we not co-designed with Stichting Vrouwen Vooruit, which better enabled us to meet the interests and skill requirements of their clients. Stichting Vrouwen Vooruit strongly influenced the subject choice and materials for the session design, as well as the learning outcomes for the participants”.

Step 3 of the Upskilling Pathways Agenda ('Validation and Recognition') is being addressed through the process of reflection that is an integral part of the Tinkering activities and their facilitation. The adult participants are encouraged to reflect on what they have learned and achieved in relation to the Tinkering process through questions that help them to explore skills that have been used e.g. 'What problems did you encounter in this activity?', 'How did you overcome them?', 'What have you learned?'. The facilitator connects these skills to STEM content and subjects and the process the participants have gone through during the activity. Participants in the later phase of the project will be given a certificate, validated by the partner organisation in recognition of their participation in the STEM workshop (appendix 1).

Tinkering: developing inclusive workshops for adult learners

Tinkering is an innovative pedagogy pioneered by the Tinkering Studio of Exploratorium of San Francisco. It supports the construction of knowledge within the context of building personally meaningful objects and experiences. It designs opportunities for people to "think with their hands" in order to construct meaning and understanding and develops skills useful for a lifetime. Over the last decade, Tinkering has gained international recognition as a powerful, motivational, and engaging approach for developing STEM learning and building 21st Century Skills (Anzivino and Wilkinson 2012; Bevan et al. 2015; Petrich, Wilkinson, and Bevan 2013; Ryoo and Barton 2018; Vossoughi et al. 2013; Vossoughi and Bevan 2014; Wilkinson and Petrich 2014). Highly personalised, learner-centred and freed from the constraints of formal scientific language, Tinkering is increasingly being adopted by a wide-range of informal STEM learning organisations to help engage diverse audiences across a range of education settings – both formal and informal (Barajas-López and Bang 2018; Barton, Tan, and Greenberg 2016; Fields et al. 2018; Lee and Worsley 2019; Martin, Dixon, and Betser 2018).

In the development phase of the project 11 Tinkering activities were selected to be developed and/or adjusted for the different adult target groups. With their community partner organisations, the science learning institutions explored how the chosen Tinkering activities could support adult learning and engagement with close reference to the Learning Dimensions Framework developed by the Tinkering Studio (appendix 2). Using insights gained from an awareness of science capital teaching and learning theory the science learning institutions sought to better understand the needs of the target groups in relation to learning and skill acquisition while, at the same time, better valuing and connecting with the varied and diverse experiences, interests, and skills the adults already possessed. According to the Science Capital Teaching Approach (Godec, King & Archer, 2017), this is important for broadening what counts as science learning, creating learning opportunities that are relatable and relevant and that therefore help the learner feel that the STEM learning content is 'for them'. This was enabled through the process of co-design work with the community partner organisations and has led to the creation of Tinkering learning workshops that:

1. Are relevant, interesting, and engaging for the adults because they are based on things that are already of interest to and relevance for the adult learners.
2. Introduce new knowledge and skills to maximise learning opportunities and meet their needs in this area.

Example case: *ScienceCenter-Network* collaborating with *Peregrina*

We knew that the age range of participants was diverse – with most women aged between 20 and 45 but some also over 60. We learned that the German proficiency level would vary within the target group, so the

Tinkering activity selected for the workshops should not require complex explanations in German.

“From the early start of the collaboration, discussions with Peregrina involved thoughts about combining Tinkering with language learning and practice and putting a specific focus on empowerment and confidence building during the workshops.”

From the beginning, our community partner shared the opinion that the target group would prefer an output-oriented activity. Ideally the activity would lead to an object or experience the participants can be proud of, which they would later share with family and friends as well as have feelings of empowerment by trying out new skills. Our partners believed that the women would prefer putting things together over taking things apart and that it would be nice if they had something to show at the end of it. Together with our community partner, we discussed what kind of Tinkering activities were suitable for the target group and would meet their interests as well as the jointly formulated goals for the

collaboration (such as: the activity should induce feelings of empowerment). Another criterion for the activity design was that it should be possible to easily integrate the activity into Peregrina’s general educational program in the long run. We conducted two R&D sessions, one of them facilitated by consultants from the Tinkering Studio.

As a result, a completely new Tinkering activity was developed: Dyeing with natural materials. In the workshop the participants tried various dyeing techniques like shibori, batik & tie-dye to create their own designs. The end result was open with possibilities for the participants to dye fabrics that they brought with them or fabrics that we brought for their common rooms or as personal items. After they saw the results for their first pieces they could iterate and dye more pieces of fabric. There were also possibilities for them to include and share their own techniques during the workshop. We used conventional dyes as well as natural dyes such as hibiscus and turmeric to incorporate elements of PH levels and colour theory.

“Dyeing with natural materials” was particularly very well received by Peregrina’s clients. Our facilitators were impressed by the participant’s high skill levels and learned a range of new techniques from them. Instead of being a classical workshop format (on the one hand the “expert facilitator” and on the other hand the “participant learner”) the entire workshop was a collaboration on eye-level, facilitators and participants working side by side and learning from each other.”

Example case: Copernicus collaborating with ‘In the heart of the Mother’ Foundation

During our co-design phase, staff at *In the heart of the Mother* Foundation collated themes that they thought might interest their adult clients. The theme of ‘home’ emerged as important because the adults were in a lockdown situation with their families due to the pandemic, many restricted to their homes, and some of whom were finding this quite challenging. We sent the adults a survey to help ascertain more information about what they were interested in. The participants, mainly females and mothers, showed preferences for art and crafts, ‘greening’ their spaces and home interior design and decorating. We then designed different options for Tinkering activities that would align with these interests and consulted with the community leader staff at *In the heart of the Mother* to guide final decisions. The final activity

design comprised designing and making furniture from recycled cardboard material using a range of joining techniques. The activity developed skills in design, prototyping and making. It utilised low-cost, readily available material so that the families, who are on low incomes with limited access to resources, could continue to use the ideas, techniques, and skills developed in the workshop at home beyond the project. There was an emphasis on techniques that could work for all ages as well as encourage intergenerational cooperation and learning to involve all of the family.

“From the very beginning, we wanted the workshops to be tailored to the interests of the target group”.

All the pilot phase activities were tested with their target group by the partner institutions in collaboration with their local community partners. During the development and testing phase, a set of observation and reflection tools were also developed and piloted which aimed to:

1. Support the community partner organisations to develop their understanding of the potential applications and benefits of Tinkering pedagogy for the groups that they work with
2. Help the science learning institutions and the community partner organisations to reflect on the process of co-design and share learnings from this that could be taken forward for their future community engagement practice.
3. Gather some information from the adult learners in a light-touch way that could serve to give some indications as to what they most valued and what they learned from taking part.

These observation and reflection tools can be found at www.museoscienza.it/tinkering-eu3/

Activity plans

Tinkering activities

Facilitation Tips

Facilitation of Tinkering activities is an important aspect of the activity design and delivery when working with adult groups along with how you prepare and display the materials and tools. In advance of planning your session, we suggest you look at the 'Facilitation Field Guide' developed by the Tinkering Studio and included in appendix 3. You could also refer to the Practitioner Guide for Developing and Implementing Tinkering Activities.

Facilitation Field Guide:

www.exploratorium.edu/sites/default/files/files/facilitation_field_guide.pdf

Practitioner Guide for Developing and Implementing Tinkering Activities:

www.museoscienza.it/tinkering-eu/download/Tinkering-A-practitioner-guide.pdf

Activity plan

Building cardboard furniture

Copernicus Science Centre

Audience	Adults
Format	Workshop
Duration	120 minutes
Staffing	1-2 facilitators
Participant grouping	Individual or groups of 2-3 participants

Outline

The aim of the workshop is to build small home furniture like shelves, nightstands, tables, using cardboard. During the activity, participants test their ideas to create a piece of furniture that meets their specific needs. In addition, they use cheap, easy to craft and affordable material such as cardboard. A secondary goal of the workshop is to show that you can create meaningful objects using recycled materials (upcycling). At the end of the workshop each participant has a piece of furniture that can be used at their homes.



Room preparation

Regular tables and chairs for the participants will be needed to conduct the workshop. It is also worth considering securing the tables against possible damage, for example with a knife. Access to an electrical outlet is required if hot glue is to be used.

Health and safety

Hazard	Controls
Cut with a knife or scissors. Burn with hot glue.	There is a certain risk of injury (i.e. burns, cuts) during the workshop. Pay attention to the way participants are using the tools. Have a first aid kit with the equipment needed to treat a possible wound.

Essential materials

Item	Comment	Total
Cardboard	Cardboard is the basic construction material during the workshop. Buy new cardboard sheets or collect empty packages boxes.	The total number of cardboard sheets very much depends on the projects that the participants will implement. However, it can be assumed that a minimum of 2-3 large cardboard boxes per participant is needed.
Tape		1 per person

Essential tools

Item	Comment	Total
Utility knife		1 per person
Scissors		1 per person
Hot glue gun		1 per 1-2 persons

Preparing materials in advance

- Before the workshop, it is enough to prepare only the tools and materials on the tables.
- If you do not want to buy ready-made cardboard sheets, start collecting empty cardboard boxes a few days or weeks before the workshop.
- We advise to prepare some ready examples of cardboard furniture as an inspiration for the participants.

Introducing the activity

During the introduction to activity, focus on two things.

- First, conduct a short tutorial showing how to safely cut, process and join cardboard elements using tools such as scissors, knife, hot glue gun, tape, etc. Explain how to use the properties of cardboard to your advantage so that the resulting object is durable and rigid.
- Secondly, show various inspirations for small pieces of furniture made of cardboard, such as shelves, cabinets or tables.

Managing the activity once it is in progress

The main task of the facilitator during the workshop is to help participants implement their idea of building a piece of furniture that meets their needs.

- The facilitator answers the participants' questions on an ongoing basis and helps them solve technical and design problems.
- The activity has been designed to use only very simple tools and materials. Thanks to this, even people without manual skills should easily cope with the construction of cardboard objects. However, it may happen that one of the participants may require technical assistance, e.g. with the use of tools or a combination of cardboard elements.
- The tools used during this activity are not dangerous, but it is worth paying attention to the safety of participants, especially those who use a knife when cutting cardboard or working with hot glue.

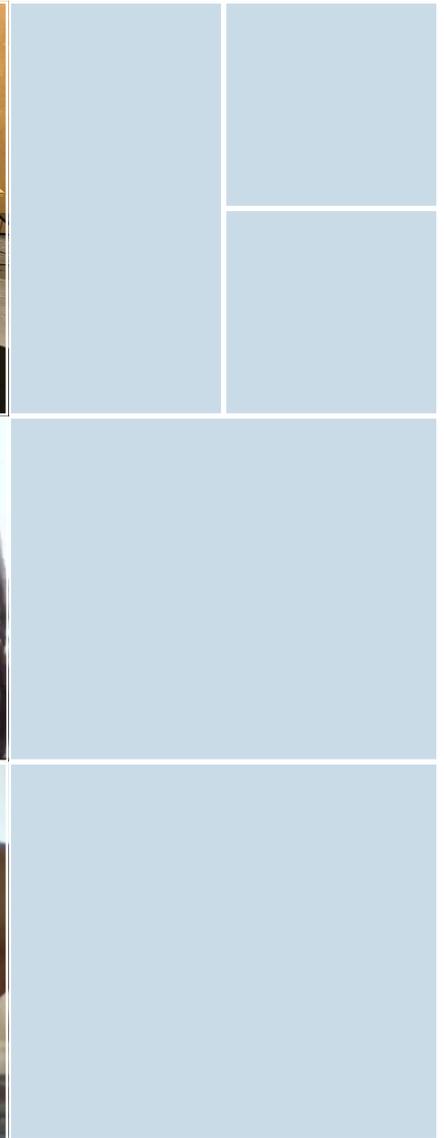
Managing the end of the activity

At the end of the activity, we encourage participants to share their project with others and say a few sentences about the process of building.

All projects created by participants are their property and may be taken home by them

Photos of possible outcomes

Some examples created by participants.



Activity plan

Chain reaction

Museo Nazionale della Scienza e della Tecnologia Leonardo da Vinci di Milano

Audience	Family
Format	Drop in
Duration	105 minutes
Staffing	2 facilitators
Participant grouping	Groups of 2-4 participants

Outline

The aim of the activity is to investigate the relationship between cause and effect. The chain reaction is a collective event, but each participant group is given a link in the chain (a piece of the chain). On a table they build their own sequence of events that must set off the machine built by the next group. The participants can use a wide variety of materials when building their piece of chain reaction. Each participant is asked to bring a personal object (for any reason relevant for them) and make up a story about it; they are asked to integrate the object in their chain reaction (in a primary or secondary role), as an element of their storytelling, which assumes value and meaning in the wider context of the museum experience. Before the collaborative good ending, each participant tells the others the story of their object and how their piece of chain reaction works.



Room preparation

Prepare the room by arranging the materials (divided by type) on tables making sure it is accessible to everyone, allowing people to walk around the room to look for them and try them out and at the same time they can look at the work of other groups, to encourage mutual inspiration.

Health and safety

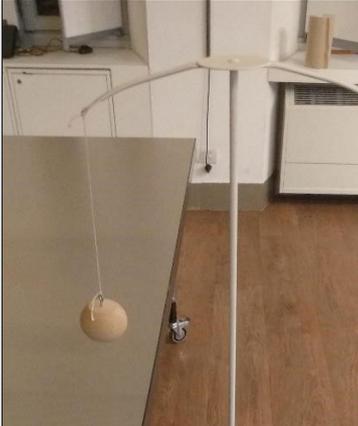
Hazard	Controls
Electrical components – potential short circuits	The facilitator pays attention

Essential materials

Item	Comment	Total
For building		
Wooden blocks	Small and large	
Wooden stands		
Large domino block		1 for each group
Cardboard		
Rubber bands		
Different types of string		
Clothespins	Wooden	
Pieces of wood or scrap building materials		
Weights		
Metal nuts		
Washers		
Objects that roll, bounce, or move		
Long pieces of material that balls and other rolling objects might slide along	Can be used to build a ramp	
Balls	Of various sizes and weights	
Wooden cylinders	Of various sizes	
Wheeled toys		
Motorized and electric parts		
A slow-moving motor		one for each group
A computer cd player motor		one for each group
Dissected and working electric toy parts		one for each group
1 battery pack		one for each group
Conductive material		
Alligator clip		
Roll of tinfoil		
Other various craft materials that conduct electricity		

Objects to inspire		
Funnels		
Musical toys		
Ping pong paddle		
Umbrella		
Skittles		
...and many other unusual object		
Personal object brought from home	No constraints are given about the type of object. For the measures, participants were told about the maximum dimensions the object could have	At least 1 for each group

Essential tools

Item	Comment	Total
Chain reaction workstation	Table with large domino block	one for each group
Stand with wooden ball to connect the workstation to following		
Masking tape		one for each group
Scissors		one for each group

Preparing materials in advance

The materials, divided by type, must be placed on tables distributed around the room, so that they are clearly visible and accessible for testing.

Introducing the activity

The activity is introduced by describing a chain reaction as a sequence of events linked by a relationship between cause and effect; then the goal of the single group is described, that is to build a “machine” on its workstation that consists of a sequence of events will start the “machine” of the following group. It is emphasized that the single “machine” will become a component in a large-scale collaborative chain reaction machine across several tables. Materials, motors, electrical materials, objects and the mechanism to activate the following station (stand with wooden ball) are described to participants. How to work a simple homemade switch is shown in a small and simple example of a sequence of events.

The activity begins by inviting participants to familiarize themselves with the various materials displayed around the laboratory. After that, the facilitator explains the role of the personal object they have brought from home, suggesting them to integrate it in their “machine” with the other available materials.



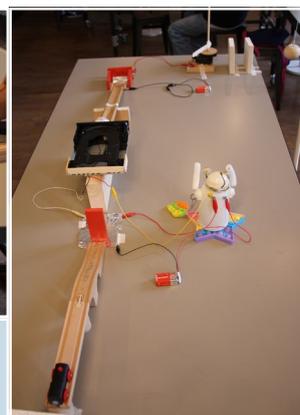
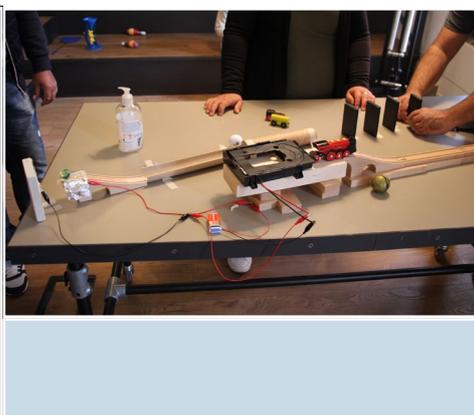
Managing the activity once it is in progress

The facilitator turns between workstations observing the work of the groups. The facilitator supports participants’ ideas, suggests alternatives. The facilitator recommends solutions without forcing but going along with the work of the participants. He/she supports the way in which the personal object has been used, whether in a prominent or in a secondary position.

Managing the end of the activity

The activity ends with the start of the collective chain reaction; each group talks about their work. They discuss difficulties, satisfactions, discoveries, and things they are particularly proud of. If willing to, each participant tells the other how their own object triggered the sequence of events.

Photos of possible outcomes



Activity plan

Dismantling and merging electronic toys

TRACES

Audience	Anyone (12+)
Format	Workshop
Duration	180 minutes (minimum)
Staffing	1 facilitator for 15 participants
Participant grouping	Individual or in pairs

Outline

The participants are invited to dismantle electronic toys and devices to see the mechanisms and the electronics that are hidden inside. Once they collectively have learned to identify and use some basic electronic and mechanical items, they are invited to re-use them, stick parts of toys together and build a personal electronic sculpture.



Room preparation

- Gather and dispose tables next to each other so that everyone could see what their peers are doing if they want,
- If possible, arrange the tools and materials in the center of the tables so that they are accessible to everyone - if it is not the case, arrange them on a separate table in a corner of the room.
- Put as many chairs as participants around the tables. Make sure everyone will have enough space on the table to craft its own project,
- On a table in one side of the room, place the electronic toys and devices that are going to be dismantled,
- On another side of the room, place the soldering iron, and the glue gun, so that the participants who will use them will be slightly isolated,
- You are good to go.

Health and safety

Hazard	Controls
Beware of electronic toys and devices that has to be plugged to the mains: this is quite dangerous when dismantled.	Take only toys that work with batteries
Some tools can be dangerous (cutter, saw, soldering iron)	Tell the participants about the hazard at the beginning. If you do not feel at ease to leave these tools without supervision, don't.

Essential materials

ESSENTIAL MATERIALS

Item	Comment	Total
Electronic toys and devices	They can be broken, recuperated from the dump. Can be brought by the participants.	Depending on the duration of the workshop, at least 2 toys per person.
Batteries	bring different voltage (1,5V, 3V, 4,5V, 9V)	At least 4 per person
Tape		At least 2 rolls per participant
Soldering tin		1 roll for the group
Desoldering braid		1 roll for the group
Copper wires		Plenty
Jack connectors		At least 1 per participant
Small containers	To store the components extracted by the participants, and not lose them.	At least 1 per participant.
Elastic bands		2-3 per participants.

Essential tools

Item	Comment	Total
Scissors		At least one pair for 2 participants
Screwdriver	Bring different size and shapes. You can check before the workshop if the screws on the toys are compatible with the screwdrivers you have.	Plenty
Smartphone disassembly kit		At least 1 for 3 participant
Soldering iron	A third hand per soldering iron can be useful, if you have it.	At least 1 for the group

Preparing materials in advance

Hacksaw		At least 1 for the group
Cutters		At least 1 for the group
Cutting pliers	Different sizes	At least 1 for 4 participants
Flat pliers	Different sizes	At least 1 for 4 participants
Universal pliers	Different sizes	At least 1 for 4 participants
Glue gun		At least 1 for the group
Clamps	Different sizes	At least 1 for 2 participants
Wire stripper		At least 1 for 4 participants
Tweezers		2 for the group
Multimeter		At least 1 for the group
Files (tool)	Different sizes, some for wood, some for plastic, some for metal	At one for each kind of material for the group
Protective gloves	Especially to protect the participants using cutters and saws	2 or 3 pairs for the group

Extra materials and tools

Item	Comment	Total
Sandpaper		
Aluminium foil		1 roll for the group
Sewing kit		1 for the group
Resistors	Different values, between, 100 – 1000 Ohm	
Decoration material	So that participants can customize their sculptures	

Preparing materials in advance

PREPARING MATERIALS IN ADVANCE

Check quickly that the tools you have can actually open the toys: that the screws of the toys are compatible with your screwdrivers.

Introducing the activity

- Present yourselves and your role during the activity.
- Prompt the challenge by saying that they are going to open electronic toys and devices, see how it is inside, try to understand how it works and what can be reused. Then they will be free to use the parts and elements they want to create their own electronic structure.
- Underline some details about the frame of the activity: everyone can use any material and tool completely freely. Encourage the participants to try, fail, adapt and watch the projects of each other, ask help, help, discuss.
- Decide and share safety rules about some of the tools (saw, cutter, soldering irons).
- Ask and underline who has useful knowledge for this workshop (can recognize electronic components, use a screwdriver, soldering...), so that their peers know they can ask them for help during the workshop.
- You can decide with the participants at the beginning of the workshop if and how their projects will be showcased at the end of the activity (exhibition, runway, pictures, movies...)

Managing the activity once it is in progress

- Make sure there are still materials and tools available.
- Tidy or throw away the elements that are not used anymore so that it is not too complicated to see what is still available.
- Before the participants start to open their toys, make them take some time to imagine how it works, what they think they will find inside ; then, once they have a guess, let them open the devices to confront it,
- Once the participants have opened their toys, help them to identify some basic elements that can be found inside (motors, speakers, resistors, LEDs, switch, gears), and try to use them or make them work.
- Once the participants are familiar with these basic elements, they can use them, and parts of toys, and connect everything into a personal project. They can disassemble other toys and devices to build their project.
- Once someone develops a new skill (ex : recognize and reuse some electronic components, soldering, using glue gun...) share it with the group so that everyone knows they can ask for help later.
- Ask the participants to give a title to their creation. This will help them channel their creativity.

Managing the end of the activity

- At the end of the activity, take some time to emphasise the skills used during this activity,
- Ask the participants to help you tidy and clean everything at the end of the activity,
- The end of this activity is really better if you find a way to showcase the projects of the participants in any way (exhibition, event...). It can be something that has been discussed and decided with the group at the beginning of the activity.

Photos of possible outcomes



When switched on, the eyes start to move and lights blink. This project re-uses motors, LEDs, switches and resistors.



When you switch on this project, the baby face starts to turn, there is light in its eyes and some gloomy music can be heard. This project re-used motors, LED, speakers, resistors, and switches.

When one switches on this project, it moves onward, and the red lights light up. It re-uses light bulbs, resistors, switches, and many parts from a lot of toys. The participant created a series of 4 sculptures over 18 hours of workshop, each one representing one of the horsemen of the apocalypse. This one is "War".

Activity plan

Dyeing

(with natural materials)

ScienceCenter-Netzwerk

Audience	Adults
Format	Workshop
Duration	180 minutes
Staffing	2-3 facilitators
Participant grouping	Individual, in pairs or in groups of 2-3 participants

Outline

In this workshop participants will try various dyeing techniques like shibori, batik & tie-dye to create their own designs. The end product is open with possibilities for the participants to dye fabrics that they brought with them or fabrics that we brought for their common rooms or as personal items. After they see the results for their first pieces they can iterate and dye more pieces of fabric. We will use conventional dyes as well as natural dyes such as hibiscus and turmeric to incorporate elements of PH levels and colour theory.



Two participants creating a rectangular shibori design



T-Shirt dyed with chemical

Room preparation

To prepare the room the essential materials such as a few pots, buckets, hotplates, tables and trays where the participants can work need to be present and the surfaces need to be safe for dying. The tables need to be covered in paper or plastic tarps and the space needs to be cleared from anything that should not get dyed. Access to water is needed for both the dyeing and rinsing of the fabrics. The room is prepared in separate areas and there is a designated space for the materials. Quiet background music can be on if it works in the space. Fabric that will be dyed in turmeric needs to be preboiled in vinegar for one hour, for the conventional dyes the other fabrics can be used without any preparation.

Health and safety

Hazard	Controls
Chemical dyes can cause skin irritations, discoloration of skin or clothing	Encourage participants to where gloves, not touch the dyes with their bare skin, wear clothes that they aren't worried about getting discoloured
Heat due to hotplates and hot water	Make participants aware of the heat, have as few people as possible involved.
Disposal	Make sure to dispose of chemical dyes according to the manufacturer's instructions.

Essential materials

Item	Comment	Total (for 10 persons)
Conventional dyes		4 different colours
Materials for Natural dyes	Turmeric, madder, red cabbage, onion skins, pomegranate flowers, hibiskus, ferruous sulfate (iron) for eco printing	According to recipe and choice of dye, recommendation to have 2-3 different natural dyes to experiment with
Fabric	Ideally cotton: bags, t-shirts, scraps, a large piece of fabric that can be dyed collectively, we recommend to source the materials from second hand shops or ask people to bring fabric. Often fabrics must be mordanted before dyeing.	At least enough for 20-30 different projects
Vinegar or Alum	For preboiling fabric that will be dyed naturally	1 litre

Essential tools

Item	Comment	Total (for 10 persons)
Hot plates	For colouring with turmeric	2 for 10-15 people
Pots	Size of pots depends on the group size and if participants are using scraps or are dyeing large pieces. Pots are only needed for dyeing with natural materials and for the mordanting process. Three high sauce pans and three larger pots would be a suggestion if some people are experimenting and others are dyeing large pieces.	6
Elastic bands	For shibori/tie dye	100 various strengths and sizes
Spring Clamps or F Clamps	For shibori	5-10
Wooden blocks	For shibori (more details below): squares/triangles/ various geometric shapes and sizes, 2 of each size (from around 5-10cm, but larger and smaller ones are possible to use depending on desired pattern)	6-12
Gloves, heavy duty reusable plastic gloves	For handling fabrics in the dyeing liquid	10 – 15 (as many as there are participants and facilitators)
Scissors		5
Buckets	For chemical dyes	4
Plastic or steel ladles	For stirring the dyes	4-5
Sea salt	To mix with the dyes depending on which dyeing process/recipe is used. We added the sea salt to the chemical dye baths as this was listed in the manufacturer's instructions	250 grams
Kettle	To warm the water for dyeing	At least 3 as large quantities of water are needed in a workshop setting
Squeeze Bottles	For creating pieces with multiple colours	4-6

Optional extra materials and tools

Item	Comment	Total (for 10 persons)
Wax, lighter & iron	For batik technique: www.dharmatrading.com/techniques/batik-instructions	A few candles or batik wax, an iron & ironing board

Preparing materials in advance

The materials that will be coloured naturally should be boiled in vinegar or alum in advance. This step will save an hour of time during the workshop and helps the fabric absorb the colours better. The materials such as elastic bands and rope will be laid out on the tables. If the participants want to bring their own fabrics they need to boil them in vinegar in advance. Participants can be informed in advance to bring materials such as flowers, spices, plants or food waste that they believe would create interesting colours to experiment with during the workshop.

INTRODUCING THE ACTIVITY

The facilitators introduce the materials and tools, have a few finished pieces to show and welcome the participants to explore the possibilities and discover the tools. The facilitators share some basic tie-dye techniques, asks what the participants think something would look like if they tied it a certain way. The facilitators offer the opportunity for people to work on creating patterns or experimenting with natural dyes. The experimentation with natural dyes offers many opportunities for discussing ph-levels and colours in general (www.fourrabbit.com/tutorials/2020/6/5/ph-modifiers-for-natural-dyes).

The workshop can be adapted depending on the interests of the group.

Prompt: Dye your personal pieces of fabric. You can let your creativity and curiosity guide you on tinkering with whatever you want. Every person can dye up to four different projects and you can either work on teams or alone. Make sure to share ideas with other people here today and collaborate on projects if you want.

MANAGING THE ACTIVITY ONCE IT IS IN PROGRESS

The facilitators go around in the room, observe, answer questions, ask the participants to share their process. They help problem solve and encourage the participants' creative process. The participants bind, tie & knot various pieces of fabric and put them into the prepared dyes for at least 30 minutes (depending on dye used). While the fabrics are in the dyes the participants can work on other projects. Once the 30 minutes are over the participants rinse their creation and decide on how they would like to make their next piece.

TECHNIQUES

- Shibori: Shibori is a Japanese technique of creating patterns while dyeing fabrics often by folding and binding the fabric. honestlywtf.com/diy/shibori-diy/
- Tie Dye: Tie Dye includes various techniques of folding, twisting, pleating, or scrunching fabric or a garment, before binding with string or rubber bands, followed by the application of dyes. pineapplepaperco.com/tie-dye-patterns/
- Batik: Batik is a method that usually involves creating various patterns with liquid wax before dyeing fabrics. www.dharmatrading.com/techniques/batik-instructions.html

RECIPES

The basic process for dyeing with natural dyes involves preparing the fabric to accept the colours by boiling them in vinegar, alum or another mordant for around an hour. There are various techniques and recipes for this depending on the dye used. Afterwards you place the fabric in the dye bath - a mixture of water with the material (e.g. onion skins, turmeric powder), you plan to use for dyeing and simmer for a certain amount of time depending on the dye recipe, but we recommend at least an hour. You can experiment with many different organic materials to see if they produce dyes from spices to food waste, leaves, flowers or other foraged plants. Recipes vary greatly and can be experimented with to receive different results. When the fabric is dyed to your liking you can still change the colour in some cases by changing the ph-level with vinegar or soda ash or in some cases colours change by adding iron or calcium carbonate. There are various methods of fixing the colour - in some cases this involves rinsing the fabric with vinegar or soda ash, in other cases by ironing the fabrics after the dyeing process. This step isn't always necessary. With dyeing the possibilities are endless and I recommend to approach this process experimentally as colours change depending on the type of fibre you are using, the ph-level of the water and the choice of dye and mordant.

- For chemical dyes follow the recipe on the package, as these vary depending on the brand used.
- Madder Root: botanicalcolors.com/madder-root-instructions/
- Turmeric: www.splendidhabitat.com/bohemian-chic-wow-my-natural-turmeric-tie-dye-experiment/
- Onion Skins: remake.world/stories/style/3-natural-dyes-you-already-have-in-your-pantry/
- Red Cabbage: tortoiseandladygrey.com/2015/05/25/slow-fashion-diy-how-to-dye-with-red-cabbage/
- Iron/Ferrous Sulfate:
www.madebybarb.com/2019/02/09/the-mysterious-iron-blanket/
botanicalcolors.com/botanical-colors-how-tos/how-to-use-iron-powder-ferrous-sulfate/
- Hibiskus: florafiber.live/blog/lets-dye-hibiscus

MANAGING THE END OF THE ACTIVITY

The rinsed fabrics can be hung on a clothesline to showcase the work of the group. The participants show the group what they have done within a gallery walk and share their process. There is a final round of applause for everyone. Afterwards the participants are encouraged to give feedback about the session.

Photos of possible outcomes



Clothesline with fabrics dyed with chemical dyes and turmeric.



Dyed with chemical dye



T-Shirt dyed with madder root, bag dyed with turmeric

Activity plan

Home garden

Copernicus Science Centre

Audience	Adults
Format	Workshop
Duration	120 minutes
Staffing	2-3 facilitators
Participant grouping	Individual or groups of 2-3 participants

Outline

The aim of the workshop is to build a small garden for their home in any form. It can be a garden with flowering plants, a small cultivation of plants to eat (such as herbs, easy to grow vegetables), air-purifying plants or green plants that do not require our attention. The participants will decide what the purpose of their specific garden is. Additionally, the task during the workshop is to build some form of our garden such as a flower bed, a stand for flowers, custom plant pots using recycled materials (PET bottles, nylon bags, empty cans etc).



Room preparation

Regular tables and chairs for the participants will be needed to conduct the workshop. It is also worth considering securing the tables against possible damage, for example with a knife. Access to an electrical outlet is required if hot glue is to be used.

Health and safety

Hazard	Controls
Cut with a knife, scissors or saw Burn with hot glue	There is a certain risk of injury (i.e. burns, cuts) during the workshop. Pay attention to the way participants are using the tools. It is worth having a first aid kit to treat a possible wound.

Essential materials

During the workshop we use a whole bunch of different tinkering materials like:

Item	Comment	Total
Cardboard	During the workshop we will use many different materials, from which participants will choose what they need. We encourage to use recycled materials that can be used to build a home garden (such as PET bottles, empty tin cans or plastic bags).	It is difficult to predict how much specific material is needed per person.
Plywood		
Wood		
OSB boards		
Empty plastic boxes		
Cans		
Plastic bags		
Paper		
Plastic sheets		
Fabrics		
Foams (i.e. XPS sheet)		
Empty package		
PVC pipes		
Cardboard tubes		
Pipe cleaners		
Popsicle sticks (any type)		
Natural plants	Use natural plants during the workshop. It is best to buy small plant seedlings from different groups like: herbs, succulents, flowers (both indoor and outdoor), air purifying plants, vegetables, fruits, undemanding plants, etc.	The number of plants strongly depends on our budget and the price of the plants. Look for plants on promotion in garden stores. 2-4 seedlings per participant should be enough.

Essential tools

Item	Comment	Total
Utility knife		1 per person
Scissors		1 per person
Hot glue gun		1 per 1-2 persons
Hand saw		1 per 2-3 persons
Cordless drill + bit set		1 per 3-4 persons

Extra materials and tools

Item	Comment	Total
Any type of fasteners will be helpful i.e. screws, nails, duct tape, glue, zip ties, strings, staples		

Preparing materials in advance

- It's best to start collecting materials some time before the workshop. Thanks to this, it is possible to collect many different types of materials that will additionally inspire participants to create their gardens.
- Many interesting and non-obvious materials can be found at a waste collection point for recycling. For example in Copernicus Science Centre regularly parts of used or damaged exhibits, are collected which then get a second life during workshops.
- Before the workshop, prepare materials and tools in one place in the room, e.g. on the table. On the second table lay out all the plant seedlings (grouped by category). You can also put a piece of paper with brief information about the plant, what it is for, and how to look after it.

Introducing the activity

During the introduction to the workshop, present its purpose to the participants - building some kind of garden at home. Show a few examples of how such a garden can look like, for example showing inspiration from the internet (Pinterest is the best place to look at) or ready-made projects implemented by other participants. This is a very important step as it will give the participants a general idea of what we are going to do.

Then ask the participants to think about what they want to achieve by building their garden and what their needs (i.e. air purification, growing your own vegetables, adding natural green to the interior) and limitations (i.e. space in the apartment, willingness/time to care for plants) are.

Then the participants choose plants that will be used in their design and start tinkering.

Managing the activity once it is in progress

The main task of the facilitator during the workshop is to help participants implement their idea of building a home garden.

The facilitator answers the participants' questions on an ongoing basis and helps them solve technical and design problems.

During the workshop, many different materials and tools can be used. If needed introduce participants to the use of a given tool. If someone has no experience with the use of certain tools, such as a saw or a drill, we recommend the use of simple materials and tools, such as hot glue.

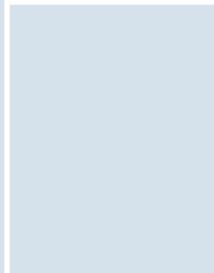
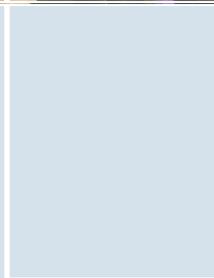
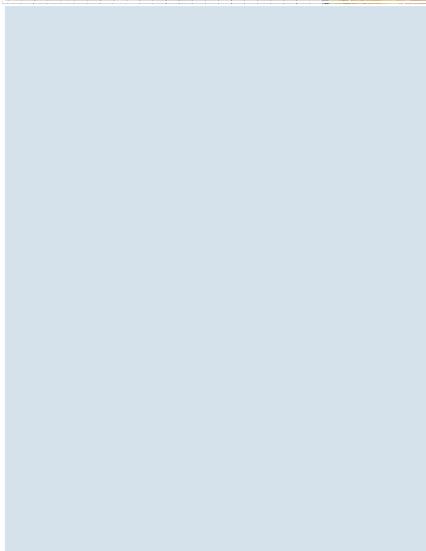
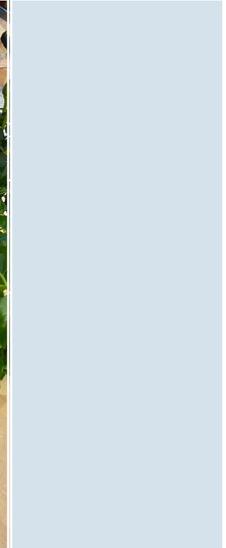
The tools used during this activity are not dangerous, but it is worth paying attention to the safety of participants, especially those who use a knife, hand saw, drill or working with hot glue.

Managing the end of the activity

- At the end of the activity, we encourage participants to share their project with others and say a few sentences about the process of building.
- All projects created by participants are their property and may be taken home by them.

Photos of possible outcomes

Here are photos of real projects created by participants on the first test of the workshop:



Activity plan

Interweaving

NEMO Science Museum

Audience	Adults
Format	Workshop
Duration	45-60 minutes
Staffing	1 facilitator
Participant grouping	Individual or groups of 2-3 participants

Outline

The aim of the workshop is to create an artwork or object by connecting materials using weaving techniques. The participants can use a range of materials, needed are materials that can serve as 'rope' and materials that can serve as a grid. At the end of the workshop the artwork that the participants made is linked to the skills the participants used and STEM content.



Room preparation

Create space for the participants to work and create 3 material stations; 1 with tools, 1 with rope materials and 1 with grid materials.

Health and safety

Hazard	Controls
Tools and ironware may cause small injuries	Facilitator keeps an eye on proper use.

Essential materials

To interweave you need materials that can serve as 'rope' and that can serve as a grid. The materials below are suggestions, you don't need all the materials you can choose a selection of materials that you have on hand.

Item	Comment	Total
Rope material, for example		
Rope (plastic, wool, cotton, etc.)		Make an estimation for enough materials. It is not necessary to have the same amount of material for each pair or group; when something runs out, it actually invites the participants to think about other solutions.
Lace and fabric		
Iron wire		
Reed, straw, rattan		
Paper strips		
Wool		
Pipe cleaners		
Tie-Wraps		
Electricity wire		
Plastic bags	Re-used	
Bicycle tires		
Grid material, for example		
Branches	Large and small	Make an estimation for enough materials. It is not necessary to have the same amount of material for each pair or group; when something runs out, it actually invites the participants to think about other solutions.
Paper		
Cardboard	Used boxes	
Wooden sticks		
Straws		
Pebbles		
Baskets		
Hoop		
Colander		
Leaves		
Mandarin net		
Disposable tableware		
Chicken wire		

Essential tools

Item	Comment	Total
Scissors		1 per pair or group
Tape		1 per pair or group
Pliers		4 per 30 participants
Perforator		4 per 30 participants
Nails +hammer	Small nails u can use in cardboard as well as wood,	1 set or per pair or group
Needles		1 per pair or group
Hole maker		4 per 30 participants

Preparing materials in advance

Prepare 2-5 examples of what you can make with the materials.
Optional: set up a big loom made of PVC pipes in a corner of the room that everybody can work on together.

Introducing the activity

There are two ways of introducing the activity.

1. With a local artist.

If possible work with a local artist. It helps to inspire the participants and makes them take the activity it helps them to take the activity seriously, to see that it is more than just crafting. Ask a local artist that works with plaiting, weaving or interweaving to introduce the workshop by telling and showing about their own practice.

2. By the facilitator:

Start the workshop by introducing the term interweaving: weave or be come woven together. Ask the participants: Can you name something in your home that is made by weaving? (baskets, fabric, hats, stools, artwork, macramé plant holder etc). Then show some examples of art that makes use of weaving. (You can use this Pinterest board <https://pin.it/2NPhaej>)

- Start the activity: explain the aim of the workshop: create something by connecting materials.
- Show 3 very different examples eg.:
 - Baskets of two materials (can be store-bought)
 - Miniature example of string art
 - Loom in a branch (or just from branches)
 - Stick wrapped around with rope
- Show the material tables. Participants can use materials they feel comfortable with or choose a material they never used before.
- Get started: Try things out with different materials and see what arises!
- Additional prompts to delineate the assignment can be:
 - Use 2 different materials. (Take two materials that appeal to you and try to braid/connect them.) For example, these could be very opposite materials such as stone and rope.
 - Create a interweaving work that takes up space; Make a wickerwork 1 meter high and wide or Make a wickerwork as large as possible.
 - Hopefully from the artist, perhaps they can also provide input/inspiration to make the assignment a little more closed off).

Managing the activity once it is in progress

Participants get started, guidance looks like this:

- Observe to see what participants are working on, and if they are frustrated or stuck.
- Ask questions to get participants thinking about possible solutions or to help them articulate their goals or problems. And then ask questions to get them to see for themselves where things might be going wrong or to encourage them to come up with their own solutions.
- Encourage creativity, challenge participants to think out of the box, for example, by providing an unexpected material.
- Encourage them to look at others or the material tables for inspiration.
- Keep an eye on the time and communicate the remaining time in between.
- Write down things that strike you.
- If applicable, put down a material that you think could move the person forward.
- Write down during the activity:
 - what techniques they use to connect materials
 - what the participants are struggling with
 - what solutions they come up with.

Managing the end of the activity

Look at each other's work. Ask the participants what they found frustrating or what they are most proud of and/or a problem they solved. Try to not discuss the products in terms of aesthetics but focus on the tinkering and technical parts. Some things we encountered:

- Connecting different materials.
- Different techniques used: knitting, crochet, braiding, knotting, weaving etc.
- Creating balance in a 3D work.
- The use of different textures.
- Building a structure.

Try to send the participants home with the following message: maybe you didn't notice but what you did today involved quite a lot of science and technology.

Photos of possible outcomes



Stick wrapped around with different kind of fabrics



A small loom made of skewers and yarn



A small loom made of cardboard and yarn

Activity plan

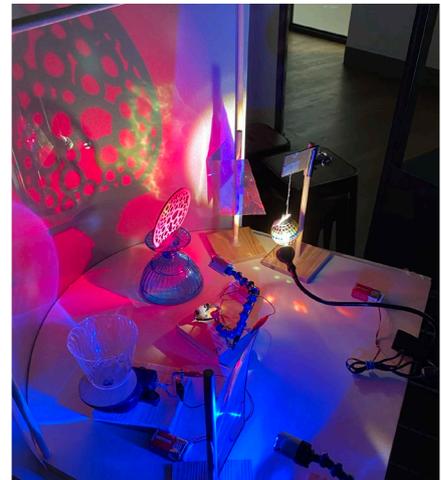
Light play

Museo Nazionale della Scienza e della Tecnologia Leonardo da Vinci di Milano

Audience	Family
Format	Drop in
Duration	105 minutes
Staffing	2 facilitators
Participant grouping	Groups of 2-4 participants

Outline

The aim of the activity is to explore the behaviour of light when it encounters various simple three-dimensional materials, opaque, translucent, glossy, and coloured. Participants become familiar with shadows, reflections, refractions, and colour changes. Using the aesthetic effects produced by the interaction between light and materials, the goal is to create a luminous “picture” that can tell a story; the picture can be made mobile with the help of small slow motors. In the end, the paintings combine into a collaborative installation. Each participant is asked to bring a personal object to the activity¹ (for any reason relevant for them). During the activity they are asked to integrate it in their boxes (in a primary or secondary role), as starting point of their personal story, which assumes value and meaning in the wider context of the museum experience. In the phase of the collaborative installation, if willing to, each participant tells the other how the object triggered the story played by lights and shadows.



¹ During the co-design process, we discussed with the operators from the partner association, to better understand how Tinkering could serve the new target group. Some of the most recurring themes emerged were their needs of belonging and of relevance. Why should they consider a museum experience for them? How can they feel science as something (at least approachable) for them? To answer these questions, we agreed on starting from an already existing activity (Light Play) and then on the need to integrate participants' personal context inside it, trying to create a dimension of personal and individual storytelling. Considering that adults are often reluctant in joining an activity, we decided to exploit the benefit of cooperative learning, using their children as drivers of the experience.

Room preparation

Due to Covid restriction we prepare the room so that each station has its own set of materials, avoiding people to walk around the room to look for them, but at the same time we assured that participants could have a look at the work of other groups, to encourage reciprocal inspiration.

Health and safety

Hazard	Controls
There are no significant hazards	

Essential materials

Item	Comment	Total
Three-dimensional shapes, grids, repetitive patterns	Items to make shadows e.g. transparencies with printed shapes or patterns, colanders, cheese graters, baskets, pegboard, mesh.	Various quantities
Coloured gels and translucent objects	Scraps of coloured translucent plexiglass, plastic cups and bowls, iridescent cellophane, dichroic film, clear coloured bottles	Various quantities
Reflective objects and materials	Small plastic mirrors, sequined fabric, holiday ornaments, disco balls, aluminium foil.	Various quantities
Wooden stands		
Light Sources	Various colours	3 in each group
Slow-moving motors	With batteries	2 in each group
Personal object brought from home	No constraints are given about the type of object. For the measures, participants were told about the maximum dimensions the object could have (to be placed inside the boxes)	At least 1 for each group, better if 1 for each participant.
Light Play Stages		one for each group

Essential tools

Item	Comment	Total
Masking tape		One for each group
Scissors		One for each group

Extra materials and tools

Item	Comment	Total
String		

Preparing materials in advance

Materials should be placed on workstations so that they are clearly visible and accessible for testing.

Introducing the activity

The activity is introduced by describing it as an exploration of light, shadows and colours with the aim of building a luminous picture also kinetic. It is emphasized that all everyday objects can be useful for exploring lighting effects and that they will have many materials to experiment with. Materials, motors and stage are described. The activity begins by inviting participants to take a tour of the materials displayed on their table, to familiarize themselves with the effects of light colours or shadows. After that, the facilitator explains the role of the personal object they have brought from home, suggesting them to integrate it in the scene with the other materials available.

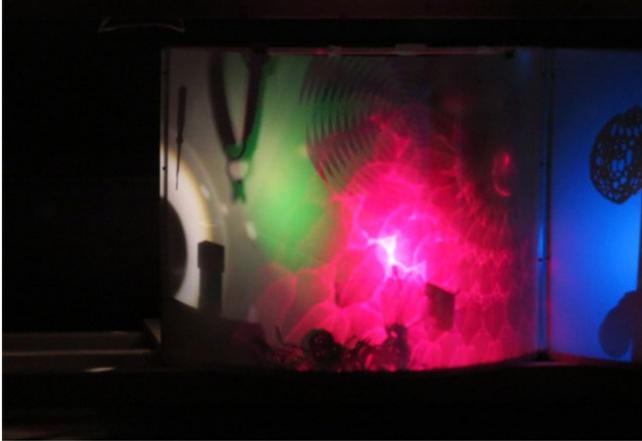
Managing the activity once it is in progress

The facilitator turns between workstations observing the work of the groups. The facilitator supports participants' ideas, suggests alternatives. The facilitator recommends solutions without forcing, but going along with the work of the participants. The facilitator supports the way in which the personal object has been used, whether in a prominent or in a secondary position.

Managing the end of the activity

The activity ends with the union of the light paintings into a single collaborative work; each group talks about their work. They discuss difficulties, satisfactions, discoveries, and things they are particularly proud of. If willing to, each participant tells the other how the object triggered the story played by lights and shadows.

Photos of possible outcomes



Activity plan

Popping balloons

TRACES

Audience	Anyone (6+)
Format	Drop in or workshop
Duration	40 minutes or more
Staffing	1 facilitator for 15 participants
Participant grouping	Individual or in pairs

Outline

With some basic tools and materials, the audience is prompted to create a mechanism that makes a balloon pop when you pull a string. There are plenty of solutions that can be crafted in less than 30-40 minutes without any prior knowledge so this activity is really efficient as a way to test the Tinkering frame with an audience that is not used to it and that could be interested in doing longer and more complex activities.



Room preparation

Gather and dispose tables next to each other so that everyone could see what their peers are doing if they want. If possible, arrange the tools and materials in the center of the tables so that they are accessible to everyone - if it is not the case, arrange them on a separate table in a corner of the room. Put as many chairs as participants around the tables. Make sure everyone will have enough space on the table to craft its own project. You are good to go.

Health and safety

Hazard	Controls
When someone wants to spike an element with a skewer while holding it, it can happen that they sting their hand.	Tell people at the beginning to take care when spiking.
Some people can be very uncomfortable with the sound of popping balloons.	If someone is afraid, do not inflate the balloons fully. It'll be harder to pop but it will be quiet and you will avoid panic attacks.

Essential materials

Item	Comment	Total
Cord, string or twine	Must be resistant and not break too easily	Enough to get at least 4 long strings per person.
Skewers	Better in wood	At least 4 per person
Toothpicks	Better in wood	At least 4 per person
Tape	The best tapes for this activity are electrical tape or masking tape (easy to stick and to remove)	At least 1 roll per person
Rubber balloons		At least 5 per person
Rubber band		At least 4 per person
Cardboard tubes	Can be a toilet roll	1 per person
Polystyrene shapes (rings, balls, disks, sheets)	Length about 5-10 cm. Can be replaced by any other materials that is easy to break/cut/sting.	At least 2 per person
Straws	Paper or plastic, has to be easy to cut	At least 2 per person
Corks		At least 2 per person
Pegs		At least 1 per person

Essential tools

Item	Comment	Total
Scissors		At least 1 for 2 people.

Extra materials and tools

Item	Comment	Total
Wooden blocks		1 per person
Wooden sticks		At least 1 per person
Little heavy objects	No need for these objects to be very heavy, for example marbles, little rocks, or metallic small objects.	1 per person
Cardboard sheets/disks		
Pipe cleaner		2 per person
Springs		1 per person
Decoration material	If you want participants to customize their project	

Preparing materials in advance

Nothing special

Introducing the activity

- Present yourselves and your role during the activity.
- Prompt the challenge by saying that the participants have to craft something that makes a balloon pop when a string is pulled. The only thing that can be touched to make the mechanism work is the string. Each project has to include a string, a balloon, and it is up to the participants to decide the way to connect these two elements.
- Ask if everyone is comfortable with balloons popping sounds. If needed, you can suggest not to inflate the balloons fully so that they will make less noise when they will pop.
- Underline some details about the frame of the workshop : everyone can use any material and tool completely freely. Encourage them to try, fail, adapt and watch the projects of each other, ask help, help, discuss... warn them that the balloon supply is not infinite so they should be careful to not pop them accidentally too much.

Managing the activity once it is in progress

- Make sure there are still materials and tools available. Tidy or throw away the elements that are not used anymore so that it is not too complicated to see what is still available.
- Try to be aware of who is going to do a test, so that you can be around to see it happen and give feedback (otherwise it is very ephemeral and you will miss it).
- If someone fulfils the challenge before the end and does not know what to do next, you can:
 - Ask them if they have an idea, a feeling of how to optimize their project,
 - Ask them if they have an idea of how to pop a balloon using a completely different strategy,
 - Ask them to craft something that can pop two balloons simultaneously while pulling only one string.

Managing the end of the activity

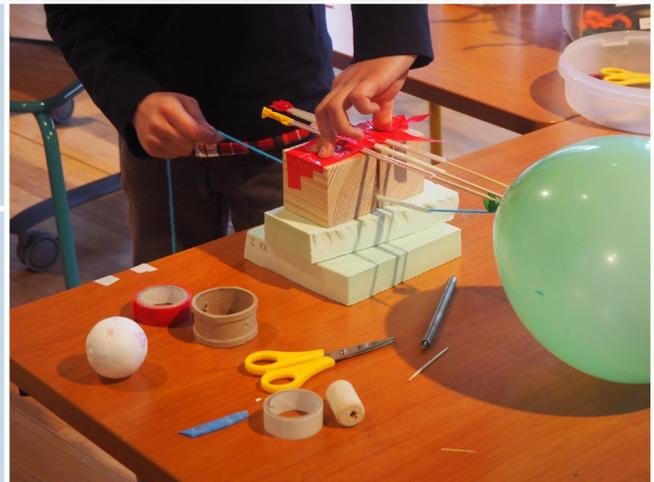
- It can be nice to take some time at the end of the activity to share everyone's projects. Ask participants to prepare a final test, and take 5 minutes to ask them to explain their strategy before doing this final test in front of their peers.
- Ask participants to disassemble and throw/tidy elements of their project before they leave.
- Take a picture or a movie of every mechanism to share with the participants.

Photos of possible outcomes



The balloon is attached so that it does not move. Heavy things are glued to a skewer so that if it falls on a balloon, it can pop it. The heavy skewer is attached to a structure by a nod with the string, directly on top of the balloon. When the string is pulled, the nod unravels and the heavy skewer falls.

Skewers are attached to an immovable structure. The string is attached to the balloon. When the string is pulled, the balloon is pulled onto the skewers.



Toothpicks are taped on the balloons and attached to the string. The balloons are attached to something heavy or the table so that they do not move. When the string is pulled away, the toothpicks move and pop the two balloons simultaneously.

Activity plan

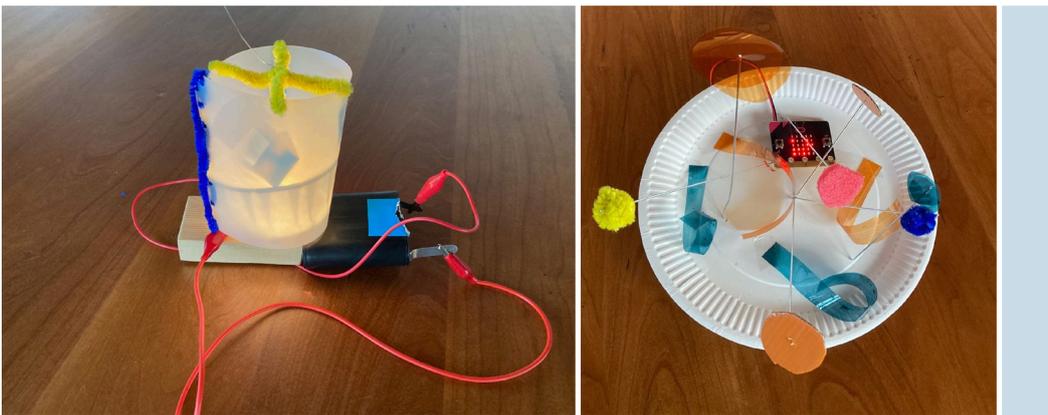
Send a message with art

NEMO Science Museum

Audience	Adults
Format	Workshop
Duration	60 minutes (main version, alterations possible)
Staffing	1
Participant grouping	Participants work in pairs or individually

Outline

The participants tinker an artwork to send a message. It is up to the participants what message they want to convey; it can be an emotion like happy or angry, a warning for danger, or something completely different. The activity is developed as an activity in which participants can try coding in a very low threshold way. The participants can use a micro:bit as part of their artwork. A micro:bit is a small computer with a LED display and two buttons. The micro:bit can be programmed using Scratch or MakeCode.



Room preparation

Prepare the room: make sure there are enough tables and chairs available for the participants, and arrange them in a way that promotes collaboration. Place at least two material tables in different locations in the room so that the participants have to cross the room to reach the materials. Place (if possible) multiple pairs at each table so the participants can see what others are making and discuss amongst each other.

Health and safety

Hazard	Controls
Tools and iron wire can cause small injuries	Facilitator keeps an eye on proper use.

Materials*

Item	Comment	Total (for 15 pairs)
Cardboard	From packaging	About 10 boxes
Paper (coloured)	Variation in colours	50 A4 Sheets
Skewer sticks or popsicle sticks		50
Paper tape		5 rolls
Paperclip		1 box
Split pin		1 box
Straws	Preferable paper	50
Rubber bands thick/thin		1 box of each
String		1 ball
Crafting materials of your choice	Preferable recycled	At least 5 of each material
LED's 1,6-2,4 V	variation in colours	About 2 per pair/group
Button cell 3V		1 per pair/group
Power wire		1 roll
Computer with USB output and internet connection	The computer is only needed to program the micro:bit, so participants can use it in succession.	Min 5 (ideally 1 per pair)
Micro:bit (+ wire and batteries)		15

* these are suggested materials, other and/or additional materials may also be used. It is important to provide a large variety of materials.

Tools*

Item	Comment	Total (for 15 pairs)
Scissors		1 per pair/group
Pliers		5
Wire stripper		5

*Tools are needed depending on the materials used.

Preparing materials in advance

Prepare 2-5 examples of what you can make with the materials.

Introducing the activity

Introduce the materials and explain what the participants are going to tinker.

- The prompt: tinker an artwork that sends a message;
 - Use a light
 - Use the microbit
- Alternative prompt: make something that can transfer a message over a certain distance.
 - Use a light
 - Use the microbit

Explain that the participants can decide for themselves what message they want to convey: it can be an emotion like happy or angry, a warning for danger, or something completely different. Let them think about who the receiver of the message is. It could be something political, funny or personal, for social media or for the neighbour on the other side of the street.

Encourage the participants to use a micro:bit in their artwork. A micro:bit is a small computer with a led display and two buttons. The micro:bit can be programmed using the website [makecode](#). Depending on the group and their familiarity with the micro:bit, you can opt to give a short instruction about the micro:bit (see attachment). Show some examples (make sure they vary), be aware that the participants may copy them. So encourage them to follow their own ideas.

Possible adjustments depending on the target group:

- Have a discussion about what the word message means and what kind of message you could send. With non-native speakers this can be a really nice addition.
- Show some examples of signs, to explain what a message can be.

Managing the activity once it is in progress

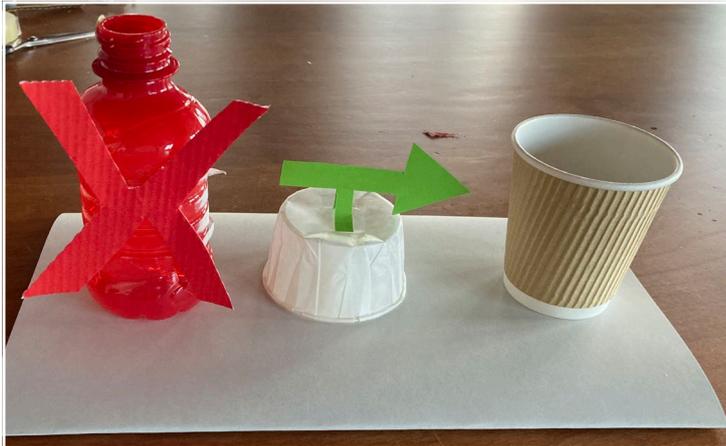
The facilitator goes around the room, observes and asks the participants to share their process. Encourage participants to experiment with the micro:bit. For example:

- Challenge them to show an icon on the led display;
- Challenge them to program a response when button a is pressed;
- Challenge them to use light in their work.

Managing the end of the activity

The participants show the group what they have done within a gallery walk and share their process. The facilitator shares something he/she saw happening, if possible for each of the pairs. For example: focus on scientific or technical problems they encountered during tinkering and how they solved these problems, the collaboration, the perseverance, or the use of materials in novel and playful ways.

Photos of possible outcomes



Here is the message:
no to plastic yes to
paper cups.

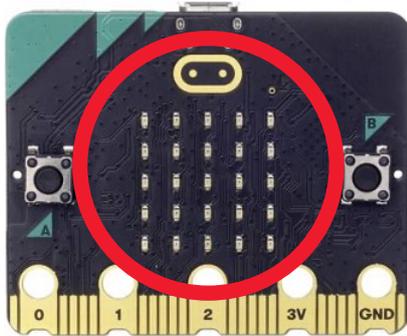
Message:
We (humans)
can't without
computers.



Attachment – working with a micro:bit

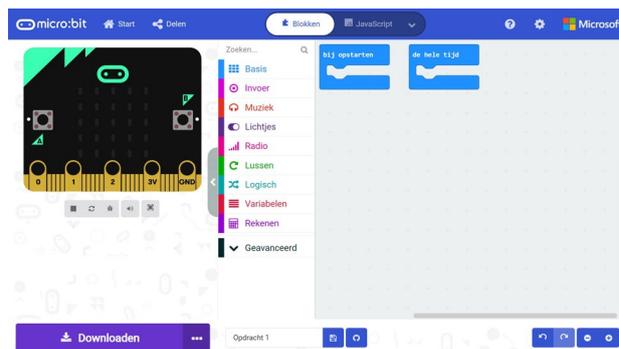
A micro:bit is a small computer. It has a LED display of 5x5 LEDs on which messages and icons can be shown. The micro:bit can also interact with the environment by means of buttons A and B. The micro:bit can be programmed using Scratch or MakeCode. In this activity the website <https://makecode.microbit.org/> is used. Instructional videos and more explanation can be found on <https://microbit.org/>.

Using the display



Source picture: makecode.microbit.org

1. Go to <https://makecode.microbit.org/> and click on **New project**. You will see:



2. Go to **Basic** in the menu.
3. Choose the block **show icon** and drag it into **on start**.
4. Click on Download to save your code onto the micro:bit.

Pay attention: your micro:bit is no longer connected if  appears next



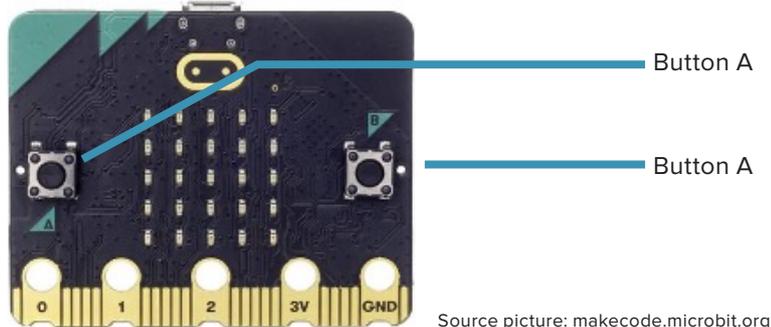
to **'Download'**. Often, the connection restores on its own after a few moments, and this icon  appears

5. Designing your own icon
 - Drag **show icon** out of **on start**.
 - Choose the **show leds block** from **Basic**.
 - In this block you can design your own icon by switching lights on or off in the LED display. An LED is switched on when the square is white, and switched off when it is dark blue.
 - Drag **show leds** into **on start**.
 - Design your own icon and download the code onto the micro:bit.

6. Showing a text string on the micro:bit.
 - Choose show string from Basics and drag this into on start.
 - Type your own text (where it says 'hello'), and download your code onto the micro:bit.
7. Showing a text string and an icon.

Multiple code blocks can be placed in on start. Experiment, and see what more you can do!.

Making the micro:bit respond to you



Find out how to make the micro:bit respond.

- Go to **Input** in the menu.
 - Choose **on button A pressed** and drag this to the work area.
 - Go to **Basic** in the menu and choose a code block, for example **show leds**. Drag this into **on button A pressed**.
 - **Download** your code onto the micro:bit.
 - Press button A and see what happens.
 - Now program the micro:bit to respond to pressing button A and B at the same time.
2. Use shaking the micro:bit.
 - Go to **Input** in the menu.
 - Choose **on shake** and drag this to the work area.
 - Go to **Basic** in the menu and choose a code block, for example **show icon**. Drag this into **on shake**.
 - Download your code onto the micro:bit.
 - Shake the micro:bit and see what happens.

Activity plan

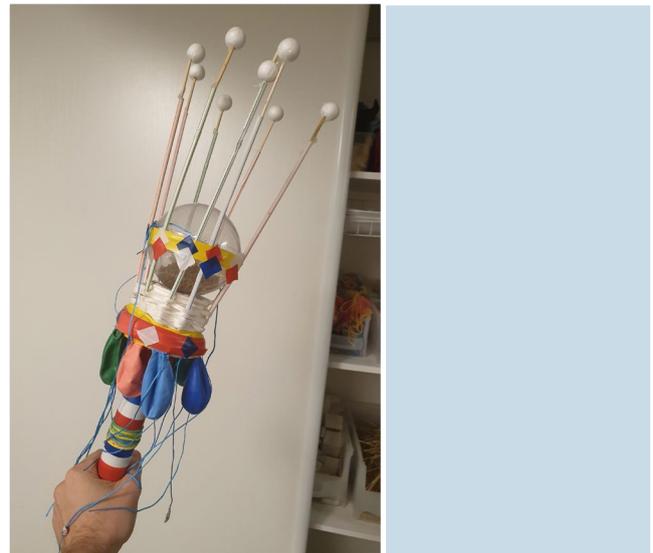
Tinkering with sound

TRACES

Audience	Anyone
Format	Workshop
Duration	180 minutes (minimum)
Staffing	1 facilitator for 15 participants
Participant grouping	Individual or in pairs

Outline

The participants are invited to choose freely among various materials and tools to explore and express their sensible relationship with sounds and create a structure that produces sounds.



Room preparation

Gather and dispose tables next to each other so that everyone could see what their peers are doing if they want.

- If possible, arrange the tools and materials in the center of the tables so that they are accessible to everyone - if it is not the case, arrange them on separate tables in a corner of the room.
- Put as many chairs as participants around the tables. Make sure everyone will have enough space on the table to craft its own project.

Health and safety

Hazard	Controls
If you use metallic sheets: sides of the sheet can be cutting.	Ask people to use gloves when they manipulate these sheets. Have bandage and disinfectant just in case.
Some tools can be dangerous (cutter, saw...)	Tell the participants about the hazard at the beginning. If you do not feel at ease with the use of some tools, do not let people use it freely.

Essential materials

Item	Comment	Total
Materials to build structures		
Polystyrene balls, shapes, rings, sheets		As many as you can
Wood shapes, tubes, sticks		
Cardboard, shapes or sheets		
Plastic shapes, sticks, tubes...		
Materials that can produce sounds when hit		
Wood, metallic or plastic planks, sheets, rings, boxes, tubes, sticks, balls...	Empty and full shapes.	At least 2 elements of this kind for each one in the group.
Membranes: balloons, rubber, plastic sheets		
Foil (aluminium, paper, plastic...)		
Materials that can produce sound when blown		
Plastic, wood, metal tubes		At least 2 elements of this kind for each one in the group.
Boxes		
Bottles		
Foil (aluminium, paper, plastic...)		
Materials that can produce sounds when plucked		
Strings, elastic bands, piano strings...		At least 2 elements of this kind for each one in the group.
Semi rigid sheets (metallic, polystyrene)		
Materials that can produce sounds when rubbed		
Membranes (balloons, rubber, plastic sheets, wood shapes, cardboard shapes)		At least 2 elements of this kind for each one in the group.
Foil (aluminium, paper, plastic)		
Materials that can produce sound when shaken		
Sheets (metal, plastic)		At least 2 elements of this kind for each one in the group.
Foil (aluminium, paper, plastic)		

Materials to glue/attach		
Tape, glue, elastic bands, strings		As many as you can
Materials that can be used to hit, rub, pluck		
Chopsticks, boards, grains, little rocks, tubes, bars		As many as you can
Decoration material		
Paper and crepe paper		As many as you can
Markers		
Feathers		
Paint		
Magazines		

Essential tools

Item	Comment	Total
Scissors		At least one pair for 2 participants
Cutting pliers	Different sizes	2
Flat pliers	Different sizes	2
Universal pliers	Different sizes	2
Glue gun		2
Clamps	Different sizes	At least 1 for 2 participants
Tweezers		2
Protective gloves	Especially to protect the participants using cutters, saws, drilling machine or manipulating metallic sheets.	2 or 3 pairs
Protective glasses	Especially for participants using the drilling machine or	2 or 3 pairs
Drilling machine		1
Punch		1
Measuring tape		1
Hammer and nails		1

Extra materials and tools

Item	Comment	Total
Sandpaper		2
Hot wire cutter	To cut any polystyrene shapes	1
Sewing kit		1
Electric material to create movement	Set of 2 batteries, 4 wires and 2 electric motors	1 set per participant
Files (tool)	Different sizes, some for wood, some for plastic, some for metal	One for each kind of material
Hacksaw		At least 1
Cutters		At least 1
Grinder saw and its safety mask, gloves and apron.	CAREFUL: if one saws iron it will project incandescent sparkles. The participants need to be away from the rest of the group and wear masks, gloves and an apron. This will not happen with aluminium.	1 set

Preparing materials in advance

Nothing special

Introducing the activity

- Present yourselves and your role during the activity.
- Explain that the activity will be split in two separate times :
 - First the participants will do short personal challenges where they will explore and play with their sensitive knowledge about sounds.
 - Then a long challenge where they can create any personal projects related with sounds.
- Underline some details about the frame of the activity : everyone can use any material and tool completely freely. Encourage the participants to try, fail, adapt and watch the projects of each other, ask help, help, discuss.
- Decide and share safety rules about some of the tools (saw, cutter, pliers, and grinder if you want to use it...).
- You can decide with the participants at the beginning of the workshop if and how their big projects will be showcased at the end of the activity (exhibition, movies, orchestra...). This is also something you can decide between the first part and the second part of the workshop.

Managing the activity once it is in progress

During the first part (minimum 1h):

- Prompt the participants into exploring some very personal and sensitivity-related challenges. Here is a list of some example of challenges that can be prompted :
 - Create a very irritating sound,
 - Create a very soothing sound,
 - Create two sounds that are the most different,
 - Create a sound related to something going on in their present life, or a personal memory.

- This part has two main goals:
 - Explore the tinkering frame with quick projects, so that the participants are more familiar with it when they will start the long projects in the second part.
 - Give challenges related with their sensitive relationship with sounds, so that the participants are more familiar with this when they will start the long project in the second part.
- Make sure there are still materials and tools available. Tidy or throw away the elements that are lingering or not used anymore. It must be possible for the participants to understand quickly the tools and materials available at any time.
- Make sure, in this first part, that the projects are very simple: they just have to gather elements that create sounds according to the challenge they are following. No need to build complicated structures that can last.
- Be aware of the noise level in the room, if it is too noisy, then ask to reduce noises.
- At the end of the first part, take a time to share what everyone have done, explain how chose their ideas and how they achieved it.

During the second part (minimum 2h):

- Prompt the participants into creating a personal project that will produce any sound they want. They can use what has been explored during the first part or go into a completely new direction.
- Make sure there are still materials and tools available. Tidy or throw away the elements that are lingering or not used anymore. It must be possible for the participants to understand quickly the tools and materials available at any time.
- If someone does not know what to do, talk about what this participant have explored during the first part. And how it can be possible to use it, create a structure that will explore further these sounds.
- Be aware of the noise level in the room, if it is too noisy and it can disturb the participants' projects, then ask to reduce noises.
- We think it is more interesting that the exploration space is more about physical sounds than electronic sounds. But if some participants are willing to explore it, and if you have material that can allow it, that can be also interesting to explore.
- We think that in order to be more inclusive, it is more interesting that the exploration space of this activity is more about creating noisy structures than music instruments. But of course, if some participants with personal affinity with music want to explore it, this is a possibility.
- Ask participant to name their project. This can help them channel their creativity.

Managing the end of the activity

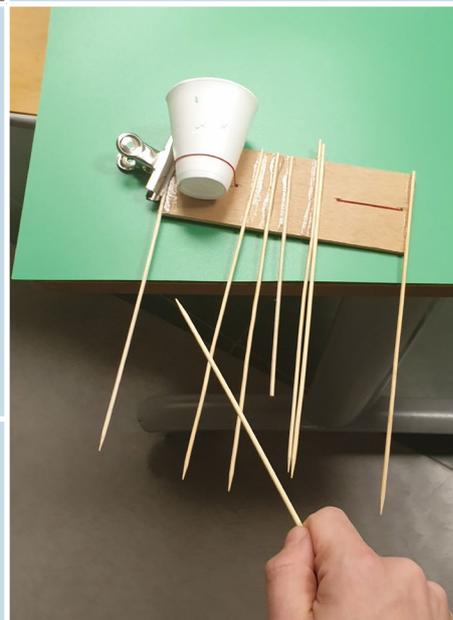
- At the end of the activity, take a time to share the projects within the group and how each one of these project has been created. The way it is done can have been decided together at the beginning of the workshop.
- Ask the participants to help you tidy and clean everything at the end of the activity,
- The end of this activity is really better if you find a way to showcase the projects of the participants in any way (exhibition, event...), with the possibility to explain the process and reflexions that led to it. The way it is done can have been decided together at the beginning of the workshop.

Photos of possible outcomes



This object, called “the Mushroom” has been inspired by popular Colombian garden decorations. The creators of this project were from Colombia. This mushroom-shaped structure have metallic objects attached around its hat, so that when there is wind, chimes noises are created. As there were few wind in the room where the workshop took place, the hat of this mushroom can turn around the foot axis ; when it turns, the metallic object collides with each other and produces a very soothing sound.

This projects called “the Balaphon” reproduces the principle of a balaphon. When the wooden skewers are hit, a sound is produced, amplified by the polystyrene cup. The longer the skewer, the higher the pitch of the sound. The participant wanted to reproduce this because it is an instrument he knows how to play.



This instrument is called “la Tchatcha”. This object is inspired by maracas: there is a plastic ball filled with lentils that can be shaken and produce sounds. Balloons filled with some chickpeas has been attached all around the structure, to add some hidden complexity to the sound : one listening to this object may think the sound of the lentils in the plastic ball is the only sound it produces. But if you listen and watch carefully, you can detect this complexity.



The participant decided to create this project while randomly trying to make noises with the material, at some point he found the plastic ball and the lentils, loved the sound it produced and he decided to use it in his project.

Activity plan

Wishcards

ScienceCenter-Netzwerk

Audience	Adults
Format	Workshop
Duration	150 minutes
Staffing	2 – 3 facilitators
Participant grouping	Individual or in pairs

Outline

The participants create two or three postcards of their choice. Therefore, they will be inspired by a wide range of materials and divers coloured paper with different structures, weight and patterns. Participants are motivated to integrate a simple circuit to highlight and illuminate some parts of their postcard. In order to connect the activity with a language learning focus, the participants are asked to add some wishes, short messages etc.



Room preparation

Large table for materials and tools. Those materials should be arranged in groups:

- materials for the postcard like e.g. different types of paper, decoration materials.
- materials for the circuits: copper tab, LED's, batteries.
- special tools e.g. soldering station.

6-8 tables as working areas – so that participants can work in small groups or pairs.

Health and safety

Hazard	Controls
Soldering station	One facilitator should be responsible for this area and support the participants

Essential materials

Item	Comment	Total (for 15 persons)
Plain strong paper (300g) in various colours	As postcard basis	50 A4 sheets
Divers coloured paper with different structures, weight, patterns, also translucent paper	To design elements of the postcard	30 A4 sheets
Several other small handicraft items	e.g. fabric or yarn remnant, buttons	
Various common handicraft materials	tape, glue, pencils	8-10 pieces per material
SMD LEDs and Gumdrop LEDs	In various colours, sizes	70
Copper tape		10m
Coin cell battery		50

Essential tools

Item	Comment	Total (for 15 persons)
Various common handicraft tools	Scissors, squares	8-10 pieces per tool

Extra materials and tools

Item	Comment	Total (for 15 persons)
Soldering station		1 or 2
Tin for soldering		
Tweezer	For working with the soldering station	1 or 2

Preparing materials in advance

It is recommended to prepare some example postcards of different complexity as inspiration in advance.

Introducing the activity

- Task for participants: Design your very own personal (luminous) postcard! Be creative and let your curiosity run wild. You can implement up to two/ three different ideas per person. You can either work together or design your own individual objects. Work (anyway) together, give advice, share your ideas and support each other in the concrete implementation.
- At the beginning, the facilitators present the rough process, create a pleasant atmosphere and clarify organizational questions such as breaks etc.
- For starting the activity, the participants are made familiar with the materials and the basic principles of simple electrical circuits and folding techniques (pop-up, paper “switches”, etc.) using samples and photos (see e.g. www.exploratorium.edu/tinkering/projects/paper-circuits).
- For lighting the participants can use gumdrop LEDs as well as solder small SMD LEDs.
- Option: To focus more on tinkering with electricity, you could start the activity by including a phase of tinkering with circuit elements (see e.g. www.exploratorium.edu/tinkering/projects/circuit-boards)

Managing the activity once it is in progress

The participants are encouraged to pursue their own ideas, try out different mechanisms and design a maximum of 2-3 luminous postcards. As a first step the participants choose some materials and start to implement their first ideas. Facilitators support the participants' thoughts, help them with electrical problems, encourage them to work together with others and assure them that it is okay if it doesn't work out right away and to learn from mistakes.

Managing the end of the activity

Gallery walk: participants present 1-2 postcards, share related ideas and processes.

Facilitators emphasize at least one positive aspect of the postcard or the working processes.

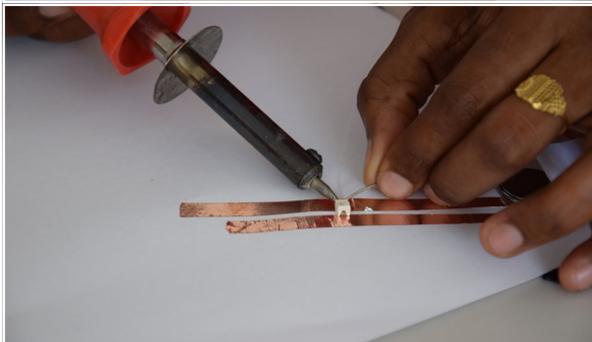
At the end the facilitators express appreciation and applause for all.

At the end the facilitators ask for a short reflection and offer the participants to take home some materials for creating/finalising one-two postcards at home.

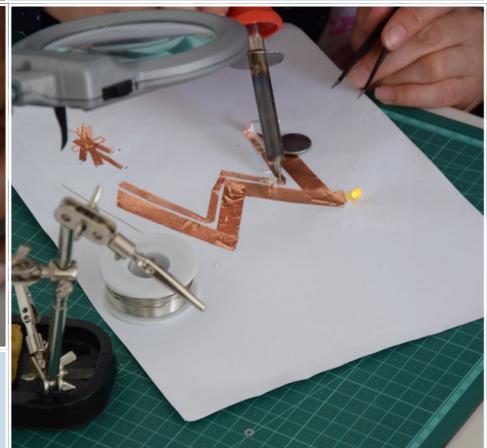
Photos of possible outcomes



Paper with interesting patterns and structures inspires individual creations and beautiful outcomes. However, make sure that participants engage in rapid prototyping on plain white paper before working on the paper of their choice for the end product.



In order to integrate SMD LEDs in a electrical circuit, participants have to use the soldering station.



Typically, projects complexify over the course of the workshop with participants advancing their ideas and learning from each other.

Appendix 1 - Example certificate for the participants

Certificate

While you tinker you ‘think with your hands’.
You decide for yourself what you are going to make and which materials you use. You can tell your own story while making and tinkering.

In the Tinkering activity Interweaving you may have addressed:

- ✓ Creativity: using your own experiences as inspiration.
- ✓ Creativity: working with new materials.
- ✓ Creativity: making and construction something with your hands.
- ✓ Problem-solving: find solutions for problems.
- ✓ Trying things out even though they might not work
- ✓ Communication: teamwork
- ✓ Communication: practicing language skills

On *insert date* *insert name*

participated in *name tinkering activity*

signature institution

logo institution



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Appendix 2 - Learning dimensions of Making & Tinkering

www.exploratorium.edu/Tinkering/Our-work/learning-dimensions-making-and-tinkering

LEARNING DIMENSIONS of Making and Tinkering

Valuable learning experiences can be gained through making and tinkering.

Use this framework to notice, support, document, and reflect on how your tinkering environment, activities, and facilitation may have supported or impeded such outcomes.

Initiative & Intentionality

- Actively participating
- Setting one's own goals
- Taking intellectual & creative risks
- Adjusting goals based on physical feedback and evidence

Problem Solving & Critical Thinking

- Troubleshooting through iterations
- Dissecting the problem components
- Seeking ideas, tools, and materials to solve the problem
- Developing work-arounds

Conceptual Understanding

- Making observations and asking questions
- Testing tentative ideas
- Constructing explanations
- Applying solutions to new problems

Creativity & Self-Expression

- Playfully exploring
- Responding aesthetically to materials and phenomena
- Connecting projects to personal interests and experiences
- Using materials in novel ways

Social & Emotional Engagement

- Working in teams
- Teaching and helping one another
- Expressing pride and ownership
- Documenting / sharing ideas with others

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the tinkering studio

RESEARCH + PRACTICE COLLABORATORY

Appendix 3 - Facilitation Field Guide

www.exploratorium.edu/sites/default/files/files/facilitation_field_guide.pdf

the
tinkering
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Facilitation Field Guide

exploratorium

Facilitation Goals	Practices	Techniques
Spark initial interest	<ul style="list-style-type: none">● Welcome people and invite them to the space● Introduce the activity and set the mood for the interaction	<ul style="list-style-type: none">● Smile and introduce yourself● Orient learners to the available tools and materials● Offer a place to start working● Meet them at eye level when explaining or modeling● Show examples that demonstrate a variety of thinking● Suggest a prompt that generates possibilities
Sustain participation by following the learner's ideas	<ul style="list-style-type: none">● Value tentative ideas, "mistakes," and wrong directions● Support their process in moments of failure and frustration	<ul style="list-style-type: none">● Observe learners for a bit before jumping in● Ask questions about their process● Listen to their ideas● Restate statements or questions● Offer new materials or tools● If you don't know the answer, work together● Give learners suggestions instead of directions● Show enthusiasm about their ideas
Deepen understanding through making connections	<ul style="list-style-type: none">● Guide people to go a little bit further than they could on their own● Surface connections between projects and links to outside learning experiences	<ul style="list-style-type: none">● Encourage people to look around the space for inspiration● Point out shared goals around the room● Offer technical terms only when relevant● Let participants explain their thoughts and define the next steps● Encourage risk-taking and experimentation● Offer challenges that allow learners to go further down their own path● Discuss how the experience might relate to outside interests● Celebrate moments of wonder, surprise, and joy

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