

# STEAM in Youth Work Toolkit

## Welcome

Welcome to the STEAM in Youth Work Toolkit.

These training materials have been developed as part of the 'Digital Youth Work' project, a strategic partnership between 7 organisations across Europe, to build the capacity of the youth work sector to deliver high quality youth work in a digital age.

They are based on training needs for practitioners identified by the [EU expert group on digitalisation and youth's 2018 report](#).

The resources from all partners are available at [www.digitalyouthwork.eu](http://www.digitalyouthwork.eu). The project has been funded by Erasmus+.

## Introduction

The STEAM Toolkit is designed to support youth workers interested in developing their practice by incorporating STEAM learning approaches and tools in their work with young people.

The toolkit includes the fundamental information you need to get started on your STEAM in youth work journey; from an introduction to STEAM, setting up a Makerspace, facilitation tips and techniques and a sample six week programme plan that you can adapt for your youth setting.

The toolkit is accompanied by three step by step Activity Guides designed to help you plan and facilitate innovative STEAM activities with young people:

- DIY Soda Drinks Machine - Intermediate Level
- Light Up 3D Paper Worlds - Intermediate Level
- LED Shake Stick - Advanced Level

The STEAM Toolkit and Activity Guides are informed by: the learnings and training materials of a two year project titled the 'NYCI TechSpace STEM in Youth Work Maker Project', a partnership between the National Youth Council of Ireland and Camara Education Ireland.

We hope you enjoy these STEAM resources and wish you luck on your journey as you begin to incorporate or advance your digital youth work practice!



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## Getting Started with STEAM

### What is STEAM in Youth Work?





STEAM is an educational approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding youth-led inquiry-based learning, collaboration, and critical thinking. (educationcloset.com)

## Why STEAM?

STEAM projects guide young people to use a constructivist approach to learning where knowledge is built, not learned. Young people can achieve this approach through a variety of methods, most notably a facilitator who openly shares the tinkering mindset where we learn by doing even if we do not know exactly what we are doing. Making mistakes is a good thing, mistakes are our best teachers. The biggest mistake we can make in life is to make no mistakes!

## What are the Youth Outcomes of STEAM Projects?

The benefits of working on STEAM projects are endless. Each project can vary hugely, with an enormous variety of beneficial outcomes for young people. However, a lot have the following underlying outcomes in common:

- *Creativity and innovation* is hidden beneath the surface of all great ideas and inventions.
- *Collaboration* through group projects.
- *Communication* by explaining complex ideas.
- *Critical thinking and problem solving* to systematically think through problems in unique ways by thinking outside the box.
- *Experiential learning* through hands-on projects.

The above outcomes are also known as 21st century learning skills, or the 4Cs (P21 Partnership for 21st century skills, 2007). Experiential learning is a widely used approach within youth work (Devlin and Gunning, 2009).

## What are the Benefits of STEAM for Youth Workers?

There are also many benefits for youth workers themselves, for example:

- It provides them with tools to engage certain young people where they would usually struggle to engage using more traditional youth work approaches (such as music or sports)
- It helps them enhance young people's learning and problem-solving skills in ways that are unique to other youth work approaches.
- It provides them with a new set of technical skills.
- It enhances their youth facilitation skills, because using STEM within youth work is inquiry-based and exploratory and encourages making and learning from mistakes.



# Getting Started with STEAM

## STEAM Terminology 101

- **Tinkering** - is a mindset - a playful way to approach and solve problems through direct experience, experimentation, and delivery. (Exploratorium)
- **Making** - is about the active role construction plays in learning. The maker has a product in mind when working with tools and materials. (Exploratorium)
- **21st Century Skills** - refers to the knowledge and skills necessary to succeed as effective citizens, workers, and leaders in the 21st century. (Exploratorium)
- **Critical Thinking** - a mental process of acquiring information and evaluating it to reach a logical conclusion.
- **Makerspace** - a physical or online place in which people with shared interests, especially in computing or technology, can gather to work on projects while sharing ideas, equipment, and knowledge. ([www.makerspaces.com](http://www.makerspaces.com))
- **Prototype** - a first or preliminary version of an object, device or vehicle from which other forms are developed. (Google Dictionary)
- **Circuit** - is a complete course of conductors through which current can travel. Circuits provide a path for current to flow. (Google Dictionary)
- **Component** - a piece or part of a circuit or machine.
- **Positive** - a connection to the positive side of the power source, usually shown as a red cable.
- **Negative** - a connection to the negative side of the power source, usually shown as a black cable.
- **Solder** - is a soft metal we use to connect components and cables together to make a connection which we also refer to as to solder a connection. (Google Dictionary)



# Setting up your MakerSpace

## Equipment Starter Kit

Every MakerSpace needs a starter kit of tools and equipment listed below, which will ensure you have the essential resources to get making. This kit allows for a multitude of projects to be created in the future. It also means activities will be of little or low cost as you should only need to buy specific project materials. After all what good is an arts & crafts room without scissors, ruler or tape?

This starter kit is based on a group of four individual young people, or four small collaborative groups:

Tool	Quantity	Description
<a href="#">Safety Goggles</a>	4	Eye protection for projects, where necessary
<a href="#">Helping Hands</a>	4	A stand that holds components in place during soldering activities. Especially helpful for those with fine motor difficulties as well as an attached magnifying glass for those with poor eyesight
<a href="#">Soldering Iron Kit</a>	4	Soldering iron with safety stand & beginner solder
<a href="#">Automatic Wire Stripper</a>	2	Removes plastic coating on wires to expose the wire
<a href="#">Wire Cutter</a>	4	Spring loaded to cut wires with ease
<a href="#">Crocodile Clips</a>	4	Allows prototype testing of connections & circuits
<a href="#">Hot Glue Gun</a>	3	Essential piece of a maker kit to build and construct
<a href="#">Precision Screwdriver Set</a>	2	Allow you to get in at those hard to reach screws.
General Supplies	Quantity	Description
<a href="#">Lead Free Solder</a>	4	Lead-free for soldering projects
<a href="#">Multi-Stranded Cable</a>	2	Wire for use in a variety of electrical connections
<a href="#">Tip Tinner</a>	2	Soldering iron tip cleaner
<a href="#">Glue Sticks</a>	10	Glue sticks should always be in your makerspace
<a href="#">PP3 Battery Connectors</a>	4	Battery connectors with power cables attached
<a href="#">AA Battery Case (x25)</a>	4	Battery connectors with power cables attached
<a href="#">PP3 Batteries (x10) - 9V</a>	6	Keep good batteries in stock. Use rechargeable where possible.
<a href="#">AA Batteries (x40) - 1.5V</a>	5	Keep good batteries in stock. Use rechargeable where possible.
<a href="#">Round Rocker Switch (x10)</a>	10	Basic on/off switches, helpful in all projects



\*This list of equipment is sourced from [www.kitronik.co.uk](http://www.kitronik.co.uk), who we have found to be one of the cheapest and ship internationally.  
Note: The equipment power connections may not be suitable for your country.

# Setting up your MakerSpace

## Health & Safety

### Equipment

Equipment used to create STEAM projects can be adjusted where needed to be safer for younger audiences i.e cold glue guns, safety scissors, softer materials, replacing plastic bottles for paper cups when building robots, etc.

Projects such as soldering will always require a very hot soldering iron to be used and therefore we recommend not allowing children below the age of 12 to solder. However, with correct guidance and supervision from a youth worker young people under 12 may learn to safely solder.

### Facilitation Space

The makerspace where projects will be delivered should be set up safely for projects based on their equipment needs.

- *Cables* such as power cables and extensions should be kept to a minimum and not placed across the floor. If unavoidable and necessary use safety mats or heavy duty tape to cover cables.
- *Soldering* irons are very hot and require a power cable each. Try to have one central location at a round table for power, also ensure the soldering iron and the power cable is on the preferred hand of a young person. If a young person is right-handed and the power cable is stretched to the left this can cause easy entanglement and potential burning of the power cable.
- *Safety Glasses* should be worn when any tools are being used. Something as simple as snipping wires or cutting components can send small pieces of metal wire into the air.
- *Materials* often come with their own health and safety leaflets. We recommend to always read the leaflets to understand and mitigate any risks that may occur.



# Setting up your MakerSpace

## Makerspace Setup

Makerspaces can get messy. Pieces can go missing very easily, which is why storage is very important. We recommend two types of storage for a:

### Shared Space Makerspace

If your space is not a dedicated makerspace we recommend getting a 'Rolling Tool Box' so that your equipment can be easily and safely stored away when your room is being used for other purposes.

Similar to this product available on [RS-Online.com](https://www.rs-online.com):



### Dedicated Makerspace

If you have a dedicated makerspace, we recommend using tool shelving units similar to above as well as a tool rack on the wall. This allows you to use coloured tape to create outlines of all the tools to easily keep track of anything that might be missing. This is called a shadow box tool rack

Similar to this product available from [Wall Control](https://www.wallcontrol.com)



# Facilitating STEAM with Young People

## What is Inquiry Based Learning?

Inquiry-based learning is not a new technique—in fact, it goes back to education philosopher John Dewey—but it does stand in contrast to the more structured, curriculum-centered framework of today's schools.

Asking questions is at the heart of inquiry-based learning. The goal is not to ask just any questions, of course, but ones that kids honestly care about. Your role is to guide the kids in finding the answers themselves and encourage them to ask new questions along the way.

Inquiry-based learning is a style particularly well-suited for out-of-school programs because they have a freer hand to complement, enhance, and expand on the work children are doing in their K-12 classes. School-based teachers may not want to go so far as to make inquiry-based learning the core of their classroom approach. It does, however, offer a powerful option for occasional projects and lab activities

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# Facilitating STEAM with Young People

## Stages of Inquiry Based Learning

### Pose Real Questions - *Introduction, What, How*

- Facilitator introduces a concept/theme attempting to evoke wonder and curiosity of young people
- Young people become curious and activate any relevant prior knowledge
- Young people are facilitated to ask questions such as:
  - What do I need/want to know?
  - How could this work?
  - How do we create it?
- Young people can often find it difficult or are afraid or embarrassed to ask questions. Your role as a facilitator is to help young people understand wanting to know something is far more important than actually knowing.

### Exploration - *Research, Find Resources, Investigate, Ask*

- Young people begin to broadly research the theme and any questions they might have. These questions should then lead to even more questions to be investigated.
- Young people will begin to develop new ways to do research.
- Facilitators should introduce the concept of mind mapping at this point to capture all of the research happening.

### Investigation & Creation - *Interpret Information, Test, Create, Explain*

- After the initial exploration young people will now be somewhat broadly familiar with the type of project they want to create.
- Young people will now begin to interpret the information they have researched.
- During this stage, young people can now begin to test their initial research by establishing a connection between theory and practice.
- Young people now being to test by creating temporary circuits, connections, and prototype ideas.

### Reflection - *Reporting Findings, Discuss, Share, Revise*

- Young people should get an overview of results from tests as well as data collected from research.
- Young people should now discuss and share plans going forward with the project:
  - Is this feasible?
  - Do we need to conduct more research?
  - Project Timeline?
  - Is this project within budget?
- Once this stage has been completed young people can now move onto project creation.

### Adapted from:

[Inquiry-Based Learning: An Approach to Educating and Inspiring Kids](#) by the Education Development Center, Inc. (2016).



# Facilitating STEAM with Young People

## Facilitator Guidelines

- **Observe Closely**
  - You are an educator, not a teacher. Take a step back, let the young people try to figure out their mistakes, let them get frustrated as much as possible as this is where the learning happens, only step in just before you think they are at breaking point. (Exploratorium)
- **Patience**
  - Be patient with their speed of learning. STEM projects are not to be rushed
- **Simplify**
  - Where possible simplify the project as much as possible to begin with. Introduce more complex components/parts later in the project if you feel they are up to it.
- **Model Behaviour**
  - Model curiosity, model inquiry-based learning. It's ok not to have all of the answers or the knowledge to hand to solve every problem. It's all part of the process.
- **Develop Understanding**
  - Then by watching them trying to hook up the new component, you get a better sense of how sturdy their thinking is in terms of their understanding of the circuits.
- **Failure & Frustration**
  - If every time I try something and the way I think it's going to work is exactly the way it works then I haven't learned anything.
  - Failure is key, we learn, we problem solve and move on.

## What to Consider for Diversity and Inclusion? <sup>1</sup>

- Is your Makerspace wheelchair accessible?
- Have thought about what you can offer to young people who find more fiddly activities challenging?
- Are you aware of your own gender-biases?
- How will you present your Makerspace to make sure it is attractive to girls, for example, offering activities that may connect with them?
- Do you take proactive steps to ensure boys and girls given equal opportunities to take on leadership roles within projects?
- Have you thought about what you can offer to young people who may struggle to maintain focus throughout longer activities?

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<sup>1</sup> Evaluation findings from the NYCI TechSpace STEM in Youth Work Project.



# Facilitating STEAM with Young People

## Learning Environment - Guidelines for how to Set up the Spaces

- **Comfort**
  - Make the space as comfortable as possible, you could be there a while. Comfort will also help with concentration
- **Social Element of Spaces**
  - Try to make it as social as possible, the young people will learn just as much from each other as they will from you. Tinkering is all about teamwork.
  - Tinkering is all about teamwork, we need the environment to support this. Rounded tables instead of square tables are important as they encourage young people to side by side as they build and experiment their projects with each other.
- **Distributed Teaching**
  - Remember, you are a facilitator, not a school teacher. Try to create a space where you are not standing in front of a group the whole time. Try to walk around and be as mobile as possible throughout the course of your meetups.
  - Rounded/circular tables also help as there is no one place for the facilitator to stand and draw everyone's attention. It encourages facilitators to work with everyone equally rather than stopping the momentum and asking everyone to pay attention to the top of the room.
- **Information & Inspiration**
  - Posters are always great, if you order from Kitronik you will most likely receive some free posters with your shipment. We would also encourage you to either buy or create some STEM poster to places around your space.
  - *Place other inspiring and wacky objects around the room - dissect toys and show inner workings and have them on show, have a shelf of previous creations or salvaged parts from various projects.*



# A Youth Worker's Journey through STEAM

## How to Prepare to Deliver STEAM?

### Introduction

- Explore the maker movement online
- Broadly research STEAM activities
- Commit to developing STEAM in a youth setting approach within your organisation/projects
- Share enthusiasm with staff around you

### Training

- Attend a STEAM Training, online course, or online tutorials and resources
- Purchase MakerSpace starter equipment and supplies
- Practice STEAM facilitation and technical skills & activities
- Create your MakerSpace

### Implementation

- Deliver various STEAM activities
- Reiterate activities
- Host tinkering sessions where young people can try create a STEAM project they have brought to the group.

### Evaluation

- Reflection of activities with young people
- Evaluate activities internally

### Celebration

- Attend a Maker event/festival e.g. Maker Faire, local Makerspaces
- Host a celebration evening to showcase projects created by young people. Invite family and friends.



# References

Devlin, M. and Gunning, A. (2009). The purpose and outcomes of youth work: report to the Interagency Group. Dublin: Irish Youth Work Press.

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