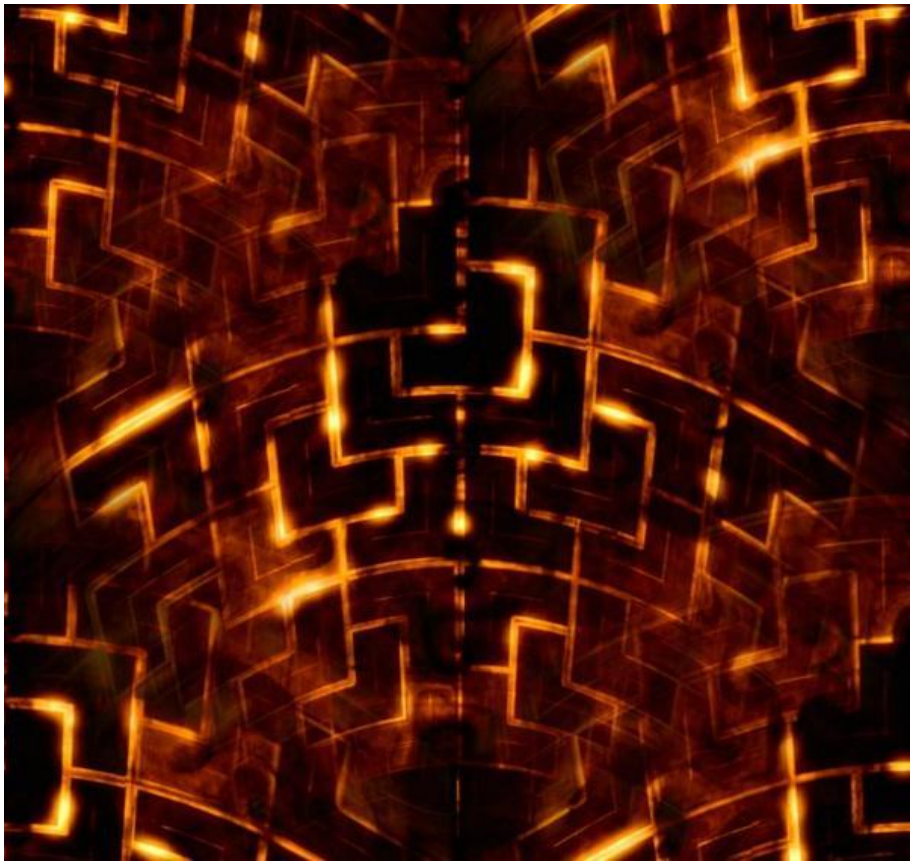
The Maze of Light

A curriculum about optics



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1. Learning objectives of the curriculum

Learning about light is the main goal of this curriculum. However, the topic of light is very broad, so this curriculum is about the reflection, refraction and dispersion of light. This curriculum consists of three parts, one for each type of school:

- the ages 3 through 6 (preschool)
- the ages 7 through 11 (primary school)
- the ages 12 through 18 (secondary school)

The specific goals are mentioned in the following table

Preschool	**Primary school**	**Secondary school**
Have experience with the Maze		
		Explain the Maze
		Build a Maze *(optional)*
Know that light travels in a straight line (rays/beams)		
Know that light is reflected by mirrors		
	Know that reflection has specific angles	
		Calculate and predict reflection angles
	Know refraction	
		Calculate with refraction
Know the difference between light and darkness		
	Understand the difference between light and darkness	
Know that light can be dispersed by prismatic tools (that light consists of several colours)		
	Know that colours of light can be filtered	
		Explain dispersion
	Use correct terminology on the topic of light	

Table 1: Learning goals for each age

2. Activities

a. The Maze of Light

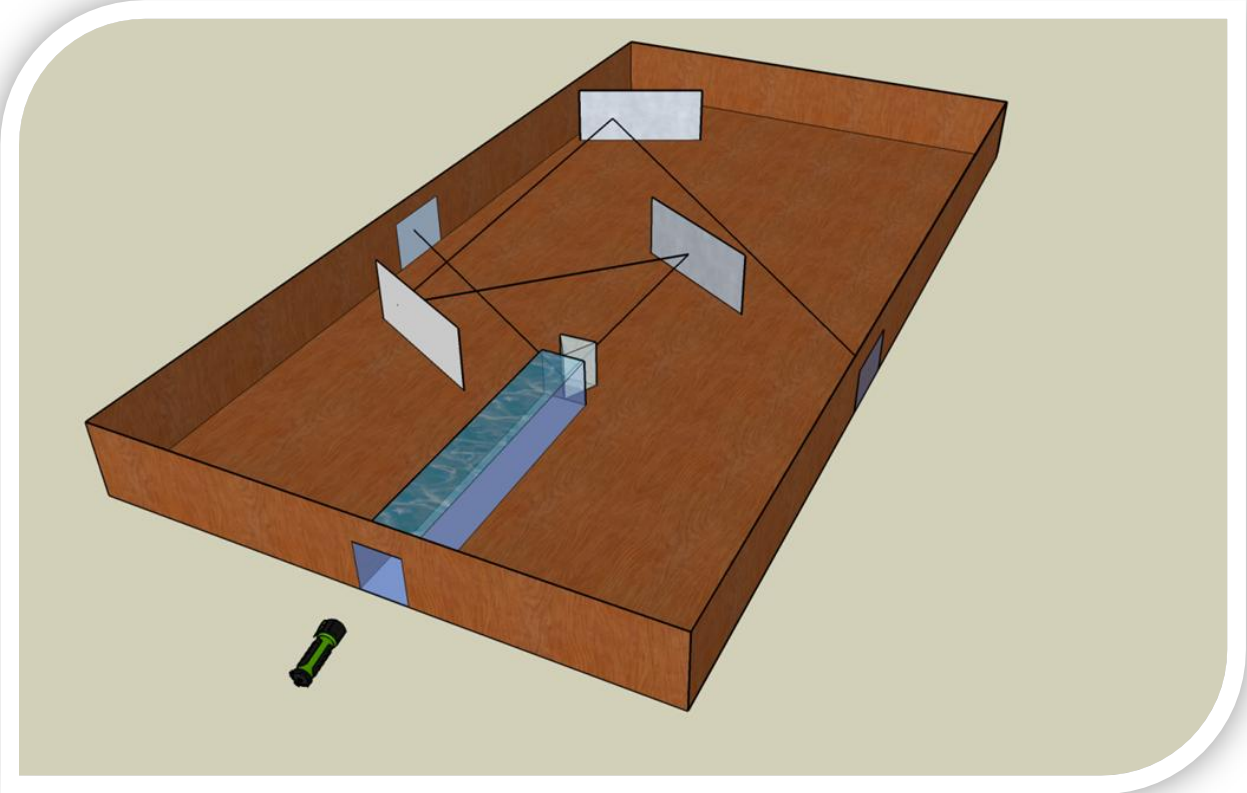

Figure 1: The Maze of Light

The Maze of Light is a box with a transparent cover and on the side some transparent windows and several knobs and switches, which control the light sources, the mirrors and prisms. Inside the box there are one or more:

- torches, that produces white light
- lasers, that produces monochromatic light
- obstacles that block any light
- mirrors that reflect light
- prisms that disperse light
- filters that filter one colour of light
- (semi)transparent materials, like perspex, that can refract and reflect light
- discoballs and hamsters, just for fun ☺

Of course it is possible to have a simplified version of the Maze of Light for younger pupils: one could omit for instance the prisms, filters or refractive materials. The Maze can be made in different sizes, from tabletop sized to room sized.

There are only two requirements for the Maze:

- Space
- A dimmed environment

The objective of the Maze of Light differs per age of the pupils.

b. Preschool

We have the Maze of Light set up in a corner of the classroom, and during a week the pupils experiment with it in a small group of 2 or 3 seperately for 15-30 minutes. When everybody has played with it, the teacher can do a circle talk with all the pupils to talk about their experiences.

c. Primary school

We have a large Maze of Light set up somewhere in a special location in school, where pupils can be sent to in groups, or if the Maze is really large, even the whole class can go to the Maze.

At the Maze, the pupils are given assignments to complete. The pupils must adjust the angle of one or more specified light sources and some specified attributes, like mirrors, prisms and filters, in such a way that some windows in the side of the Maze will light up in a specified colour.

For example: using only a torch, 2 mirrors and a prism, window 1 must be coloured red and window 3 must be coloured blue. All the other windows must remain dark.

The pupils should be able to use to correct terms for this topic at the end of primary school, so that they are well prepared for secondary school.

d. Secondary school

Using the assignments from primary school, one could ask the pupils to predict (by calculation) the path of the light. The Maze could be altered to include angle meters on the knobs (of the mirrors, prisms and light sources), so that the pupils can calcultate angles of the reflection.

Optionally, some pupils could do a project that includes building a Maze of Light.

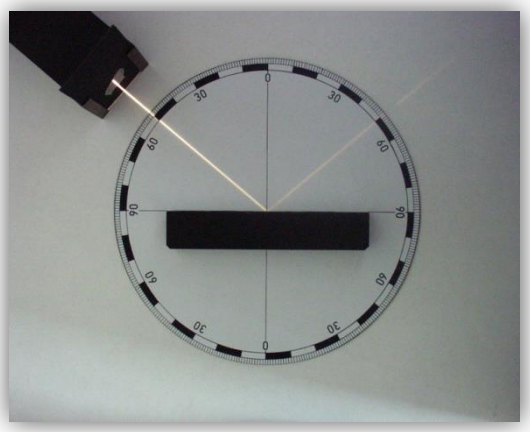

Figure 2: Angle of entrance = angle of exit

3. Didactical decisions

a. Role of the teacher

The teacher should be a leader and instructor, but not be dominant. The children are supposed to experiment and discover. The pupils become more and more responsible for their own activity and development. The teacher is more an assistant ot be available for questions.

b. Picture and perspective of science

Let the children learn that science could be fun and let them be interested. This innovative excercise describes a way to work together as a group and learn that science also could be teamwork and something that can make you develop as a group. Besides that, it shows that one can start with science on early age, instead of the age when one gets grey hair.

c. Connection to society:

Take advantage of museums and experiment centers. Let the children visit the science museum and see how light could be used and experimented with. Or else an expert of the museum / science center could visit the school to experiment in the classroom or the schoolyard.

d. The "-isms"

Our curriculum can be taught from different perspectives. The obvious combination is essentialism and progressivism, because this has proven to be a good way to transfer knowledge. Depending on the choice of the teacher, reconstructivism and/or perennialism can be added aswell. The arguments are as follows:

- Essentialism, because without the facts you don't have anything to teach. You cannot do without essentialism, because the pupils will not find out all knowledge by themselves.
- Progressivism, because experimenting with light themselves is a good way to gather knowledge: "Learning by doing". Also, the pupils can learn at their own speed and don't have to rush or get bored.
- Reconstructivism, because they hopefully realize that light and reflections are all around them and therefor they can understand that the experiment is related to the real world.
- Perennialism, because light will always be here and the knowledge of light is something that should not be forgot. It is basic component of our environment, so the knowledge of it must be transfered to the next generation.

e. The use of ICT

It is possible to create simulation software for this topic. The Maze could be made digital, so it would be cheaper to use and easier to place at school. Also it would enable the pupils to work at home.

Besides the simulation, there are several computer games available to learn about reflaction, refraction and dispersion on a easy way.

Science kids: How we see
(mirrors and a light beam)
http://www.sciencekids.co.nz/gamesactivities/howwesee.html
Prism: Light the way (also available for Nintendo DS)
(prisms, light beams, filters, mirrors)
http://www.bubblebox.com/play/puzzle/1094.htm
Yet Another Laser Game
(prisms, light beams, mirrors, different light sources)
http://www.softlist.net/program/yet_another_laser_game-software.html

4. Future work

- Use the Maze to illustrate shadows and silhouets.
- Make a computer simulator
- Build a maze with multiple levels.