A workshop made by Giulio Bonanome & Valentina Ercolani (H-Farm Education)

Pinball Machine

focus on problem solving

Stimulate problem solving	**Platinum**	**Stimulate entrepreneurship**	**Bronze**
Stimulate creativity	**Gold**	**Informal learning enviro.**	**Gold**
Stimulate critical thinking	**Gold**	**Technology use**	**Bronze**
Stimulate group work	**Platinum**		

Practicalities

Preparation: 30’

Duration: 3h

Material needs:

- Masking and clear tapes, strings
- Scissors, utility knife
- Hot glue gun
- Multi-Colored Paper
- Rubber bands
- Paper clips
- Straws
- Craft sticks, toothpick
- Brass fasteners
- Marbles
- Cardboard or veroboard
- Copy paper or pieces of white paper
- Shallow boxes
- Objects to decorate: googly

Group size range: 20
Ideal sub-group size: 3-4

Workshop made for: 12-16
Easily transferable to workshops for ages between: up to 12 (-12)

Environment FabLab necessary: NO

Educational area:

* Engineering
* Science
* (Visual) Arts

eyes, pipe cleaners, pencils, markers, craft paper, bottle caps, aluminum foil, odds & ends...

Precognition

Knowledge about pushes and pulls (forces), levers and inclined planes.

(see box 'content links' below)

Preparation

Be sure to have the following materials for each team:

- at least 1 marble
- at least 1 shallow box (pizza box, shoebox lid, copier paper box lid, ...)
- paper for planning

Kids can share others materials such as cardboard, tape, straws, paper clips, brass fasteners, craft sticks.

Plan to have available as many boxes, rolls of masking tape and pieces of cardboard as possible. Don't forget to provide additional craft supplies (or other items such as balloons, glitters, pipe cleaners, ...) to inspire creativity.

We invite you to try the activity yourself before doing it so you can anticipate where kids may get stuck or need guidance.

Environment

If available we suggest to arrange the space with islands of tables spread around the room, so that both educators and participants can freely walk around them. One of the tables will be set up with tinkering materials and with other tools and supplies for the activity.

Workshop Guidelines

Phase 1: Orientation and Instruction Phase

Material needs:
Essential:

- Pictures of pinball games
- Tables arranged in small islands spread around the room
- Tools and materials on a separate table

Goals:
Skill Goals (**Blue**)

Content Goals (**Green**)

(C1) Analyzing everyday objects/games/machines and finding out how they works
(C2) Understanding what is a lever and an inclined plane from own experience

Background story:

Pinball machines are mechanical wonders that launch a steel ball on a wild ride around a colorful table full of flashing lights, bells, buzzers, and flippers. The golden age of the pinball machine was in the 1950s and 1960s. Kids used to play them in penny arcades and amusement parks.

Pinball game starts with the launcher that is designed to push the ball with enough strength to move it all the way to the top of the game board, where gravity takes over. To keep the ball moving it requires a lot of pushes and pulls (forces), which can change both the ball's speed and direction. All pinball game designs depend on two machines: the inclined plane and the lever. The game board is an inclined plane that uses gravity to keep the ball moving. To win players have to keep the ball in motion using flippers, which are levers made from various materials (wood, metal or plastic).

In teams, participants will design, build and decorate their own pinball machine formed by a lever that launch the ball to the top of the box, flippers to keep the ball in motion and inclined planes that lead the ball to the bottom.

3D Pinball for Windows - Space Cadet
Game Options Help
3D Pinball
Space Cadet
BALL 1
1
0

BATMAN
IN COLOR
BATMAN
BAT GADGET SELECTOR

GETAWAY
REDLINE
FREE RIDE
DRIVE AGAIN

Goals	Activities	Duration
C1, C2	**Explanation** of what is a Pinball game by starting a discussion with participants. Ask them what they know about pinball machine and if they ever played one. Show them some pictures to help them to analyze and describe this type of games. Ask for example: ● What do all Pinball machines have in common? ● What causes the ball to move through a Pinball machine? ● What is the goal of the game? ● What are the key elements of the game board? (launcher, obstacles, sounds, lights, inclined planes and levers) Explanation of the rules of the challenge.	10’
	Materials and space exploration Give some time to participants to look and touch different materials and tools available.	5’

Phase 2: Design Phase

Material needs:

Essential: sketching materials: paper, pens, pencils, …

Goals:

Skill Goals (**Blue**)

(S1) Abstraction of an idea to a 2-dimensional sketch
(S2) Teamworking
(S4) ***Optional***: communication
(S5) ***Optional***: to provide feedback on someone else idea

Content Goals (**Green**)

(C1) Strengths and weaknesses of different materials

Goals	Activities	Duration
S1, S2 C1	**Make a plan** Each group needs to brainstorm and draw a sketch of how their Pinball machine will look like, which kind of materials they want or need to use to build the launcher, the levers and the inclined planes. The expected outcome is not a technical drawing but just a raw sketch of their Pinball table, a list of materials they need for the mechanisms and an explanation of how the game will work. During this phase let also the team highlight which member will be responsible for which part/phase of the building. Maybe one could be responsible for the launcher while another for the obstacles and another for the flippers and another for the decoration. If participants are stuck, try to stimulate their thinking asking for example: • How will you keep the game inclined/slanted? • How will the ball be launched? • What kind of obstacles will you include and how many? • What kind of materials can you use to build the flippers? • Who will be responsible for which part of the pinball?	30’

S4, S5	***Optional*** You can make a circle and ask each group to present and share its idea with the rest of participants. After each presentation ask for feedback from the public. You can organize the feedback with the following guiding questions: • Is there something you didn't understand from the presentation? • Is there something you liked about the presentation? • Have you got some suggestions (for example about the implementation of the design, the use of materials or the design/location/material of the levers)?	20'

Phase 3: Making Phase

Material needs:

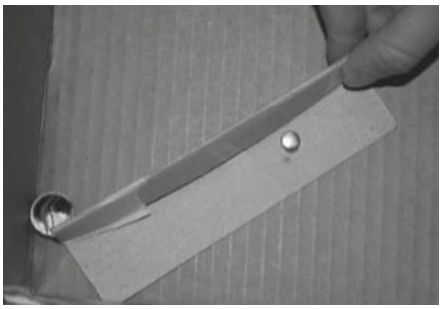
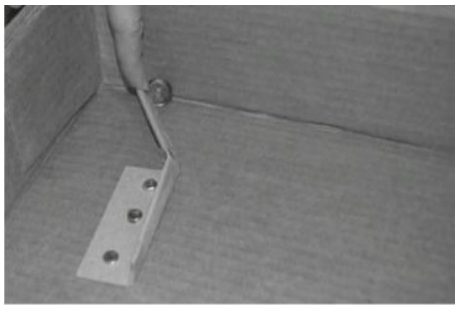
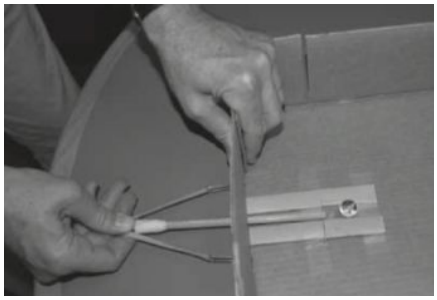
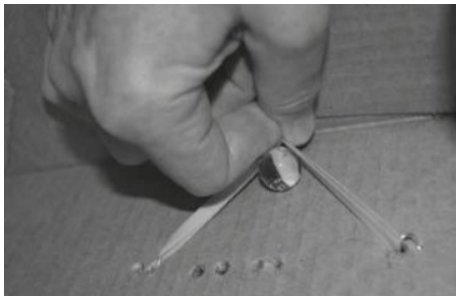
Essential: building materials and tools. Inspiring pictures of cardboard launchers. Paper for planning.

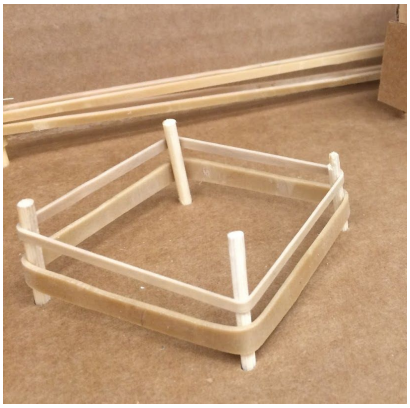
Goals:

Skill Goals (**Blue**)
(S1) Trial and error / Deal with failure
(S2) Working in group
(S3) Asking for help
(S4) ***Optional***: communication

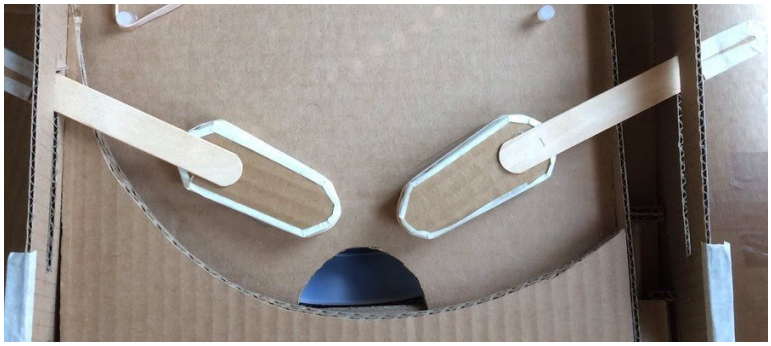
Content Goals (**Green**)
(C1) Strengths and weaknesses of different materials

Goals	Activities	Duration
S1, S2 S3, C1	**Let's build!** Each group build its Pinball machine in stages with a lot of try and error. Be sure the teams test each stage as they go. The first stage consists in designing the launcher. Participants can use rubber bands or craft a lever to send the ball up the ramp into the main area of the game. If they need to sketch the mechanism, give them paper and let their creativity lead the design. If they are stuck, try to stimulate them by asking what they have in mind and showing	1h30'

	some inspiring pictures. There are a lot of ways to build a launcher, educator's role is to let the kids know that there's no only one way possible. While testing the launcher with a marble, participants will notice that it's necessary to build a path/ramp to lead the ball to the top and to add a curve at the top of the launch ramp to direct the marble to the obstacles.    	
	The next stage is to build the obstacles that lead the ball to the bottom of the board. It's better to work from the top to the bottom testing each obstacle (they can be arches, tunnels, curves, … made by different materials).	



Teams can now add two flippers (or pivoting launchers) on both sidewalls of the board: they will help the player to keep the ball in motion. To build them, participants have to insert a piece of cardboard into a notch in the sidewalls. Kids will build and test both levers with try and error.



Let the participants test and redesign the layout of the board until it works as they expect.

	Let kids time to decorate their Pinball machines. Stimulate their ideas showing all the items available (paper cups, pipe cleaners, bottle caps, markers, glitters, googly eyes, aluminium foils, odds and ends and all the materials and objects you can provide).	
	Optional **Gallery walk** To spark creativity and share ideas, let each team show to the others its project focusing the attention on how the launcher and the obstacles will work. This is an opportunity to highlight how they can help other groups or to anticipate huge mistakes.	15’

Phase 4: Operational Phase

Material needs:

Essential: tables for the testing phase

Goals:
Skill Goals (**Blue**)
(S1) Trial and error / Deal with failure
(S2) Working in group

Content Goals (**Green**)
(C1)

Goals	Activities	Duration
S1, S2	**Test and troubleshooting** Let teams test their design and give them some time to fix problems and make adjustments and improvements as needed. Tips for educators: - If the ball doesn’t launch straight up, it’s necessary to build a path/ramp to lead the ball to the top and to add a curve at the top of the launch ramp to direct it to the obstacles. - If the ball moves through the obstacles too quickly, teams	10’

	should consider reducing the angle of the board. - The length of the lever and the location of the lever's fulcrum (pivoting point) can affect the amount of force with which the lever hits the ball.	
	Let's play! Give participants some time to play with their own Pinball machine and suggest them to try other kids' models. While playing, kids will test the Pinball machines designed by others and in a second moment they can give feedback to other teams.	10'

Phase 5: Evaluation Phase

Material needs:

Essential: chairs for all the participants

Goals:

Skill Goals (**Blue**)
(S1) Reflecting on the project
(S2) Communication

Content Goals (**Green**)

Goals	Activities	Duration
	Showcase and reflection Gather as a group and guide the showcase of the projects team by team asking them to describe their Pinball machine and to point out any unusual or especially creative features. Ask participants to reflect on the whole design process and to share their experience. Ask for example: • Did your game work the way you wanted it to? If not, why? • If you had more time, what would you add, fix, improve or change? • How did you build the launcher in your board? • What materials did you use to make your Pinball machine? Why did you choose those materials? • What was the most difficult thing to achieve as a group? Why? • How different is the final outcome of the Pinball machine compared to the design you made on paper at the beginning? Why?	20’

Pedagogical tips

We invite you to try the activity yourself before doing it so you can anticipate where kids may get stuck or need guidance. There are some mechanisms that may be difficult to build, for this reason we suggest you to prepare some inspiring pictures that can help them to get unstuck.

Facilitating this activity require you to support everyone's ideas, inviting to test contraptions and offering suggestions on how to make things work. We know how difficult it will be, but remember to let the participants explore their own path, without imposing your own ideas about how they might do something.

During the activity, even if you don't have time for the gallery walk, invite groups to take a look on different solutions and what's happening around.

How to transfer to non-Fablab environment

Transfer to non-fablab environment is very feasible, as long there is enough space and tables available.

The materials used for construction of the Pinball machines is dependant on the available resources.

Evaluation of achievements

At the end of the workshop you can give the different groups achievements.
For example for:

- The Pinball machine with the most beautiful decorations
- The Pinball machine that works as expected
- The team that designed the most creative launcher

The most collaborative team or the team that helped more other teams.

Content links

Some interesting links that can inspire you

- Caine's arcade short movie
- Design Your Own Cardboard Pinball Machine
- Pinball wizard activity on PBS Kids