

PHABLABS 4.0

Photonics enhanced **fAB LABS** supporting the next revolution in **digitization**



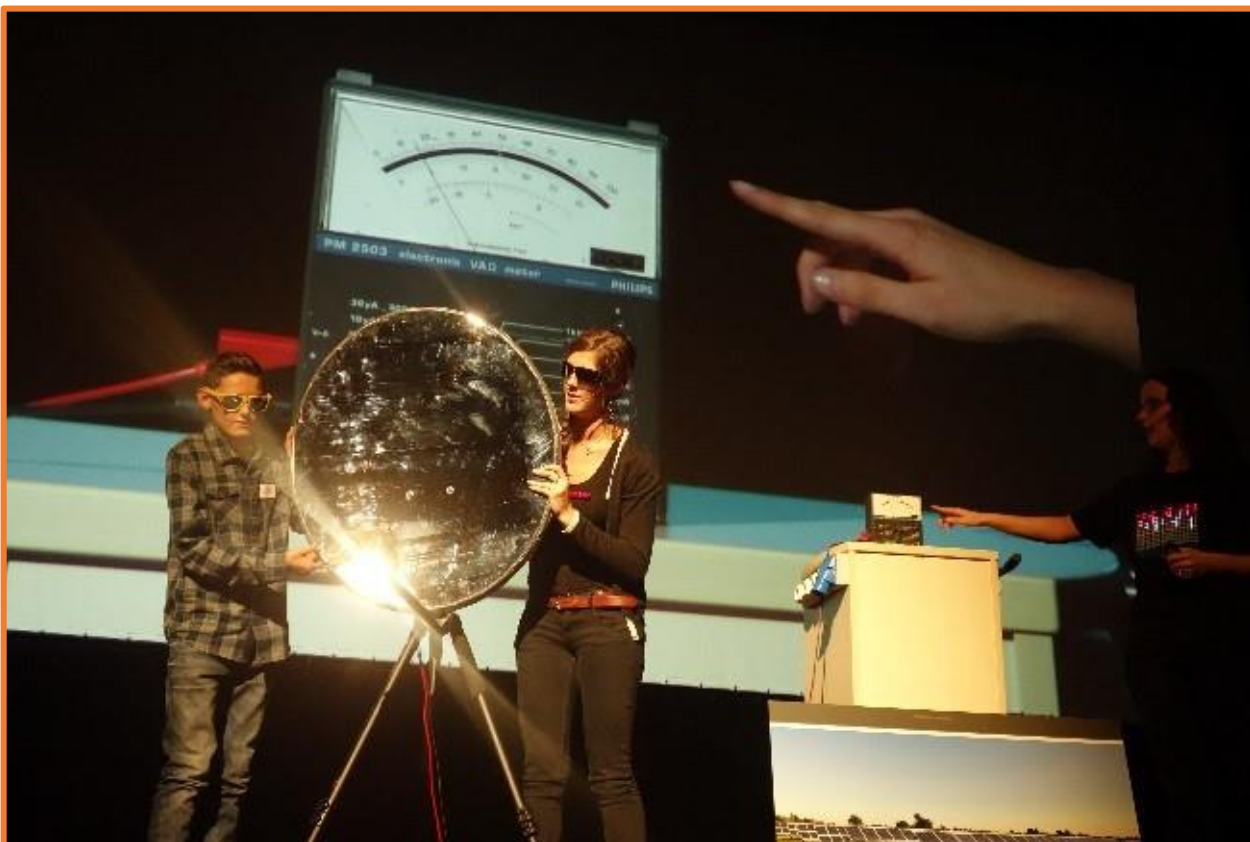
HELLO, I AM ...



OUTREACH IN PHOTONICS



OUTREACH IN PHOTONICS



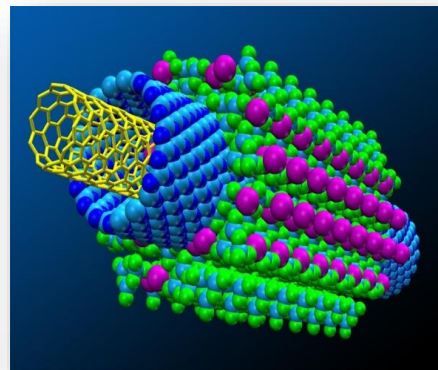
PHOTONICS?



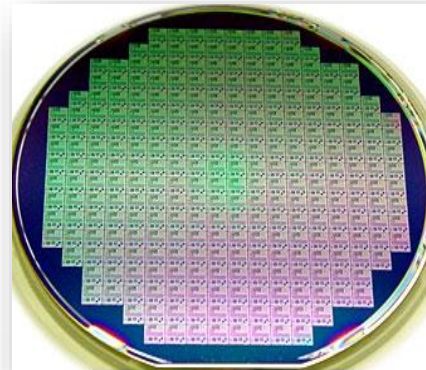
PHOTONICS = KEY ENABLING TECHNOLOGY



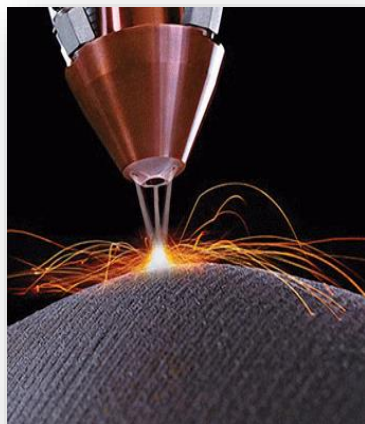
Biotechnology



Nanotechnology



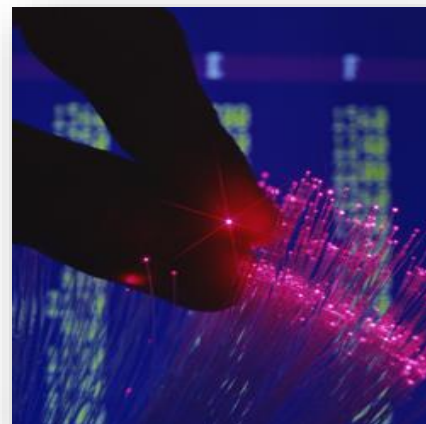
Nanoelectronics



Advanced Manufacturing



Advanced Materials



Photonics

PHOTONICS = KEY ENABLING TECHNOLOGY



Optical Datacom



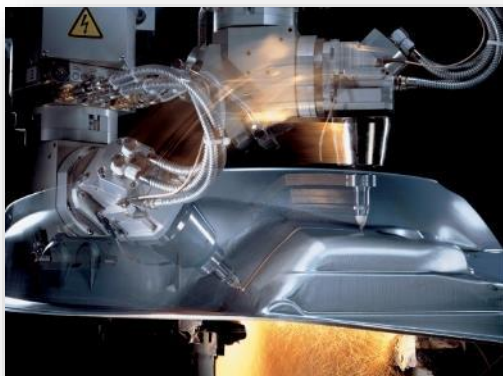
Photovoltaics



LED Lighting



Displays



Lasers in Manufacturing



Machine Vision

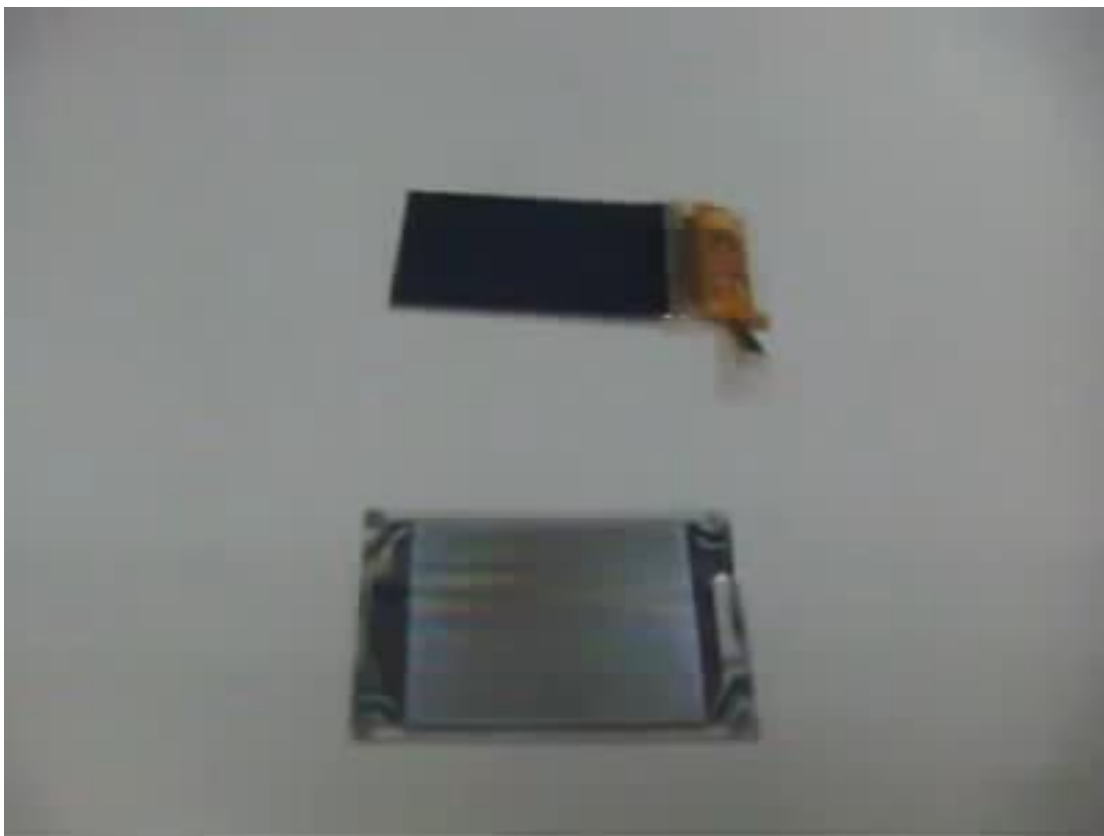


Medical Optics

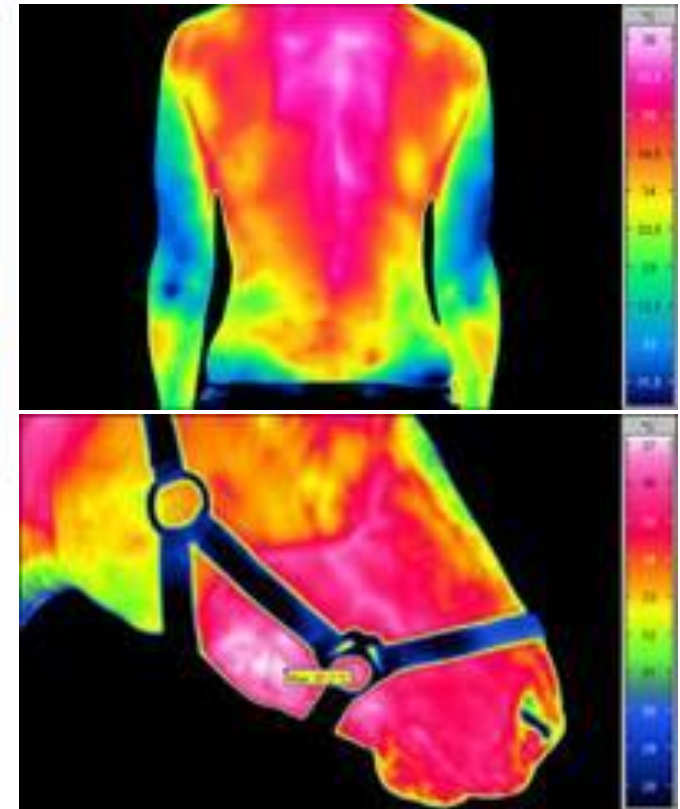
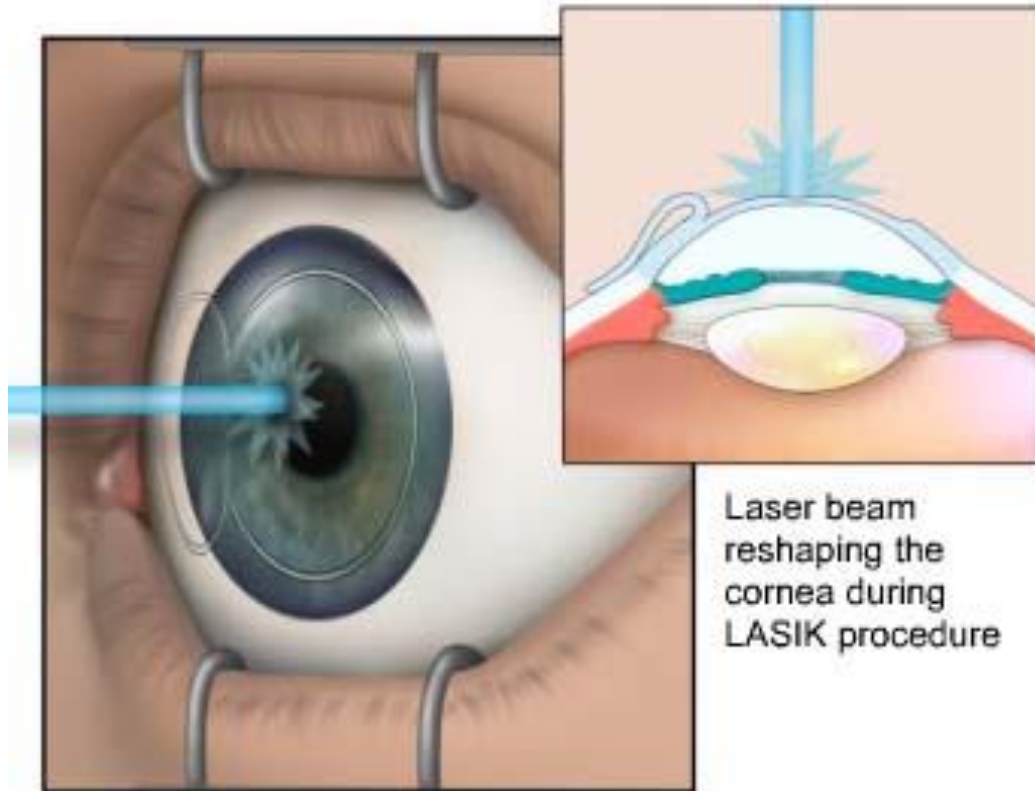
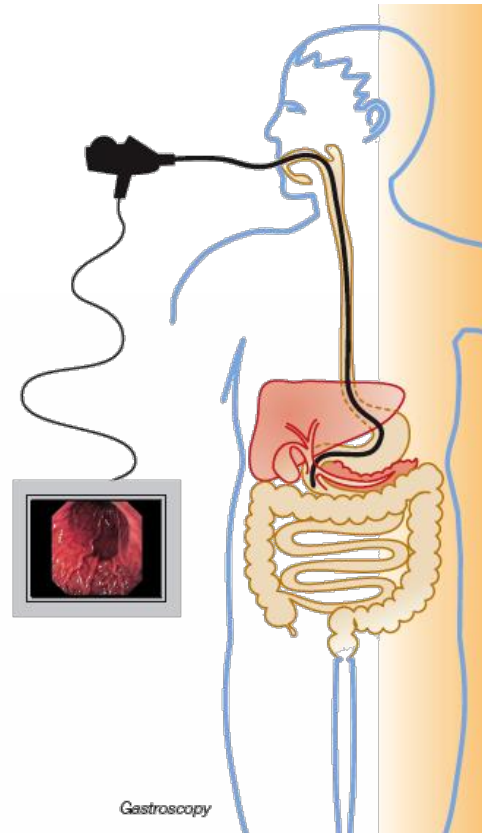


Optical Components

PHOTONICS IN SMARTPHONES



PHOTONICS IN HOSPITALS




PHOTONICS IN HOSPITALS



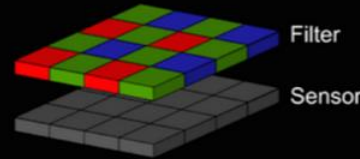
Heart Rate

Learn

The flash on your smart phone acts as a white light source which emits all visible wavelengths (colours). This light travels into the skin on your finger and interacts with the tissue and blood.



In every camera, there is a colour filter over the camera sensor which will allow an individual sensor pixel to capture red, green or blue light. This means that it is possible to access the red, green or blue images independently. The filter pattern is $\frac{1}{2}$ green, $\frac{1}{4}$ red and $\frac{1}{4}$ blue. The reason for more green than blue or red is to mimic the colour-sensitivity of the human eye.




← Home

Heart Rate

Measure

Start 49 BPM

Intensity 

Fourier Transform 

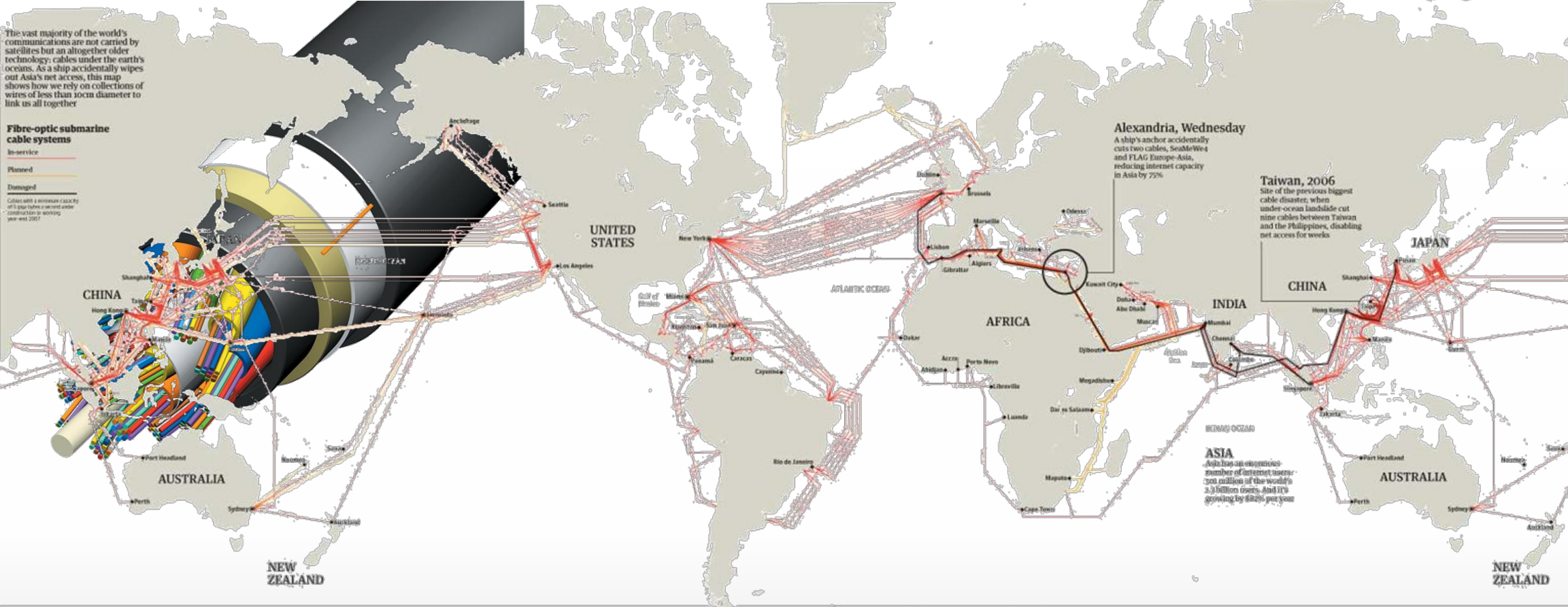
Heart Rate



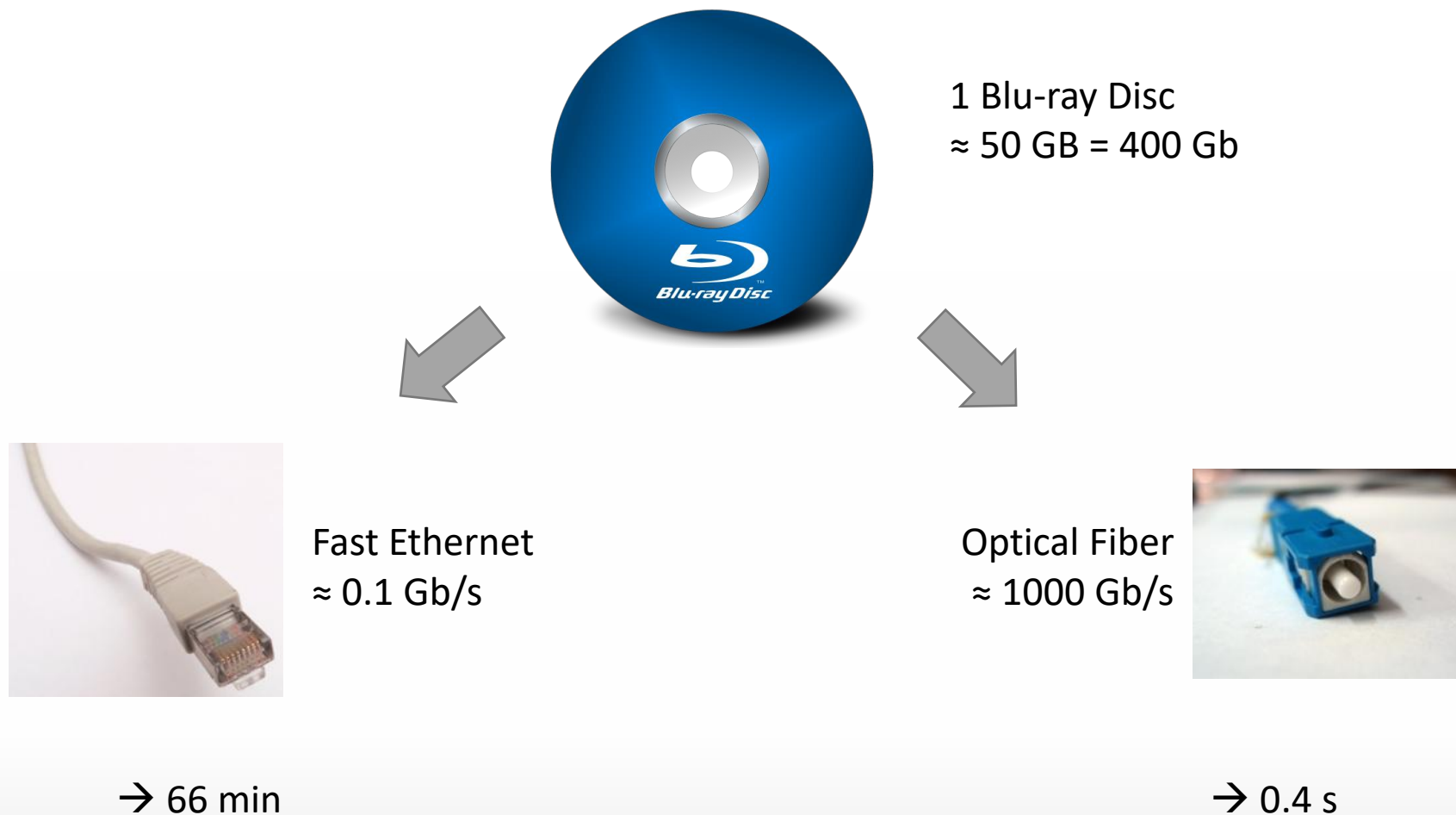
← Home

PHOTONICS IN TELECOMMUNICATION

The internet's undersea world



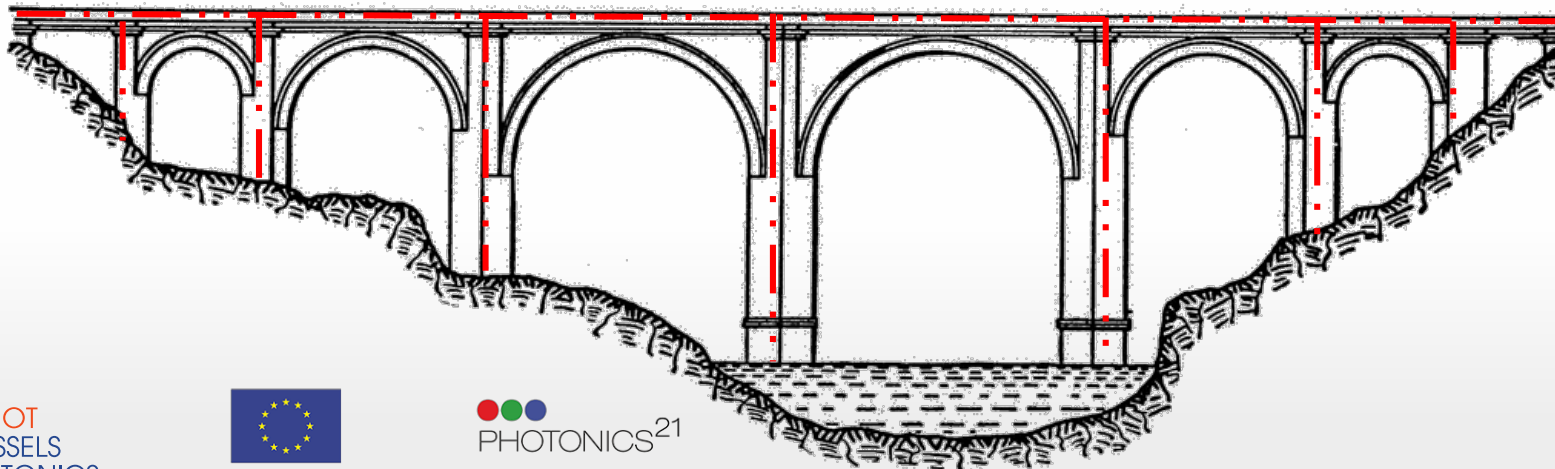
PHOTONICS IN TELECOMMUNICATION



PHOTONICS AS SENSORS



Fiber Sensors



PHOTONICS IN FOOD



STEM, SAY WHAT...?



COMBINING PHOTONICS & FAB LABS



Photonics



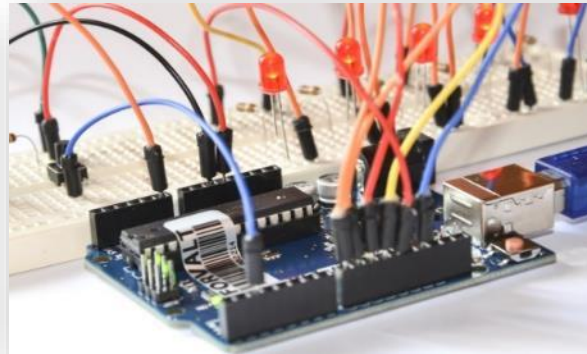
Fab Labs



FAB LABS & Maker Spaces



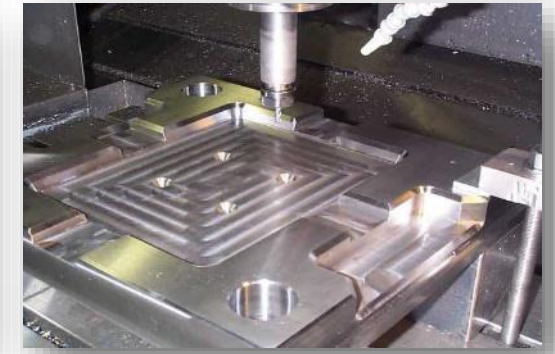
Laser Cutting



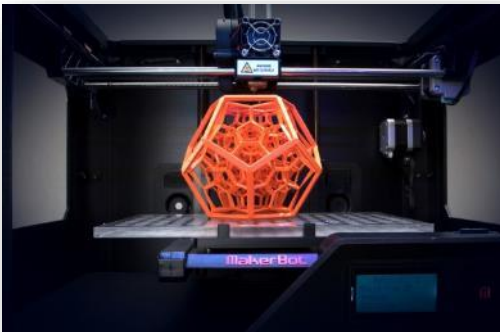
Electronics



3D scanning



CNC milling machines



3D printing



Robotics

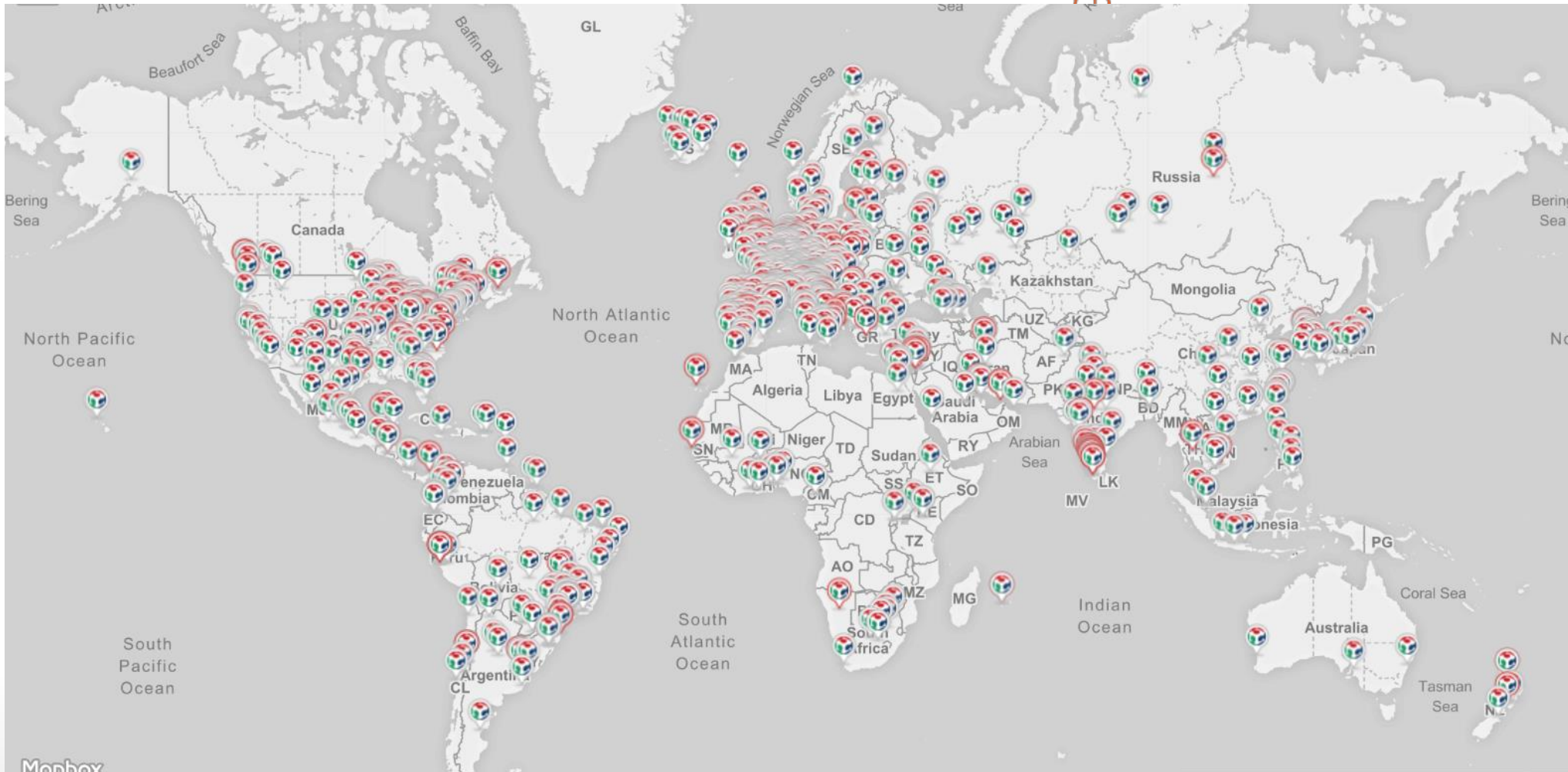


STEM projects

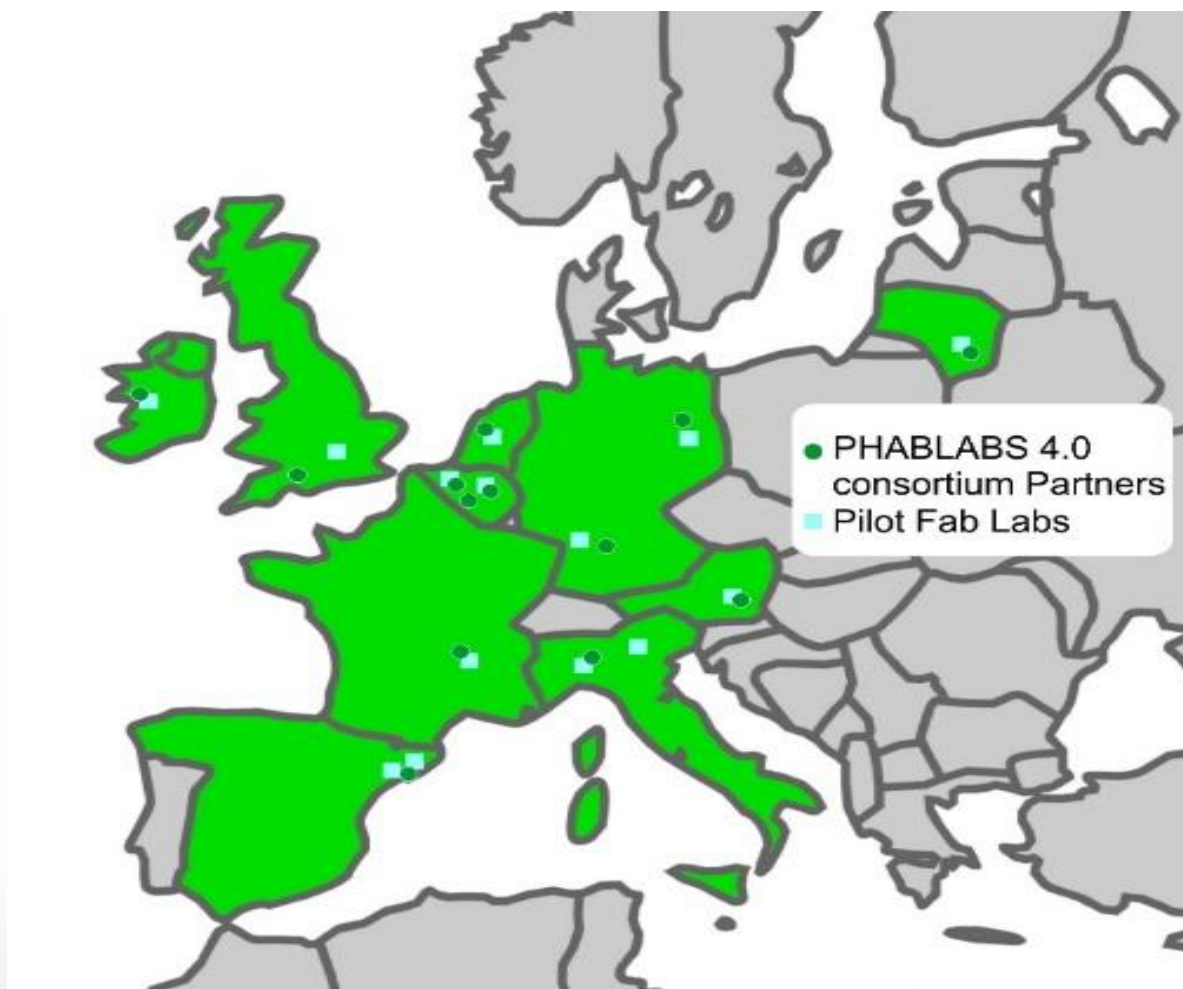


Computer modelling design

FAB LABS & Maker Spaces

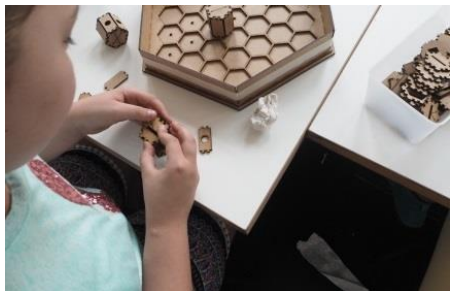


11 Photonics Partners & 14 Fab Labs



Photonics Partners	Pilot Fablabs
Brussels , VUB	FabLab Brussels FabLab Erpe Mere
Barcelona, ICFO	FabLab Barcelona Tinkerers Fab Lab
Berlin, FBH	ViNN:Lab
Milan, IFN-CNR	Muse FabLab, Trento FabLabMilano
Galway, NUIG	Makerspace of NUI Galway
Paris, UJM	OpenFactory42
Southampton, UoS	Fab Lab London
Graz, JR	FabLab Graz
Stuttgart, SEZ	Fablab Karlsruhe
Delft, TUD	Science Centre TuDelft
Vilnius, FTMC	M-LAB

TARGET GROUPS



Young minds (10-14y)

Raise awareness about the different unique characteristics of light



Students (15-18y)

Enhance Photonics **skills**, 21st century skills and general makerskills.



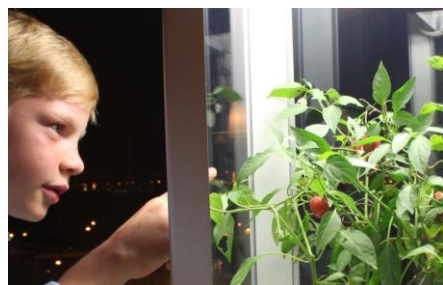
Young professionals (+18y)

Stimulate innovation with photonics.



PHOTONICS WORKSHOPS

Master the enabling character of photonics and its many applications



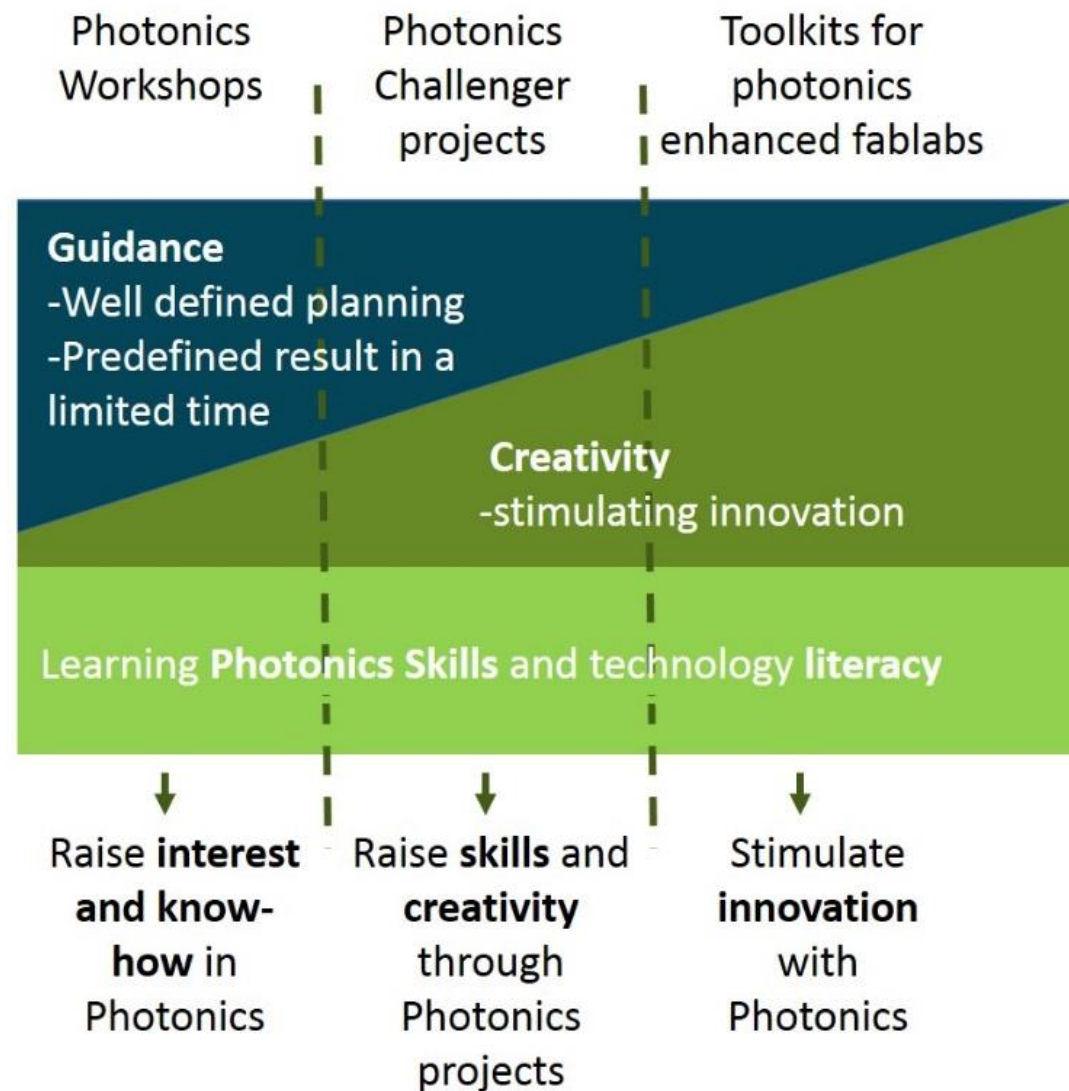
PHOTONICS CHALLENGER PROJECTS

As eye-opener to discovering the wide range of potential applications with photonics technology and **trigger creativity**



PHOTONICS TOOLKITS FOR FAB LABS

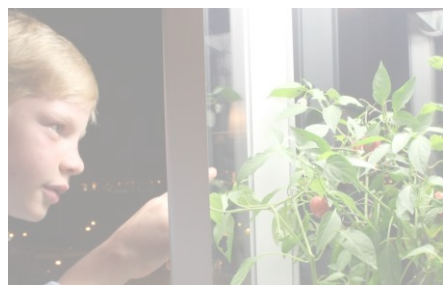
Make available durable low-cost photonics components and inspire innovation with photonics technology





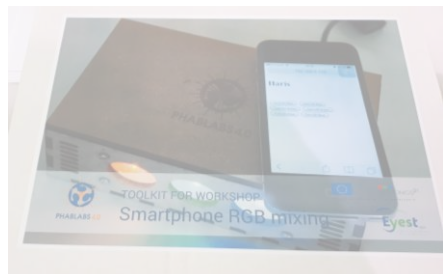
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PHOTONICS TOOLKITS FOR FAB LABS

Make available durable low-cost photonics components and inspire innovation with photonics technology

PHOTONICS WORKSHOPS



Workshop instructor
has a strong
guiding role

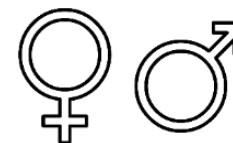


Duration:
½ day up to 1 day



instructables

Pre-defined
end-result/system



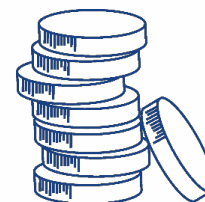
A female-friendly
approach



Target groups:
*Young minds (10-14y)
*Students (15-18y)
*Young
professionals (18+)



Creative commons
"Attribution-
Non-Commercial-
No-Derivate Works"



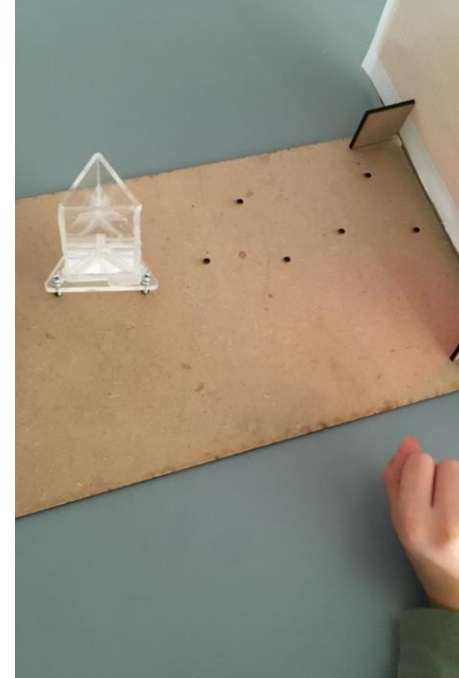
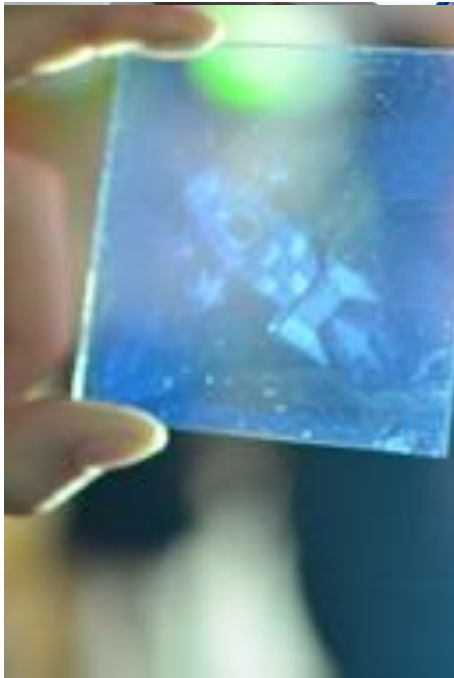
€10 - €32 per
participant



Possibility to
combine several
workshops in a
Photronics Camp

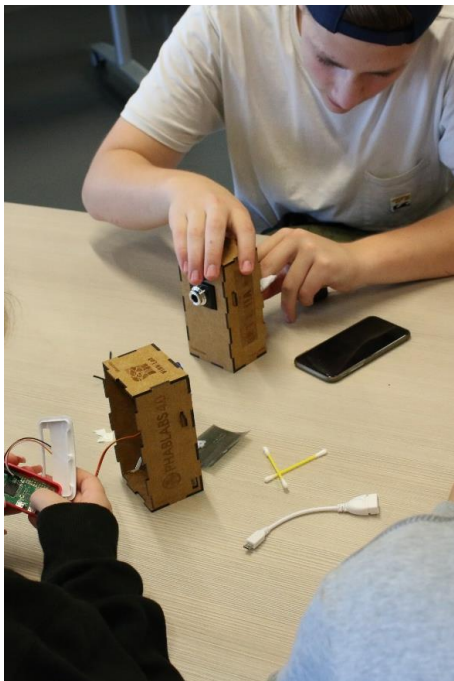
PHOTONICS WORKSHOPS

Young Minds (10-14y)



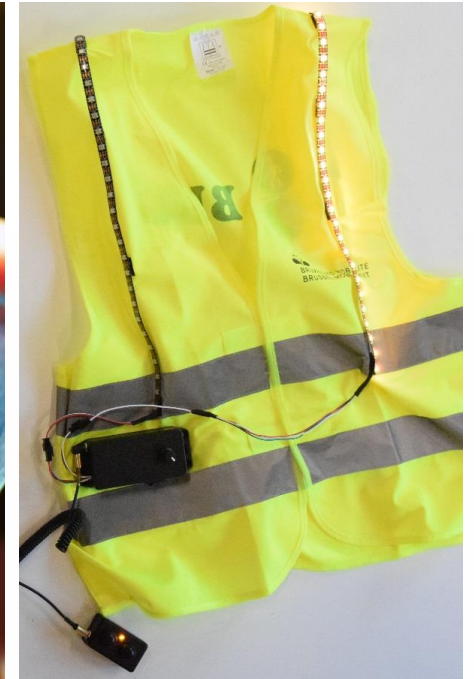
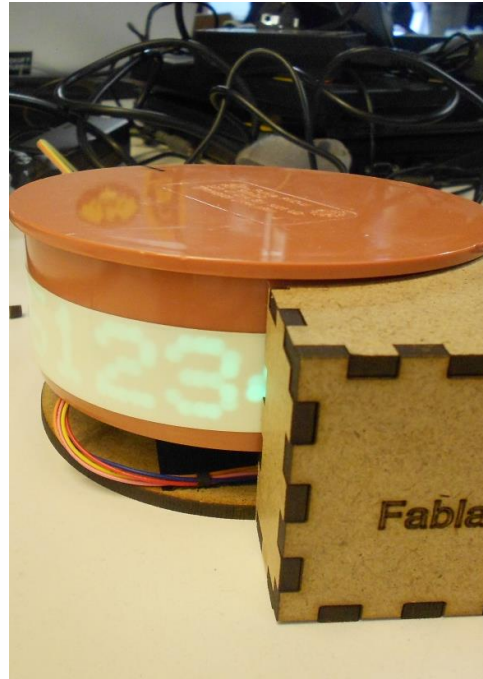
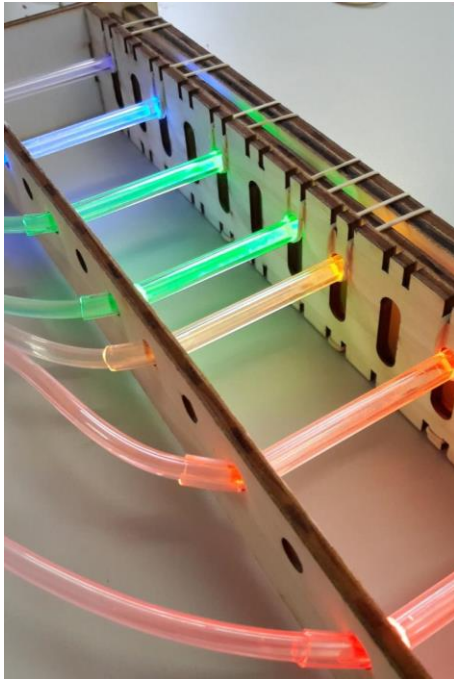
PHOTONICS WORKSHOPS

Students (14-18y)



PHOTONICS WORKSHOPS

Young Professionals (+18y)



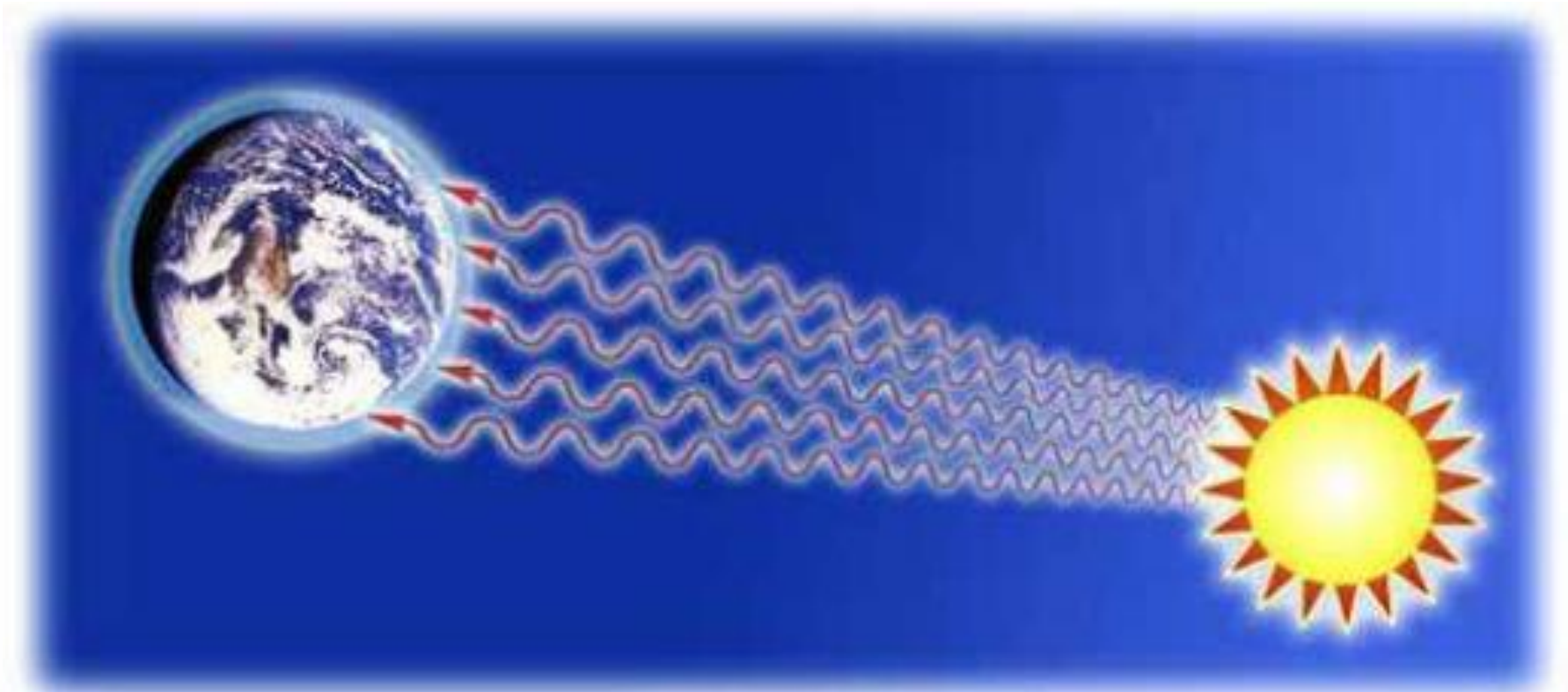
ART WITH LIGHT: POLARISATION

Young Minds (10-14y)



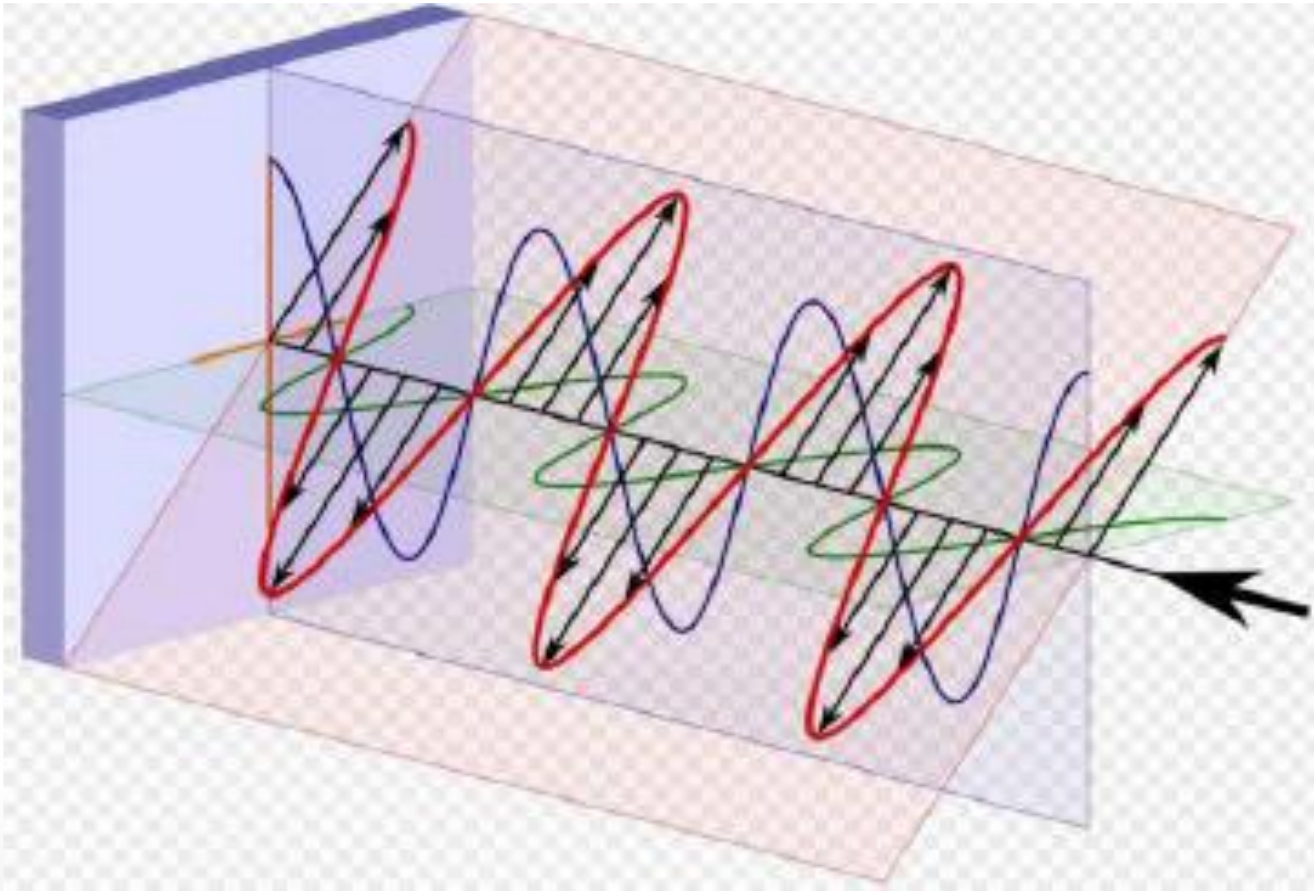
ART WITH LIGHT: POLARISATION

What is polarisation?



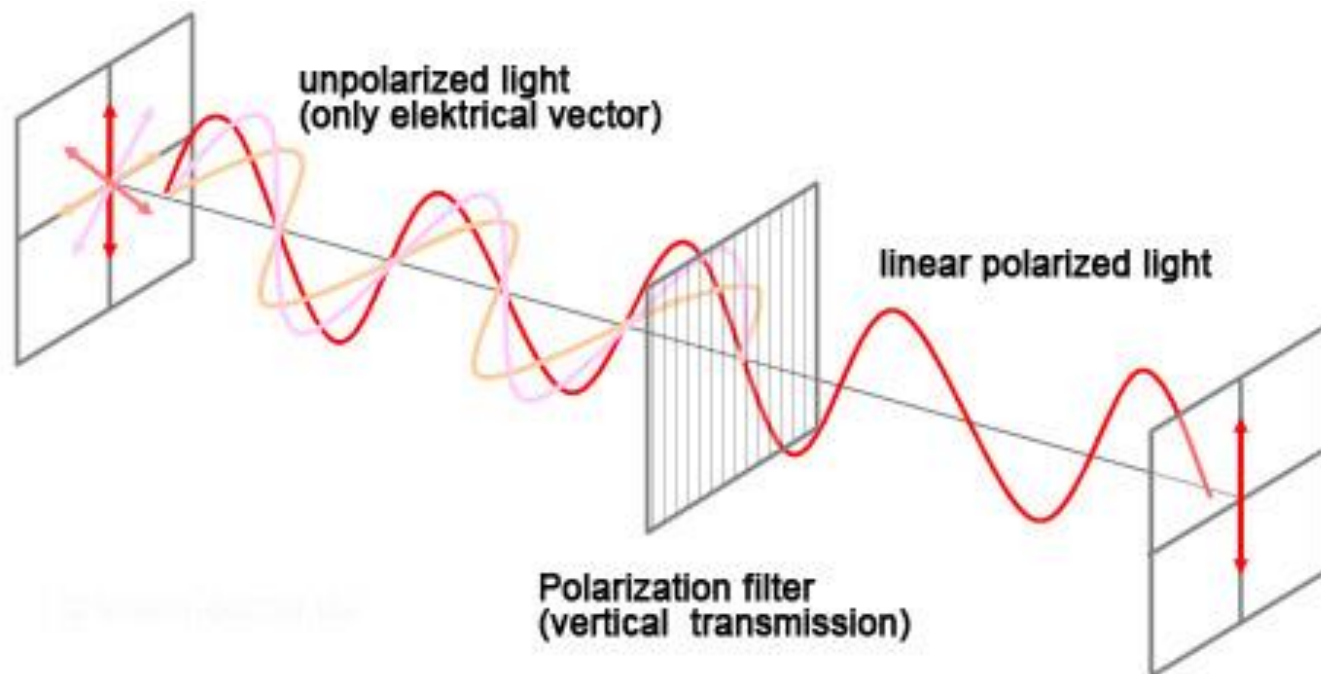
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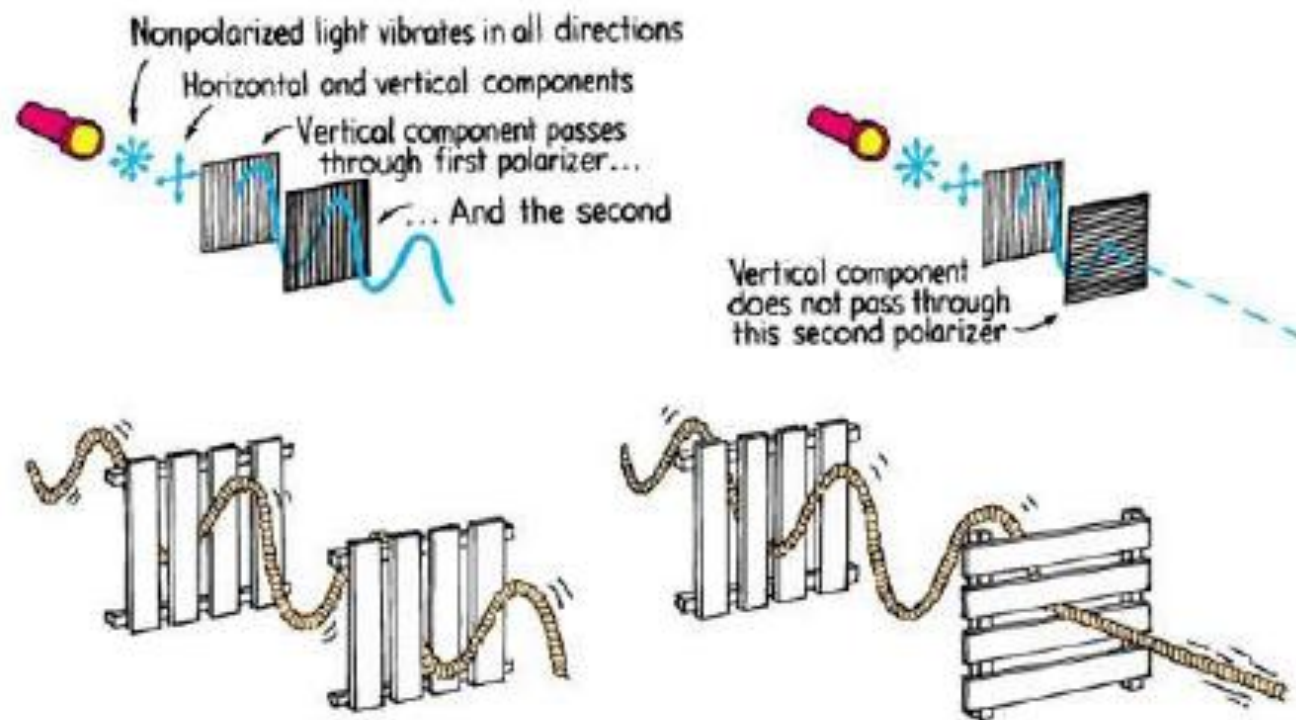
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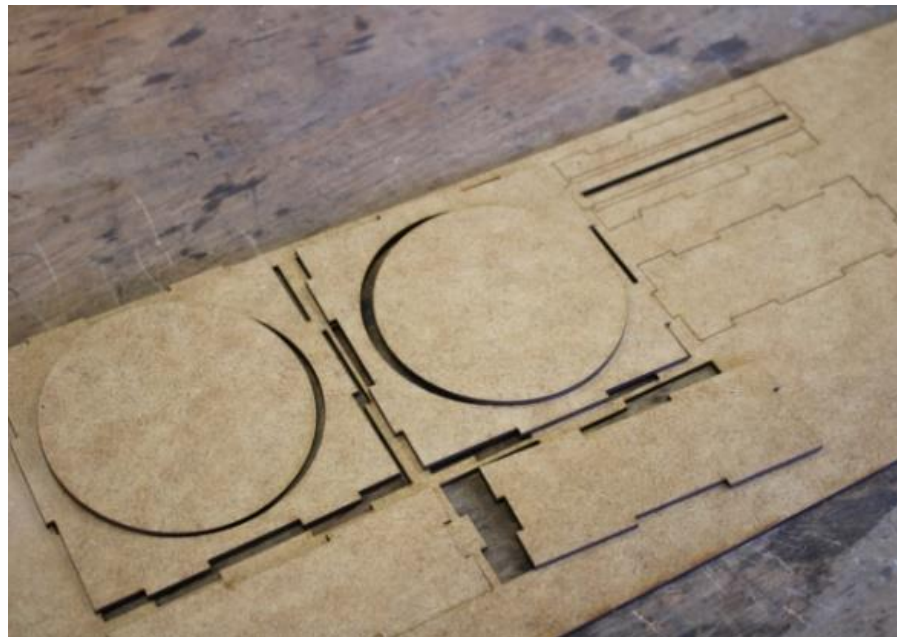
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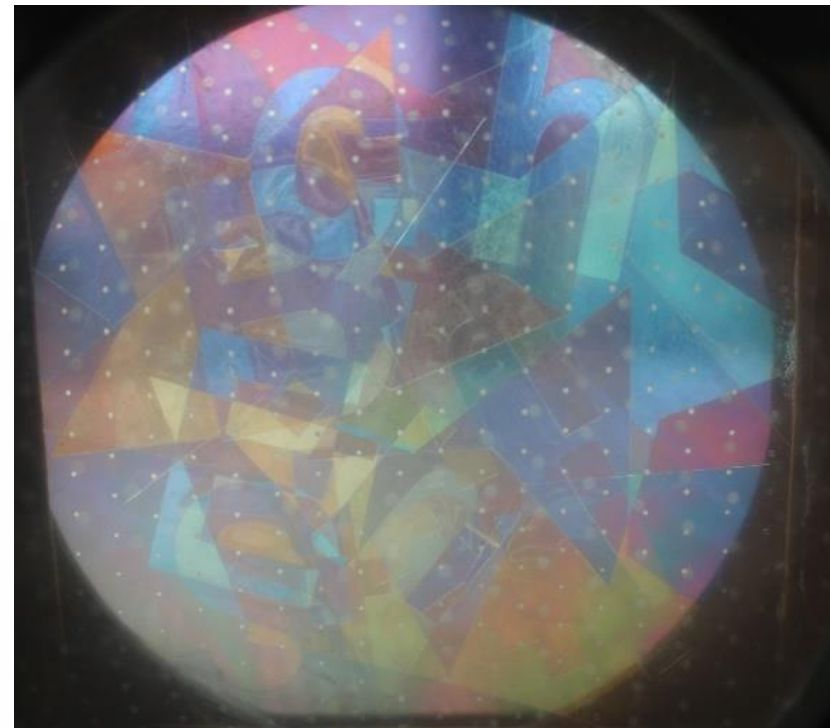
ART WITH LIGHT: POLARISATION

Art with polarisation



ART WITH LIGHT: POLARISATION

Art with polarisation



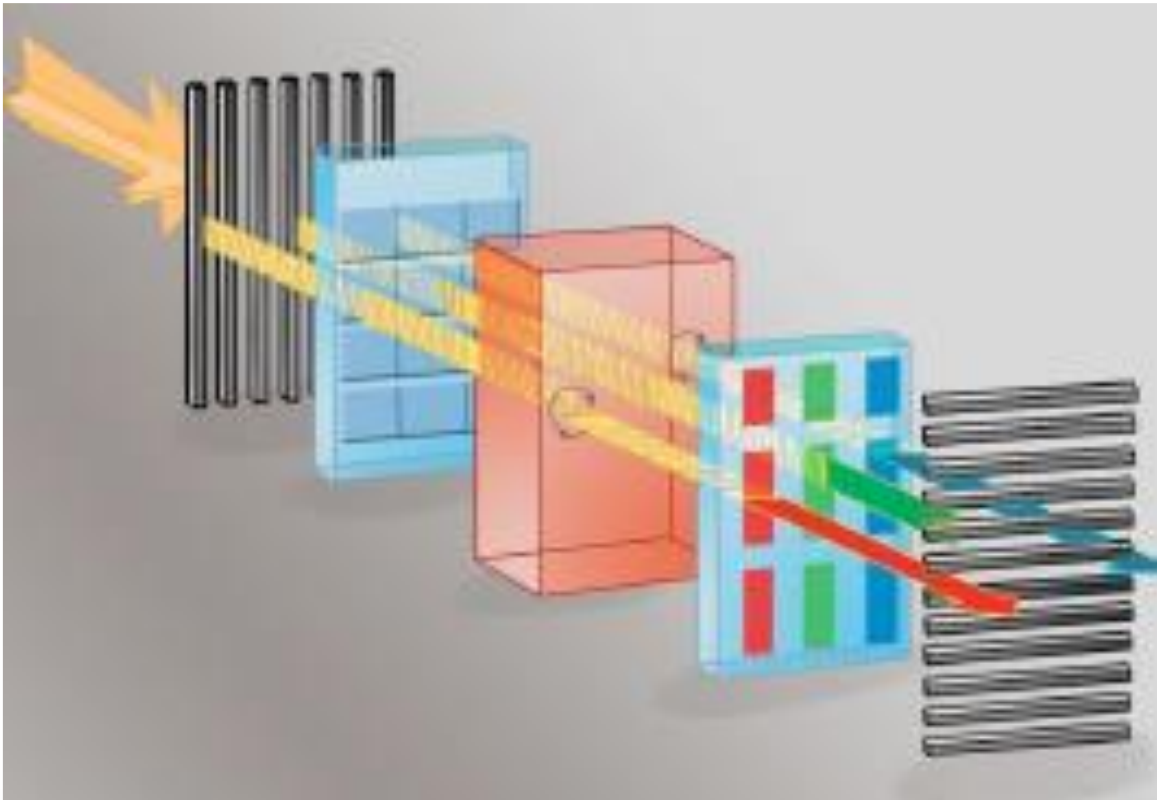
ART WITH LIGHT: POLARISATION

Application: LCD display



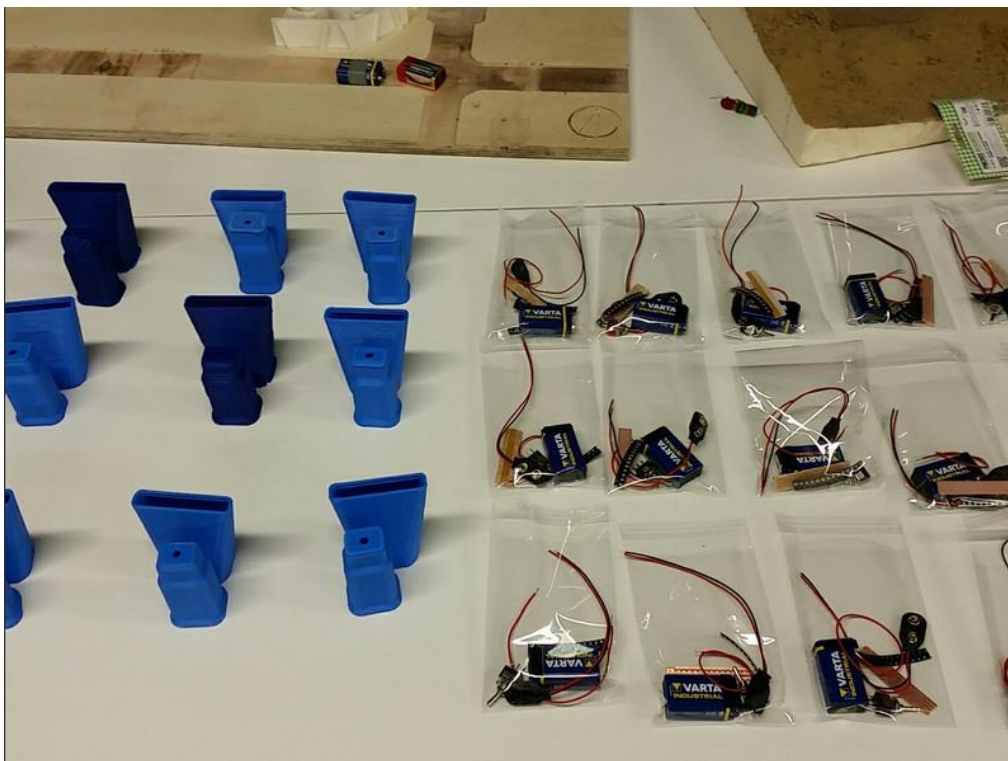
ART WITH LIGHT: POLARISATION

Application: LCD display



LIGHTPAINTING

Students (14 -18y)



LIGHTPAINTING

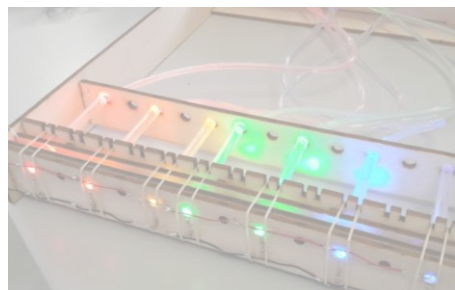
Students (14 -18y)



LIGHTPAINTING

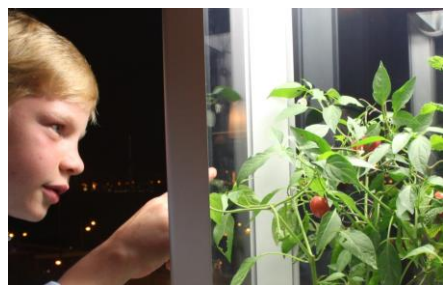
Students (14 -18y)





PHOTONICS WORKSHOPS

Master the enabling character of photonics and its many applications



PHOTONICS CHALLENGER PROJECTS

As eye-opener to discovering the wide range of potential applications with photonics technology and **trigger creativity**



PHOTONICS TOOLKITS FOR FAB LABS

Make available durable low-cost photonics components and inspire innovation with photonics technology

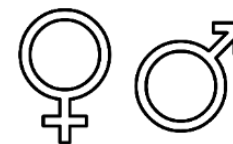
PHOTONICS CHALLENGERS



Mentor the projects more than guide them.



Duration:
Several months



Encourage team-work.

A female-friendly approach



Target groups:
*Students (15-18y)
*Young professionals (18+)



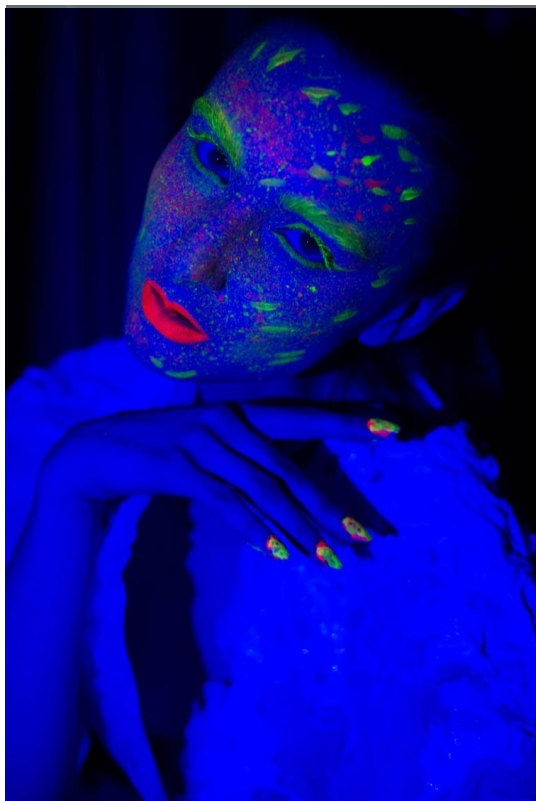
Creative commons
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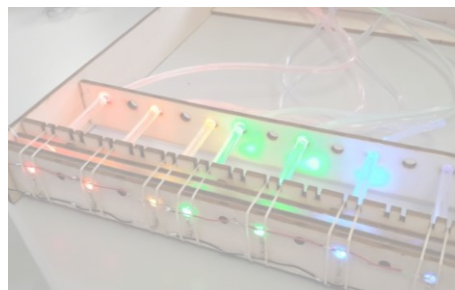
€160 per team

Promote
creativity: only
the assignment is
determined

PHOTONICS CHALLENGERS

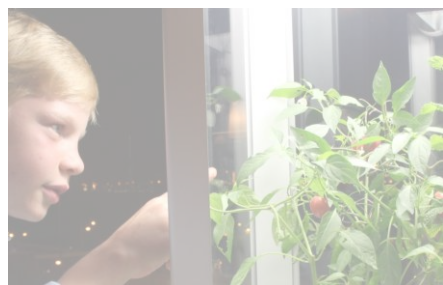






PHOTONICS WORKSHOPS

Master the enabling character of photonics and its many applications



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PHOTONICS TOOLKITS FOR FAB LABS

Make available durable low-cost photonics components and inspire innovation with photonics technology

PHOTONICS COMPONENTS TOOLKIT



OPTICAL FIBERS

An optical fiber is a flexible, transparent fiber made of glass or plastic, the diameter of which can vary. Optical fibers are often used as a means to guide or transmit light between the two ends of the fiber.

Characteristics

- Flexible plastic optical fiber
- 3mm Solid core, 5mm cladding
- Outer diameter 4.5 mm
- Transmitted PVC

Ideas

- Light in features
- Light structured in furniture
- Guiding light
- Optical communication

Workshops

- Photonics Map
- Crafty Toy





PLEXIGLASS

A hard transparent plastic sometimes used instead of glass. This material can be easily cut by the laser cutter.

Characteristics

- Extruded acrylic
- Thickness: 3mm
- Size: 300 mm

Ideas

- Cutting light waveguides
- Engineers figures
- Projector chart

Workshops

- Imagology
- Creative drawing using light board
- Playing with lightguides





LENSES

A lens is a transmissive optical component that focuses or disperses a light beam by means of refraction. It is made of a transparent plastic or glass material. It is used for imaging applications, light beam shaping or light collectors.

Characteristics

- Plastic lenses
- NOM1: D=16.5mm, H=25mm
- NOM2: D=16.5mm, H=30mm
- NOM3: D=16.5mm, H=40mm

Ideas

- Message
- Camera

Workshops

- Audio disc projector
- Diagram the torch





COLOURED LEDs

A light emitting diode is a two-terminal semiconductor light source. It is a p-n junction diode that emits light when activated. Coloured LEDs are made from a variety of semiconductor materials.

Characteristics

- LED diameter: 5mm
- Viewing angle: 8°
- Different wavelengths

Ideas

- Routing antennae
- Fashion
- Lamps and signalisation

Workshops

- Photonics Map





POWER LEDs

A light emitting diode is a two-terminal semiconductor light source. It is a p-n junction diode that emits light when activated. High power LEDs are all about efficiency and lowering forward voltage (VF) to achieve a higher luminance.

Characteristics

- 1 W high power LED
- Max: 650-660 nm
- Power: 100-150 mW
- Size: 400-450 nm

Ideas

- Projector
- Lamps

Workshops

- With controlled RGB LED for lighting





RGB LEDs

White light can be formed by mixing differently coloured LEDs, the most common method is to use red, green and blue (RGB). Colour mixing is possible with this LED that contains red, green and blue LEDs.

Characteristics

- LED diameter: 5mm
- Emitting colour: Red, Green & Blue
- Size: 5x5
- VF: 2.0V

Ideas

- LED cube
- 4x combination with optical fiber
- Alcohol lamps

Workshops

- Crafty Toy
- Art with light RGB LED pen for light painting





LED STRIP

A LED strip is a flexible circuit board populated by surface mounted light emitting diodes (SMD LEDs) and other components on an organic backing. It can be used as accent lighting, task lighting, ...

Characteristics

- W52012, 48 LEDs/m, 52V, 3.3 W/m
- IP67 waterproof (capable of withstanding water immersion between 10 cm and 1m for 30 min.)
- RGB, each LED separately controllable (compatible with Arduino)

Ideas

- Fashion
- Lighting systems
- In combination with glass

Workshops

- Project for solar cycling





SOLAR CELL

A solar cell is an optoelectronic device that converts the energy of light directly into electricity by the photovoltaic effect, which is a physical phenomenon.

Characteristics

- Solar cell Optiphot
- V = 0.5V
- Power = 0.25W
- Dimensions: 120 x 60mm

Ideas

- Light lamp
- Light lamp

Workshops

- With controlled RGB LED for lighting





OLED DISPLAY

An organic light emitting diode is a LED in which the emissive electroluminescent layer is a film of organic compound that emits light in response to an electric current. These OLEDs are used in displays.

Characteristics

- 5.9" display
- Characteristics: 1.28W/m
- Drive voltage: 3.3 - 3V DC
- Can be driven by Arduino

Ideas

- Display in robots/vehicles
- Alarm Clock
- Smart Fashion

Workshops

- Photonics





LASER DIODE

A laser diode is an electrically pumped semiconductor laser in which the active laser medium is formed by a p-n junction of a semiconductor diode similar to that found in a light emitting diode. The laser light is a directional lighting source.

Characteristics

- Optical power: 0.5 mW (output rate)
- Size: 3x3 mm
- VF: 3.0V
- Size: 3x3 mm

Ideas

- Barcode scanner
- Laser image
- Laser scanning
- Laser shooting

Workshops

- Laser Labyrinth
- Laser telescope





MIRROR

A mirror reflects light in such way that, the reflected light preserves most of the detailed physical characteristics of the original light. An aluminium mirror doesn't break as well as glass or made of glass.

Characteristics

- Size: 100x100
- Thickness: 0.4 mm
- Round corner
- Reflectance coefficient: > 90%

Ideas

- Art with mirrors
- Light pipe

Workshops

- Laser Labyrinth
- Mapping device
- Lasers





POLARIZERS

A polarizer is an optical filter that transmits light waves of a specific polarization and blocks light waves of other polarizations.

Characteristics

- Transmittance single: 38% at 1% @ 550 nm
- Transmittance crossed: < 0.05% @ 450 - 650 nm
- Polarizing efficiency: > 99.9%

Ideas

- Hidden messages
- Visualization of mechanical stress and strain

Workshops

- Art with polarization
- Photometer



TECHNICAL DATASHEETS of all components can be found online: www.phablab.eu/photronics-toolkits

PHOTONICS TOOLKITS

GENERAL PHOTONICS TOOLKIT



PHOTONICS TOOLKITS

WORKSHOP SPECIFIC TOOLKIT



PHOTONICS TOOLKITS

SMARTPHONE RGB colour mixing



Included in the Photonics Toolkit:

- Instructions to perform this workshop
- All Photonics & Electronics material for 10 participants

PHOTONICS TOOLKITS

SMARTPHONE RGB colour mixing: instructions & educational value



PROPERTIES OF

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Step 1: Parts list

Collect all materials

Photonics Part

Red, green & blue

1 piece of each

'LED' stands for Light

generates light of color

one-way street for electricity

you turn around the blocked.

Lenses

3 pieces

The lenses we use are provided by each LED attached to the LED.

The photonics part

The electronic part

PHABLABS 4.0 4

Step 2: Electronics

Voltage and Current

It is useful to compare water pipe system which corresponds with the other to a current correspond resulting water flow (a ball of hair in a circuit to an electrical resistor)

What have we learned

In this workshop, we microcontroller WeMos available on the internet power-LEDs. We also device using laser-cutting

Concluding thoughts

Arduino-based systems only a couple of years a community around the than happy to share the workshop to come up with

PHABLABS 4.0 5

Step 3: The micro

Protecting LEDs

First we prepare the current, each the largest resistor moderate voltage. Each resistor has

This project uses a do as well. To keep WeMos. When using ingly, which we will The WeMos is powered, it can be The WeMos is an Arduino desktop or laptop of the Arduino platform which is a tiny, cheap but which can be based on the internet, which on everything new

The metallic box or to wireless communication is its antenna. Don't The WeMos is powered out, the WeMos can board which provides

Explanation for the but different voltage serial resistor connected selected current of: $= (5-3.4V) / 0.1A = 16\Omega$

In the text above various reasons, the resistor When we connect resistor, which is 1 resistors, which are Here are the values

LED
Red
Green
Blue

Depending on the high-power-LEDs

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Step 4: Peripherals

The WeMos switch your smartphone. ULN2003A powers would burn up. The ULN2003A, and the

PHABLABS 4.0 8

Step 5: Quick start

For programming (ment), which can

After we start it, so that the approach

In order to program Arduino program WeMos as well as

1. Open the Arduino

Preferences

Sketchbook location:

C:\Users\jaya\Documents

Editor language: System

Editor font size: 12

Show verbose output during compilation: No

Compiler warnings: No

☐ Display line numbers

☐ Enable Code Folding

☒ Verify code after upload

☐ Use external editor

☒ Check for updates on startup

☒ Update sketch files when uploading

☒ Save when verifying

Additional boards Manager

More preferences can be found in the Arduino IDE (edit only when Arduino is not running)

Copy the following

http://arduino.cc

and press OK to

2. Select "Tools"

Navigate to "serial programming environment" as shown.

PHABLABS 4.0 10

Assembling the electronics

(a)

(c)

Insert the nuts in each top of the LEDs (c,d), to keep everything in

(a)

(c)

Then we put in the of the WeMos. We WeMos is connected of the WeMos to the

(a)

The figure above is to the small break ULN2003A output

Then, connect all b, and the negative

3,3ohms (orange), 4,7ohms (yellow-violet) and 5,6ohms (green)

PHABLABS 4.0 11

PHABLABS 4.0 is a European project where two major trends are combined into one powerful and ambitious innovation pathway for digitization of European industry. On the one hand the growing awareness of photonics as an important innovation driver and a key enabling technology towards a better society, and on the other hand the exploding network of vibrant Fab Labs where next-generation practical skills-based learning using KETs is core but where photonics is currently lacking.

www.PHABLABS.eu

This workshop was set up by the Institute of Photonics Sciences, ICFO in close collaboration with Fablab Barcelona and Tinkerers Lab.

PHOTONICS PUBLIC PRIVATE PARTNERSHIP

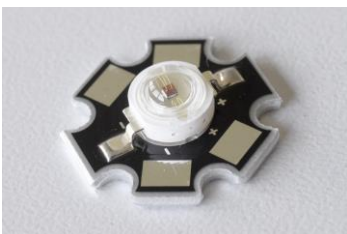
B-PHOT
BRUSSELS
PHOTONICS

PHOTONICS PUBLIC PRIVATE PARTNERSHIP

PHABLABS 4.0
18-9-2018 | 51

PHOTONICS TOOLKITS

SMARTPHONE RGB colour mixing: Materials per participant



3 High Power
LEDs: Red,
Green & Blue

Resistor 3.3 Ohm

Resistor 4.7 Ohm



3 lenses for
High Power
LEDs

Resistor 5.6 Ohm

ULN2003A

Breadboard small



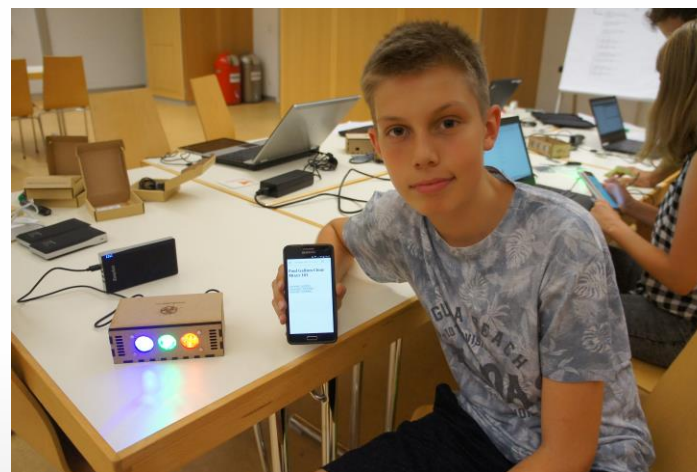
WeMos
microcontroller

Breadboard extra small

USB A to Micro B

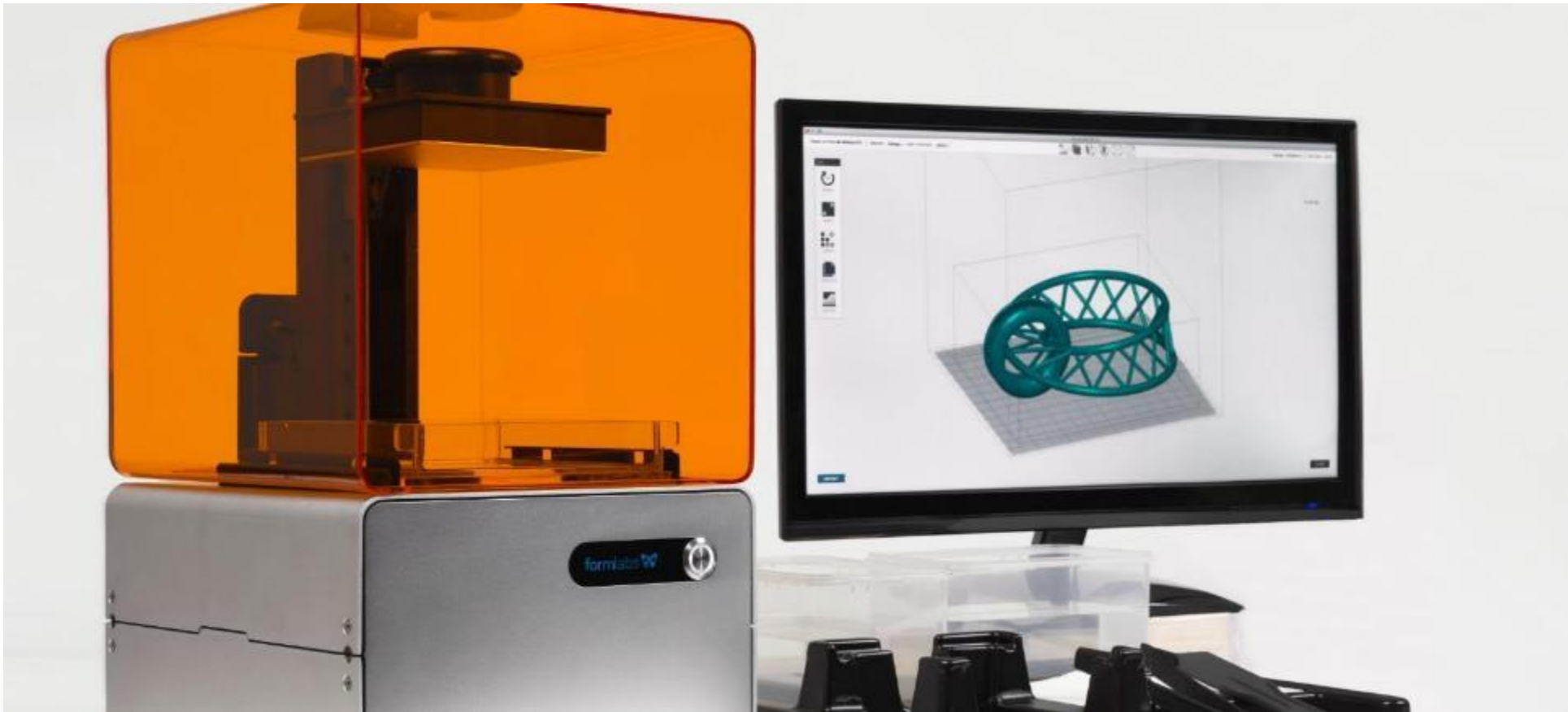
PHOTONICS TOOLKITS

SMARTPHONE RGB colour mixing: Tests in secondary schools



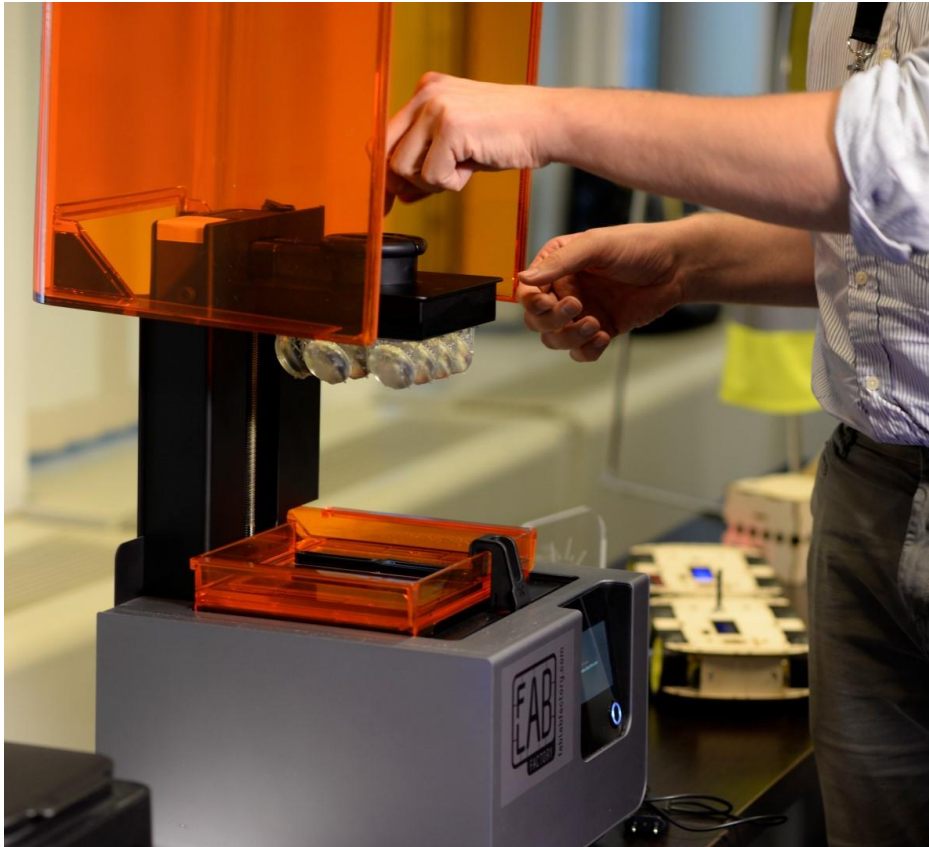
PHOTONICS TOOLKITS

3D printer for transparent material



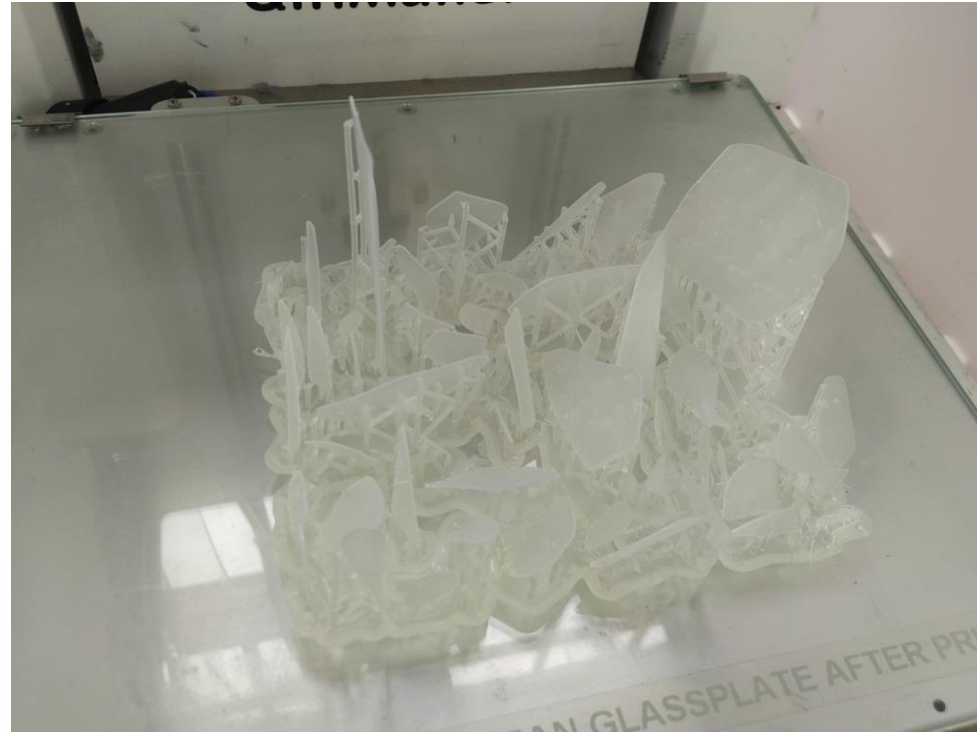
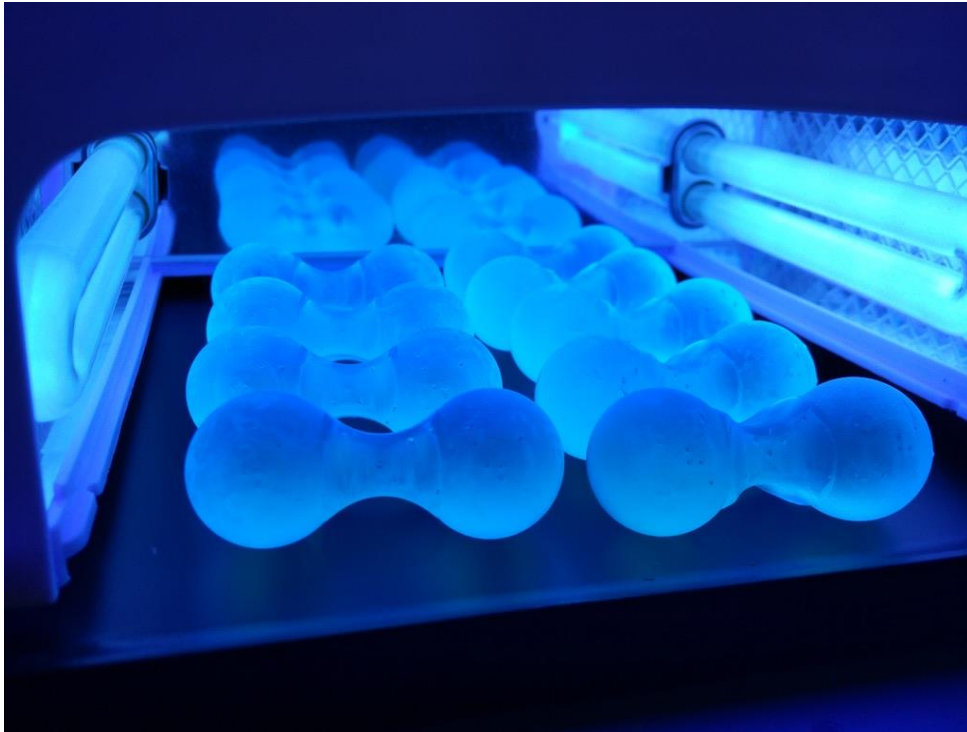
PHOTONICS TOOLKITS

3D printer for transparent material



PHOTONICS TOOLKITS

3D printer for transparent material



GIRL FRIENDLY APPROACH



IET
@TheIET

Follow

More than one in 10 girls think that STEM careers are more suited for boys. In modern society, it's important to disregard stereotypes.

[#SmashStereotypesToBits](#) [#INWED18](#)

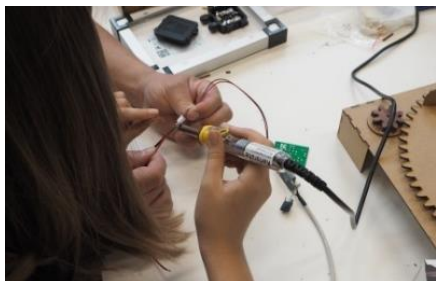


12:00 am - 21 Jun 2018

500 Retweets 666 Likes

@L Cyl All Ka Ge To Nir uh Chi

GIRL FRIENDLY APPROACH



Aim

To increase **the number of females** who consider studying Physics/Photonics.

Philosophy

Start from where the girls are (**their self-identity**). Do **NOT** expect them to change or to act like/become proto males.

Motto

Equality of experience is not the same as equality of opportunity

GIRL FRIENDLY APPROACH



What activities **don't work**?

- Competitions

▶ The PHABLABS 4.0 consortium changed the Photonics Challenger contest into an award system.

- After-school STEM clubs

▶ We tried to integrate the PHABLABS 4.0 activities into other hobbies/activities of the girls.
E.g.: youth movement, schools...

- Activities that don't involve mum

▶ We organised PHABLABS 4.0 workshops that include Mothers – either on the day or via a flyer to take home to show Mum.



GIRL FRIENDLY APPROACH



Pragmatic approach during workshops in Fab Labs

Objectives:

- Explore how to **engage** girls
- Be aware of how instructors' behaviour can **encourage** or put off students
- Increase awareness of strategies to manage your engagement with young people to encourage them to see photonics as "**something for them**"



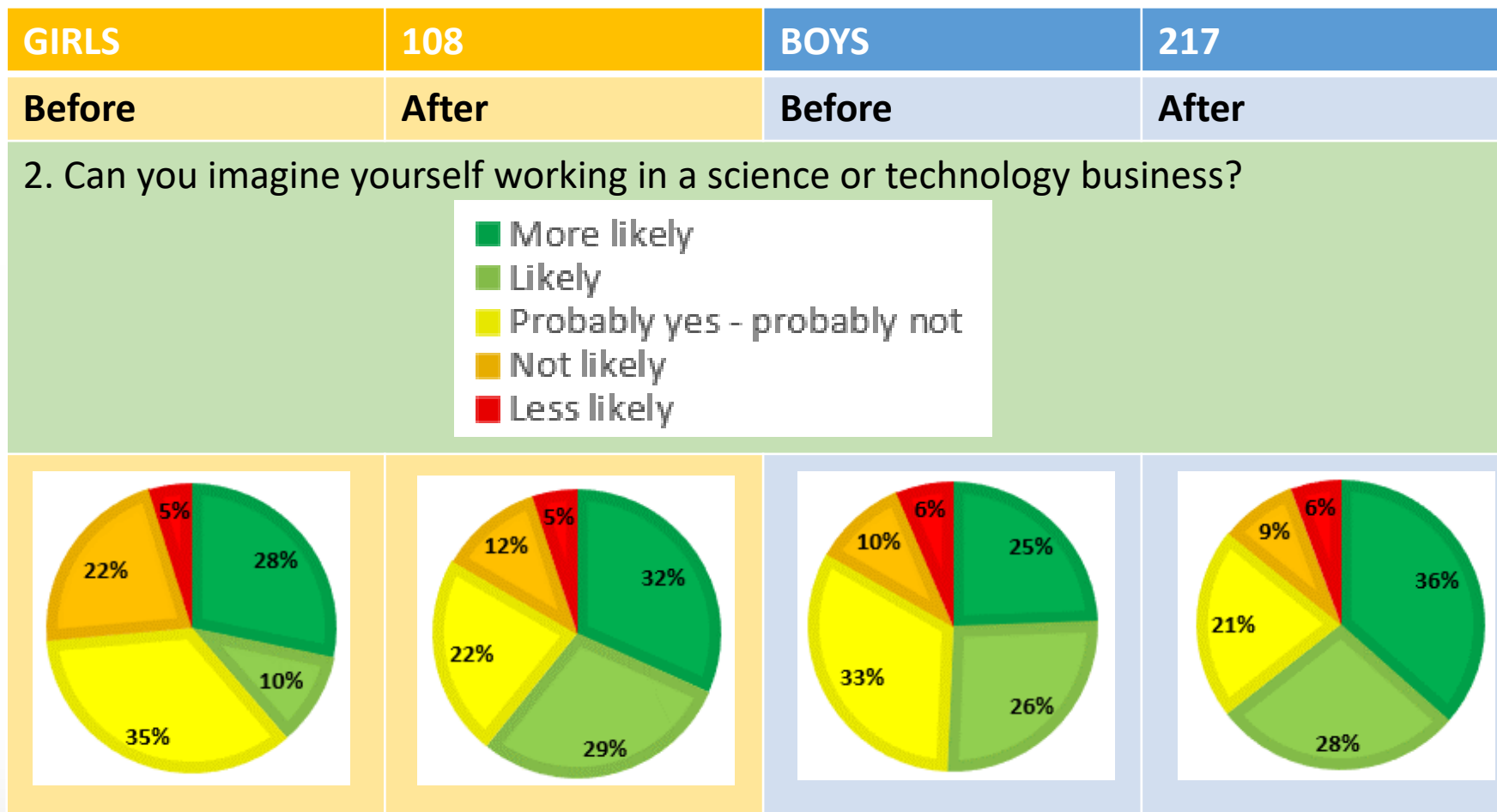
Ensure you spend as much time with girls as boys. Choose your vocabulary and messages during the workshops and challenges carefully.

PHOTONICS WORKSHOPS

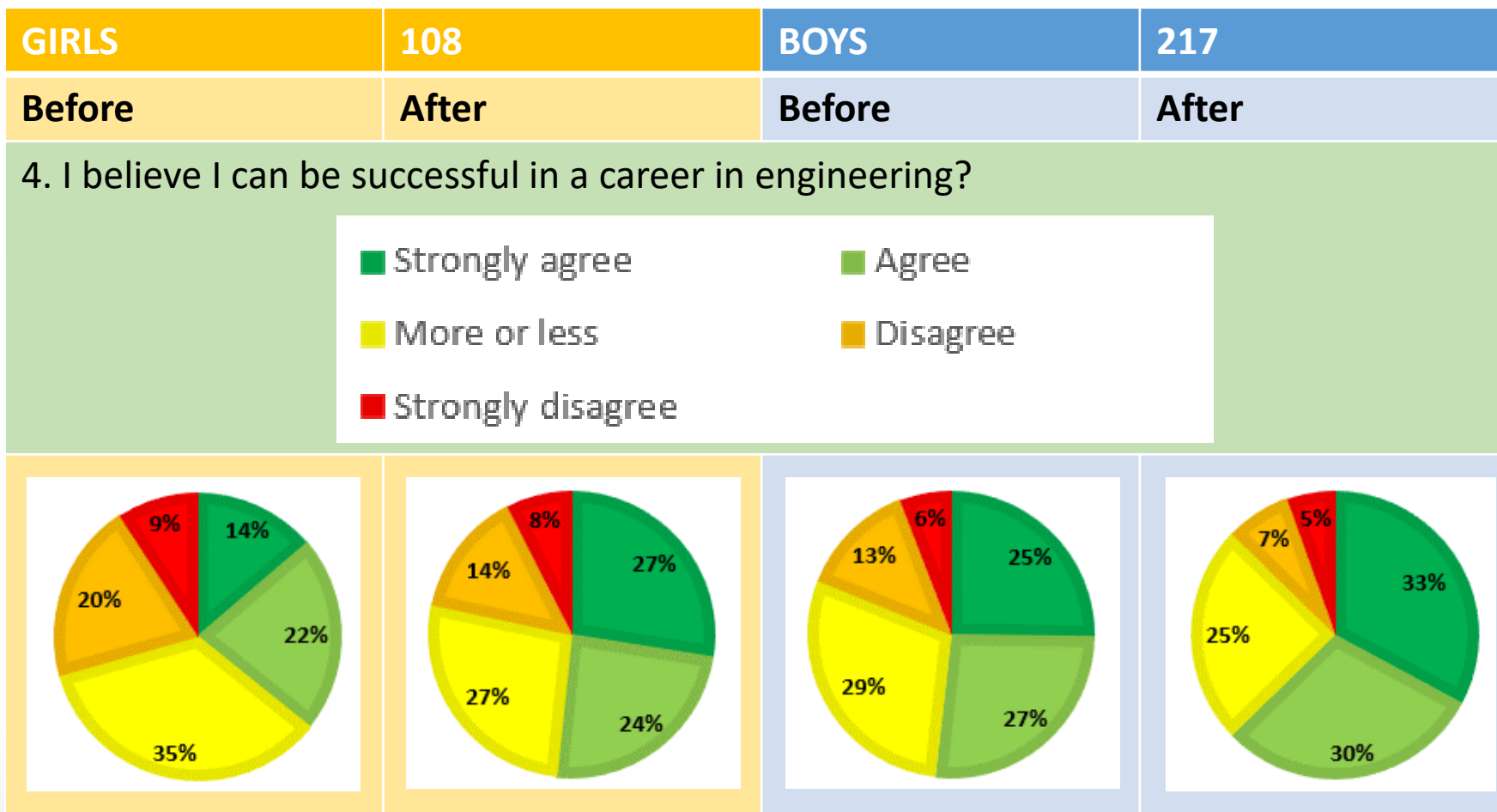
Tested during 12 months



GIRL FRIENDLY APPROACH



GIRL FRIENDLY APPROACH



NEXT STEPS?



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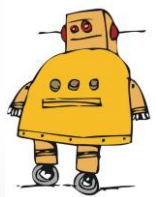
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PHABLABS 4.0 Youtube Channel



Instructables PHABLABS 4.0