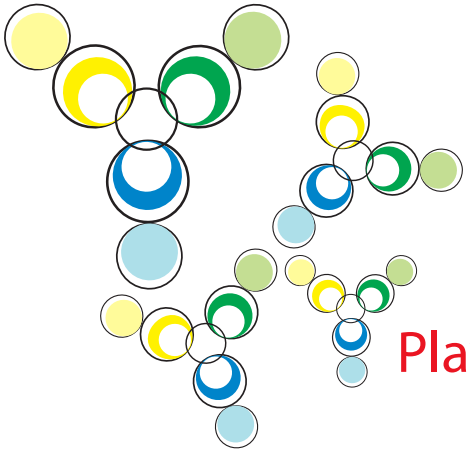

Playful learning for children in Indian context

Project II

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Indian Institute of Technology, Bombay

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Approval Sheet

The Visual Communication Project II titled "PLAYFUL LEARNING FOR CHILDREN IN INDIAN CONTEXT" by J N Somya (08625804) is approved towards partial fulfilment of the requirements for post graduate degree of Master of Design in Visual Communication.

PROJECT GUIDE : _____

CHAIR PERSON : _____

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I am grateful to all the children and teachers from Navnirmiti and IIT Campus School for their active contribution towards my understanding of the learning environment.

Special thanks to the library as well as the cooperative workshop staff of IDC.

A heartfelt thanks to friends Sakshi, Pragati to listen to my cries; Chitra, Supratim for their help and Shruti to listen to all my doubts.
And lastly to my family and Manan for always being there.

Contents

Introduction

I have always had an inquisitiveness to observe children behavior. The way children see, explore, learn, react and interact with various things and people.
Various children-centric projects (story book design and video) and particularly proposal towards Right to Education Bill in the last semesters at IDC heightened my interest towards working for children.

My constant interaction with children of 10-16years age from Kendriya Vidyalaya, Powai for Creativity sessions also helped me in knowing them better in terms of their likes, approach and behavior. Some of the interesting insights were that children associate creativity with imagination, materials and art. Together, they help, discuss and create objects which are different from others' objects.

This project gave me an opportunity to respond to their learning with a problem-solving design process.

Abstract

Science is all around us. Everyone enjoys the pleasure of learning about universe and tries to understand it. But, children have an inborn curiosity and yearning to make sense of things, people and the world around them. Play is a voluntary intrinsically motivated activity being associated with pleasure and enjoyment and It presents the best answer towards learning in for children.

The project is an attempt to facilitate playful learning for children of 11-14years of age which can be adapted to different learning environments of Indian context. It has been built on a conceptual framework of children, play and learning. It has explored how an activity can be planned and designed for the learning of a child without a textbook and without one to all teaching method. Emphasis is to enable experimentation and creation by children themselves rather than just communication and passiveness towards knowledge. It aims at a solution in the form of an activity kit to enhance sensitivity in realm of light (with reflections and shadows) as well as physical, social, emotional and intellectual development of a child.

Design Methodology

STAGE 1
JULY - SEP'09

RESEARCH BASE

Readings on:
- Learning theories for children
- Play & Learn

Case Studies:
- Visit IIT Campus School &
- Community Centre (facilitated by Navnirmiti)
- Interact with teachers
- Observe children

STAGE 2
SEP'09

NEED IDENTIFICATION & AGE-GROUP SELECTION
- Whom to facilitate?
- What to facilitate?
- How to facilitate?

FORMULATING DESIGN GOALS

IDEATION

STAGE 3
OCT'09

CONCEPT DEVELOPMENT

CONCEPT FEEDBACK

FINAL STAGE
OCT - NOV'09

FINAL CONCEPT & DETAILING

CONCLUSION

1. Understanding CHILDREN

1.1 Learning theories
- Behaviorism
- Cognitivism
- Constructivism
- Vygotsky's Zone of Proximal Development (ZPD)
- Bruner's Constructivist theory (1973)
- Papert's Constructionist theory (1980s)

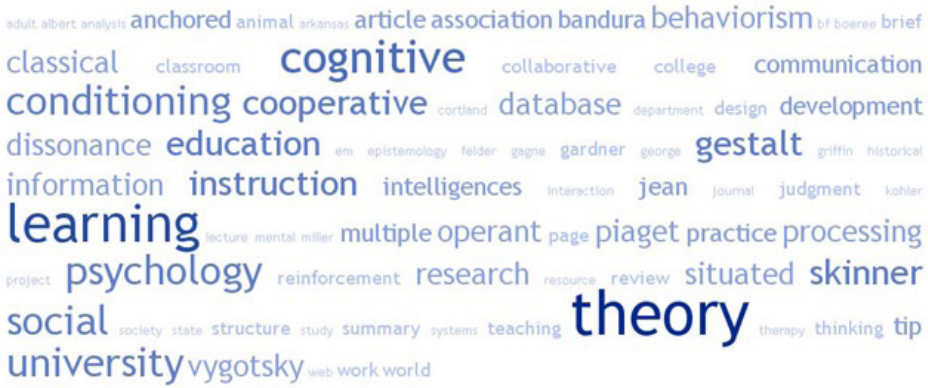
1.2 The Montessori method of learning

1.3 Education in India
- Right to Education Bill
- J. Krishnamurti

1.4 Visit to learning environments
- IIT Campus School, Powai
- Community Centre run by L&T, Powai

"To present an adequate notion of learning one must first explain how the individual manages to construct and invent, not merely how he repeats and copies."

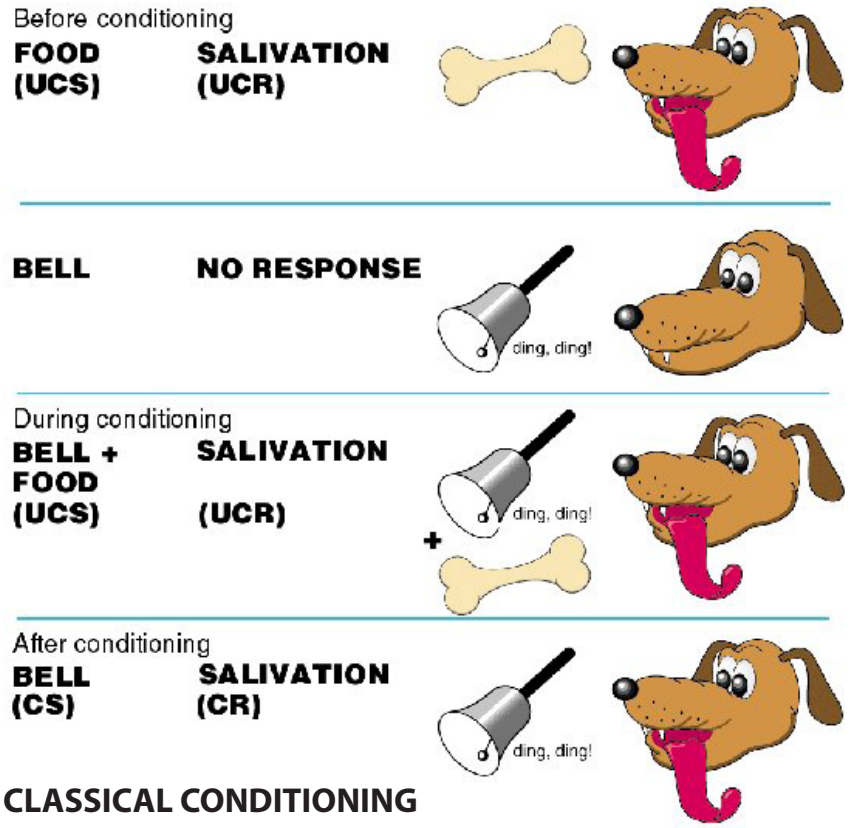
Jean Piaget



1.1 Learning Theories

What are the assumptions that we make about learning when we try to help somebody learn and we teach them by different ways?
One needs to think about the several layers of beliefs and action that are relevant to learning things and how is it that we go about designing learning?

So, my research base started with understanding beliefs and rationale behind different theories of learning and what conceptions influence both beliefs and behavior of children.
Theories are guide and inspiration for different teaching techniques and one can adjust or link theories to get a different approach of learning.



Behaviorism

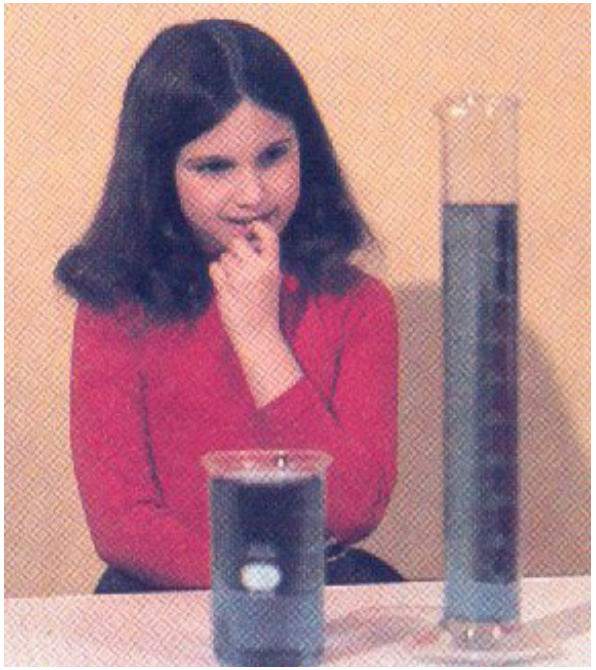
Learning involves variable behaviors of organisms according to different environmental conditions.
We do some things in an environment and then something happens. Sometimes it is good and sometimes it is bad. But, if we learn, more good things will happen.

It is the most common scenario where educator sets goals and shapes behavior.
A learner would find things on his own but behaviorist approach makes it to happen quickly for desired results.

Ivan Pavlov - Classical conditioning in 1890s to 1900s
Learning consists of changes in observable and measurable behaviors based on stimulus (S) and responses (R).

B. F. Skinner - Operant conditioning in 1930s to 1950s
Shaping and reinforcement of responses closer to desired behaviors by a reward or punishment.

Source: http://www.learningwiki.com/theory



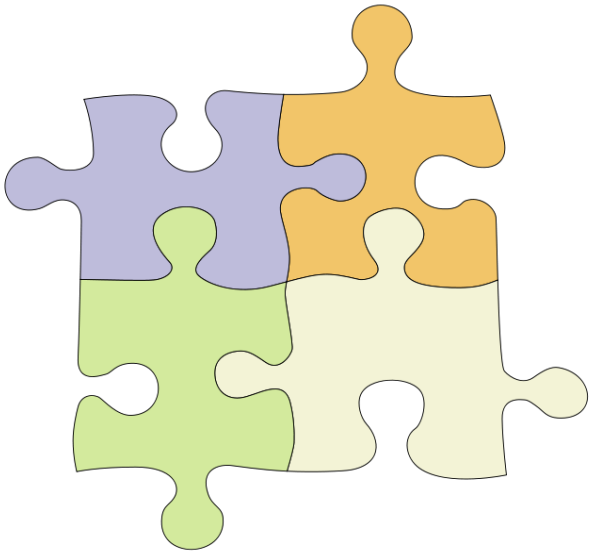
Cognitivism

There is a mediating step in between the stimulus and the response. We don't just react to the world, we think about the world, we make sense of the world and we react based on the sense we are making of it.

Learners can't be forced, learners have to use their own resources, use their own models to make sense of what's happening and teachers can only provide environments.

Cognitivism believes that people have an intrinsic motivation to know. People have desire to learn what it is that's going on around them. But, extrinsic reinforcement can ruin this innate desire to just learn stuff, to be curious and to want to think up new ways of making sense of the world.

Source: http://www.learningwiki.com/theory



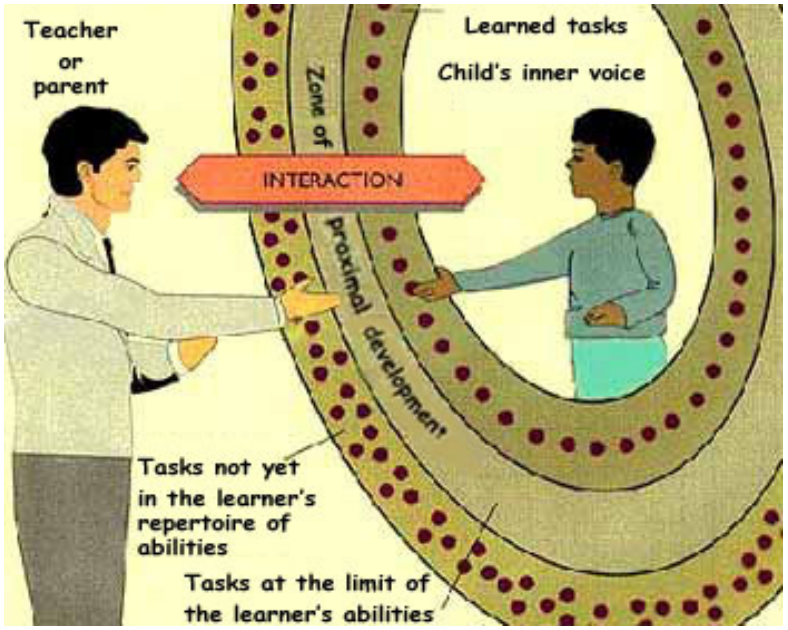
Constructivism

Constructivism views learning as a process in which the learner actively constructs or builds new ideas or concepts based upon current and past knowledge or experience.

Jean Piaget explained Constructivism through accommodation and assimilation. When individuals assimilate, they incorporate the new experience into an already existing framework without changing that framework. Accommodation can be understood as the mechanism by which failure leads to learning: when we act on the expectation that the world operates in one way and it violates our expectations, we often fail, but by accommodating this new experience and reframing our model of the way the world works, we learn from the experience of failure or others' failure.

Learners learn by experimentation and not by being told what will happen. They are left to make their own inferences, discoveries and conclusions.

Source: http://en.wikipedia.org/wiki/Constructivism_(learning_theory)



Vygotsky's Zone of Proximal Development (ZPD)

ZPD is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.

Tasks below the zone the child can already accomplish with no help. Thus giving the child this kind of task involves no new learning.

Tasks above the zone cannot be accomplished even with help. Thus, giving the child this kind of task causes frustration and failure and results in no meaningful learning.

Scaffolding is provided by knowledgeable others. This may be the teacher or other students in the classroom. Thus, Vygotsky would be a proponent of cooperative learning.

Source: http://en.wikipedia.org/wiki/Zone_of_proximal_development

Bruner's Constructivist theory (1973)

Learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge. The learner selects and transforms information, constructs hypotheses and makes decisions, relying on a cognitive structure to do so. Cognitive structure (i.e., schema, mental models) provides meaning and organization to experiences and allows the individual to "go beyond the information given".

The facilitator should try and encourage students to discover principles by themselves. The facilitator and learner should engage in an active dialog (i.e. socratic learning).
Instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness). Instruction must be structured so that it can be easily grasped by the student (spiral organization). Instruction should be designed to facilitate extrapolation and or fill in the gaps (going beyond the information given).

Source: http://tip.psychology.org/bruner.html

"Constructionism—the N word as opposed to the V word— shares Constructivism's view of learning as 'building knowledge structures' through progressive internalization of actions… It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe."

Seymour Papert

Papert's Constructionist theory (1980s)

The central concept is that people learn through making things, creative experimentation and there is very limited value in theorizing without practical application or without practical doing. In fact, theorizing itself may be entirely unnecessary when learners explore and create and through that process of creation achieve a deeper level of understanding than what could possibly be acquired through instruction.

In contrast to Piaget, Papert draws our attention to the fact that "diving into" situations rather than looking at them from a distance, that connectedness rather than separation, are powerful means of gaining understanding.

Source: http://learning.media.mit.edu/content/publications/EA.Piaget%20_%20Papert.pdf

"Think of how hatchlings learn to fly. Not by listening quietly while an adult bird explains the various properties of flight; not by being tested and ranked on their ability to memorize and recall. For birds—and for humans—learning is best when it's active and experiential, not passive and abstract. We learn to fly by flying. Because, ultimately, it is only our own hops, glides, and flutters that have the power to take us higher."

1.2 The Montessori method of learning

In the Montessori system of education, each child is a unique being. Montessori school activities promote the development of a child's social skills, emotional growth and body-mind coordination as well as cognitive preparations for future intellectual activities.

The main premises of Montessori education are:

- Children are to be respected as different from adults and as individuals who differ from each other.

- The child possesses an unusual sensitivity and intellectual ability, unlike those of the adult, to absorb and learn from his environment, both in quality and quantity.

- The first six years of life are the most important years of a child's growth when unconscious learning gradually emerges to the conscious level.

Both the easy-going and the strong-willed belong in the Montessori classroom. One reason why both types of children and all of those in between have such a high degree of success are due to the Prepared classroom environment, absorbing through the senses, learning from one another, the hands-on approach, work done in their own time and help only when needed.

Source: http://www.lifepositive.com/mind/education/alternative-education/montessori-education.asp

Enrollment in Class Five was 62.5 per cent of enrollment in Class One.

Drop-out rates are officially admitted to be as high as 35 per cent.

As many as 52 per cent schools lacked playgrounds, 89 per cent did not have toilets and 59 per cent did not have drinking water. As for teaching aids, 26 per cent did not have blackboards, 59 per cent had no access to maps and charts, 67 per cent lacked any kind of teaching kits, and 75 per cent had no toys for the children. In 77 per cent of the schools, there were no libraries.

1.3 Education in India

The vast majority of the population in India, both rural and urban, sends its children to government-run schools, as these are free, i.e. they do not charge fees. However, given that the quality of education in these schools is usually quite poor, the fast-increasing middle class prefers to send its children to the government-aided and privately-run schools.

Though economic and other circumstances may be the reason for a high drop out rate of children in school. The high drop out can also be due to the unattractiveness of the school and teaching processes.

The PROBE (Public Report on Basic Education in India) report recorded startling data about the lack of or dysfunctional state of basic amenities in many schools.
In this regard increased amount of infrastructure available to the learning environment will help in a great way in improving the interest level and the attractiveness of the learning to the child.

Also of importance is the need to lay the foundation for a system that provides for a holistic learning environment where children has the right and responsibility to chart his/her own path towards the future of their life at their own individual pace without any pressure from any external system or institution.

Source: UNESCO Institute for Statistics (01.05.08)

The model Bill that has been proposed is even more appalling - it removes any mention of common schooling and allows for "alternative" non-formal education for children for reasons of disability or disadvantage or nature of occupation of parents, thereby creating the possibilities for all sorts of exclusion by class and social group. In sum, it is a Bill of exclusion rather than inclusion, a complete denial of rights.

Jayati Ghosh

Right to Education Bill (RTE)

Every child of the age of six to fourteen years shall have a right to free and compulsory education in a neighbourhood elementary school.

Millennium development goals seek to achieve universal primary education by the year 2015. Looking at this in the Indian context one realizes that there is a long way to go. Its taken over six decades since the independence for the Indian government to clear the Right to Education Bill.

Keeping the realities in mind and in the wake of Indian Government clearing the Right to Education Bill we looked at how the Bill strives to correct the present situation and if the provisions in the Bill adequate to bring about a radical impact through Proposal for the Right to Education Bill, 2008 prepared as part of the course 'Visual Design' at Industrial Design Center, IIT Bombay under the guidance of Prof. Kirti Trivedi and Guilherme Vaz.

Source: Refer to features of RTE and Proposal in Annexure1

" The aim of education is to help the child develop his intellectual, aesthetic, emotional, moral, spiritual being and his communal life and impulses out of his own temperament."

Sri Aurobindo

The Right Kind of Education by J Krishnamurti

What we now call education is a matter of accumulating information and knowledge from books, which anyone can do who can read.

The right kind of education, while encouraging the learning of a technique, should accomplish something which is of far greater importance: it should help man to experience the integrated process of life. It is this experiencing that will put capacity and technique in their right place. If one really has something to say, the very saying of it creates its own style; but learning a style without inward experiencing can only lead to superficiality.
The right kind of education consists in understanding the child as he is without imposing upon him an ideal of what we think he should be.

The real issue in education is "to see that when the child leaves the school, he is well established in goodness— both outwardly and inwardly."

"Do not … keep children to their studies by compulsion but by play."

- Plato

1.4 Visit to learning environments

In order to observe and understand children, visits to IIT Campus School, Powai and Community Centre run by L&T, Powai were carried out.

The observations and interactions with 55students of 11-14years of age and some of the teachers happened in IIT Campus School. The present teaching process was observed as well as a session was conducted to know interests of children.

The children of 6-11years of age were observed at the Community Centre while they explored and learned through various kits.

Inferences were drawn after the visits to understand children in learning environments in Indian context.

"It is paradoxical that many educators and parents still differentiate between a time for learning and a time for play without seeing the vital connection between them."

- Leo Buscaglia

IIT Campus School, Powai

Inferences from Interaction with children of 11-14years of age

- Children are keen to explore new materials (apart from their textbooks)
- They are always keen for a change in learning environment.
- Children like to show off their achievements.
- 90% of children wait for Sports period in the week.
- 45% of children have their favorite subject as Mathematics because they enjoy the act of solving and finding the right solution.
- 37% of children have their favorite subject as Science because they gain knowledge and would like to conduct experiments when they grow up.
- While boys enjoy playing computer games, girls prefer board games and puzzles than computer games.

Inferences from Interaction with teachers

- Examples from daily life are incorporated to explain the concepts.
- Children build enthusiasm and understand better with diagrams, demonstrations and activities.
- Children are encouraged to involve in group projects.
- Projects, visits and creative workshops are not part of the regular curriculum and conducted during holidays only.
- Children have more questions and doubts after exercises and experiments as compared to teaching sessions.
- Evaluation is stressful for children, parents as well as teachers.

Community Centre run by L&T, Powai

(using Navnirmiti kits)

- Lower age group children of 6-9 years were learning though Mathematics kits by Navnirmiti.
  Object interaction though objects, props with different colors and materials made understanding easy.

- Children enjoyed the act of creating something by themselves.

- Children of 9-11years of age were finding difficult to learn with only textbooks and worksheets.

- Children were eager to learn through their kits without the teacher. Each child used the kit differently.

- Teacher was participating as a learner.

- One kit was being shared between at least three children, so they prompted and learnt from each other.

- The kits were modular and used in multiple concepts. Language was being learnt through flash cards.
  Workbook was there but basic understanding happened through props and objects.

- Playful element of ball was introduced to understand counting easily. Different and bigger objects were introduced when the child was bored of using the same objects.

- After children figured out and understood the kit, they didn't need the teacher to help them in work sheets.
  They don't need kits once they understand the concepts.

2. PLAYFUL learning

2.1 Defining Play

2.2 Play & Learn

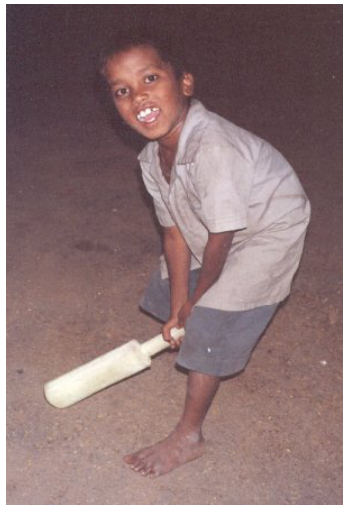
2.3 Edutainment

2.1 Defining Play

verb
1 engage in games or other activities for enjoyment rather than for a serious or practical purpose. 2 take part in (a sport or contest). 3 compete against. 4 take a specified position in a sports team

noun
1 games and other activities engaged in for enjoyment. 2 the progress of a sporting match. 3 a move or manoeuvre in a sport or game. 4 the state of being active, operative, or effective: luck came into play. 5 a dramatic work for the stage or to be broadcast. 6 the ability or freedom of movement in a mechanism.

Source: http://www.askoxford.com/concise_oed/play?view=uk



Researchers generally discuss four types of play although in practice these often merge:

- *Object play*: the ways in which children explore objects, learn about their properties and morph them to new functions
- *Pretend play* (either alone or with others): variously referred to as make-believe, fantasy, symbolic play, socio-dramatic play or dramatic play, where children experiment with different social roles
- *Physical or rough-and-tumble play*: the ways in which children explore objects, learn about their properties and morph them to new functions
- *Guided play*: where children actively engage in pleasurable and seemingly spontaneous activities under the subtle direction of adults

Play is:

- voluntary motivated activity
- pleasurable and enjoyable
- involves active engagement
- is generally engrossing
- is non literal
- can contain a certain element of make-believe

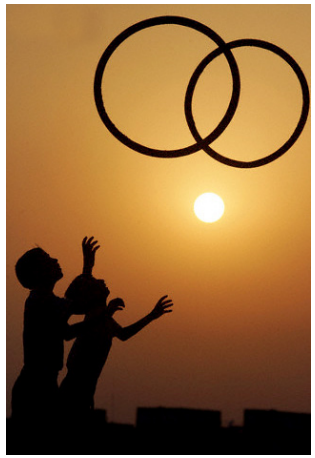
Source: Why Play = Learning; Kathy Hirsh-Pasek, Roberta Michnick Golinkoff; Temple University, USA, University of Delaware, USA; October 2008

2.2 Play & Learn

Children have fun while learning by experience, inquiry, trial and error, cooperation or even by simple observation. Play is a central ingredient in learning, allowing children to imitate behaviors, practice skills, process emotional events and learn much about their world.

Learning and play are not discordant, learning takes place best when children are engaged and enjoying themselves.
Both free play and guided play are essential for the development of academic skills.

In playful learning, aspects of collaborative learning by exploring and wondering together should be emphasized.



Playful learning should encompass the following five core inter-related learning activities:

Exploration
Engagement
Reflection
Creation
Collaboration

2.3 Edutainment

The American Heritage Dictionary defines edutainment as "the act of learning through a medium that both educates and entertains." In this definition, learning is the key element. In case of location-based entertainment (LBE), the emphasis is switched. LBE can be defined as LBE edutainment as "events, programs and attractions where the entertainment qualities are the primary draw, with the learning or education being a byproduct."

Various types of LBE edutainment are as follows:

1. Interactive & Participatory
    - Open-ended & Immersive (play)
    - Structured (participatory games)
    - Scripted (mazes)
2. Non-interactive & Spectator
    - Seated & Scripted (movie, play or science show)
    - Explorative
        Scripted (aquarium, some museums)
        Free-choice (zoos, some museums)

Source: http://www.whitehutchinson.com/leisure/articles/edutainment.shtml

The first use of the word edutainment was for educationally oriented CD-ROM games to teach children in an entertaining way. Edutainment is becoming as much a marketing concept as it is content. Because of edutainment's appeal, more and more entertainment products are marketing themselves as edutainment to increase their perceived value.
Though the aim of most of the edutainment products is to provide education with entertainment without realizing it, it creates a negative implication of providing education with a support system of entertainment.

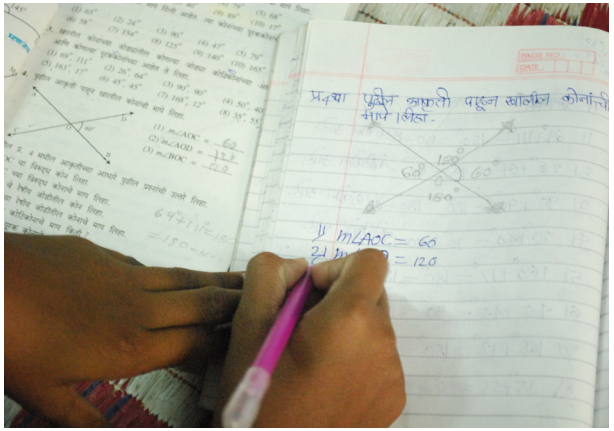
Education associated with schools, teachers or system and entertainment with movies, actors, games or music, edutainment aims at solutions provided by others.
But, both play and learn are explored by children themselves according to their level of engagement.
Thus the phrase playful learning, as opposed to edutainment, conveys a stronger sense of active participation.

3. NEED identification

3.1 Whom to facilitate?
- Characterstics of age-group

3.2 What to facilitate?
- Why Science?
- What in Science?
- What in Light?

3.3 How to facilitate?
- Illustrations
- Experiments
- Installations
- Multimedia
- Science Museums
- Build a project
- Do-it yourself activities
- Learning kits



3.1 Whom to facilitate?

Level of abstraction and complexity increase in terms of learning language, theories and facts for children of 11-14years of age. They are expected and facilitated with lot of content and concepts.

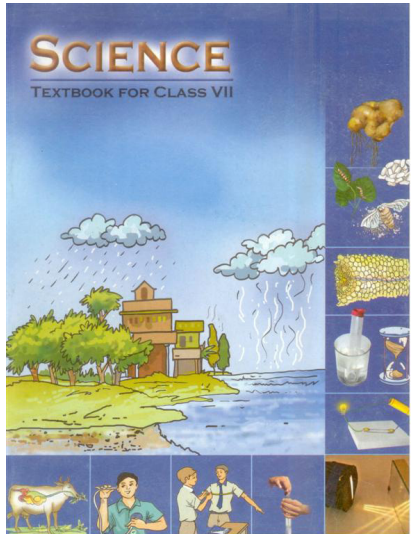
Children are supposed to remember and develop understanding with least number of activities.
They are majorly dependent on text books to build their knowledge.

Characteristics of age-group

Children step towards a different and complex level of emotional, mental, intellectual and physical development at 11-14years of age. They explore their future potential to bridge dependence with their approaching independence. Wonder and spontaneity are being replaced by feeling self-conscious during adolescence.

The characterstics being associated with children of 11-14years of age:

- want to be active and motivated to learn something new.
- develop new interests and hobbies.
- have increased attention span but interests change rapidly.
- start to think logically.
- are extremely curious, constantly asking "why".
- like to show-off their accomplishments. Parents expect them to be high achieving.
- have mostly interacted with computers at home or learning environment though it is still not that easily accessible to them.
- prefer working in teams and being with peer groups.
- need positive support, guidance and encouragement.



3.2 What to facilitate?

Science as a subject has always fascinated me. But, now when I look back and try to assimilate what theories and concepts I learnt in school, I can only remember textbook, teacher and exams. I remember learning different subjects and topics from lots of textbooks but can't articulate my understanding of that content.
The only activities I remember in Science are experiments and examples from daily life.

Through this project, I want to attempt at an intervention in subject of Science which can facilitate understanding of a concept as well as social and intellectual development of a child without a text book.

Why Science?

Young children are naturally curious and constantly exploring the world around them.

Science exploration in early childhood is science inquiry –exploring materials/events, asking questions, investigating, recording/ representing their work, reflecting on what they have done and what it means – allowing them to create new theories or ideas about how the world works.

Science provides children with direct experience with materials, events and ideas that are important to later learning.

Food
Air
Water
Electricity
Magnetism
Light
Plants
Body
Heat
Acids, Bases & Salts

Force
Climate
Respiration
Reproduction
Winds, storms and cyclones
Materials
Combustion
Sound
Stars
Pollution

What in Science?

Children learn about various topics in the area of nature, physics, chemistry and biology at this age level.

Interaction with teachers at IIT Campus School gave an insight that children find difficulties in understanding the concepts of force, electricity, magnetism, light and acid, bases & Salts. The topics where examples from everyday can be included are easily grasped by children. Not only children but teachers also find some of these topics difficult to facilitate with just blackboard, textbook and worksheets.

The world of 'Light' is an opportunity to facilitate learning in a different and better way than just diagrams and textbook.

What in Light?

Light is mysterious.
Light is unique.
Light is fascinating.
Light is the future.
Light is endless.

Topics of light being taught in schools were studied to know and understand the concepts aimed at this age group.

The aim is not to incorporate and facilitate all the concepts through one intervention but to design a learning experience which gives children encourages their abilty to observe and a chance to explore further.

Sources of light

Transparent, translucent & opaque objects

Shadows

Umbra & Penumbra

Pinhole camera

Mirrors & reflections

Kaliedoscope

Light travels in a straight line

Reflection of light

Periscope

Mirror image

Spherical mirrors

Image formed by lenses

Sunlight- white or colored

What makes things visible?

Laws of reflection

Regular and diffused reflection

Multiple images

Eyes

55 children of class 7 and class 8 of IIT Campus School were asked to articulate their knowledge and ideas about 'light'. Class 7 children didn't have a background in studying light as class 8 children. Some of the inferences were:

- Children of class 7 were fearless of articulating because they didn't study or give an exam in 'light' before. They didn't think they were being judged by others.
- 80% of children were able to identify different sources of light.
- Most of the children remembered the concept 'Light travels in a straight line' because of the experiment conducted in previous year.
- Other concepts that they remembered were umbra & penumbra, periscope and laws of reflection.
- Some children related 'light' to concepts of heat, solar energy, electricity and solar system.

Source: Refer to drawings by children in Annexure 3

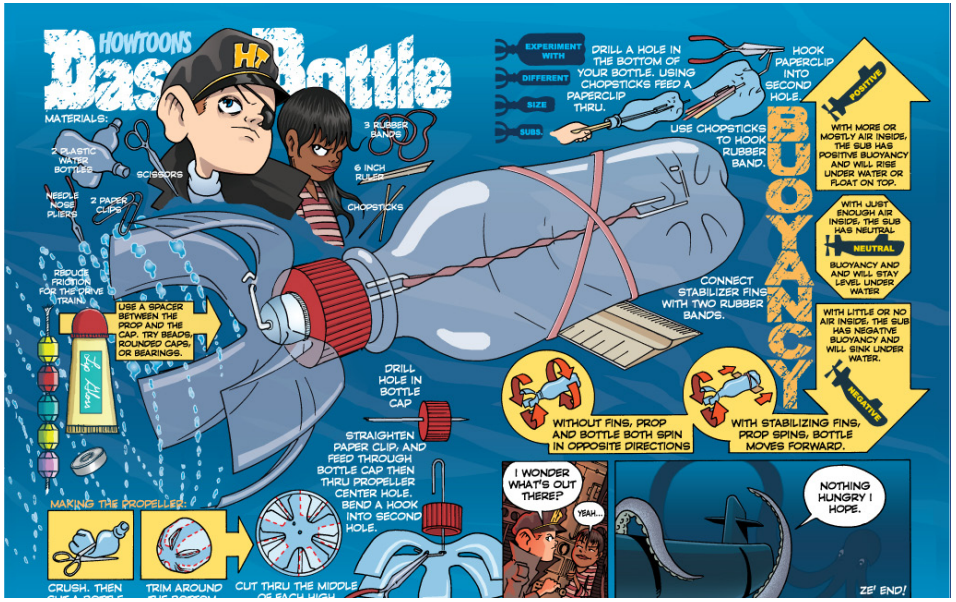
3.3 How to facilitate?

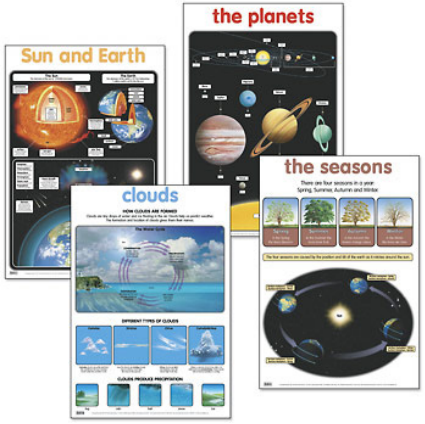
Scientists observe. Scientists infer.

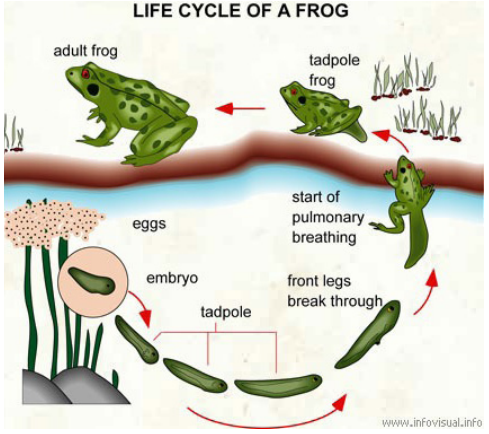
The way to facilitate science should be developmentally appropriate, interesting and relevant.
The traditional textbook only and work sheet teaching of science is not recommended with inquiry and hands on experiences.

One of the widest used methods is learning through discovery. Discovery is finding out information using hands on experiments. The children can discover what happens in science and why. They answer the problems for themselves. They use their schema, prior knowledge of science, to search for information.

The ways discussed in following sections have their positives and limitations at the same time based on approach and feasibilty in terms of cost, materials and accessibilty.

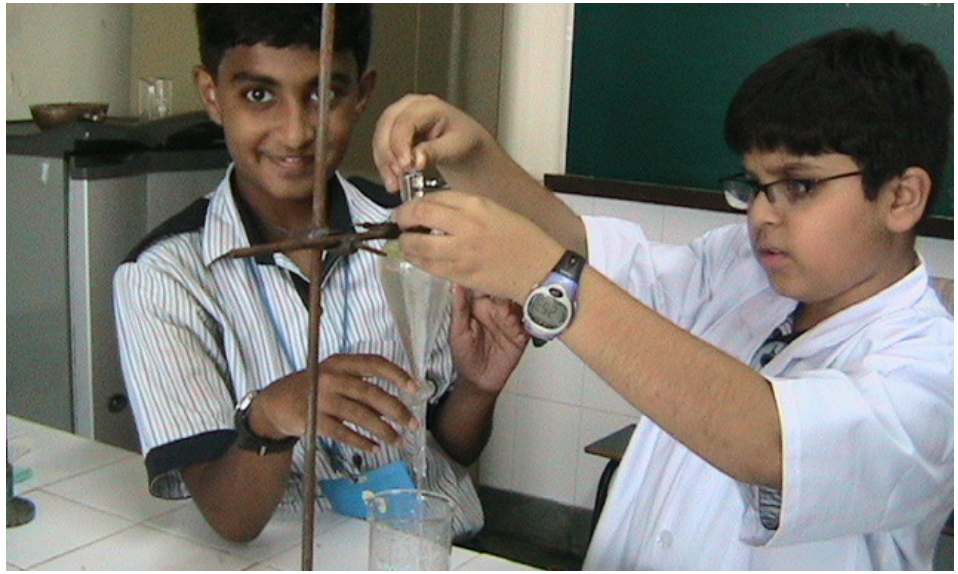






Illustrations

Colorful illustrations and posters can help in active participation of children in their learning process.
Most of the children like colorful pictures and cartoons. Style of illustrations for children can have a positive influence on increasing their attention and curiosity span of children.



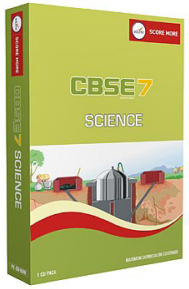
Experiments

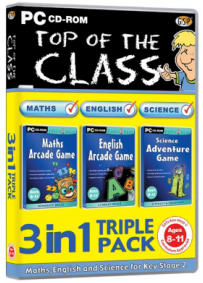
Science is all around us in our daily lives and the more we experiment with things and observe, the more fascinated we become in finding answers.
The complex experiments can be performed with the guidance of facilitator and peer groups.

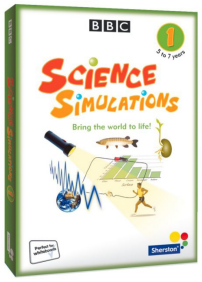
Installations

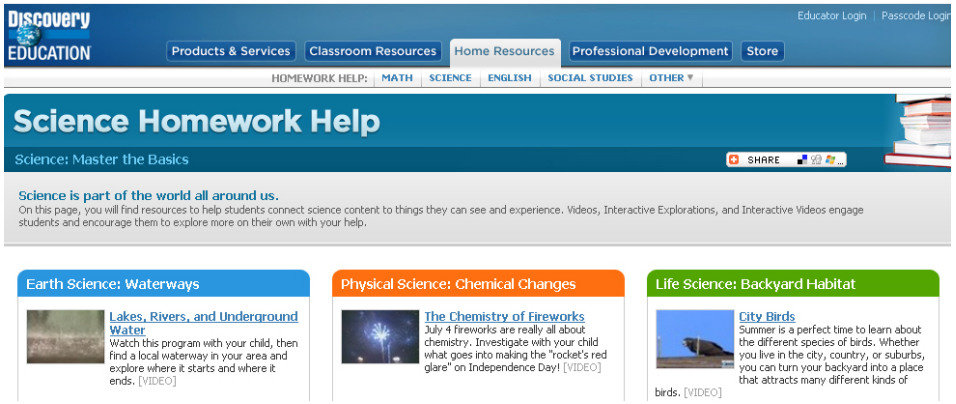
Humane size experiments with metaphors from play environment and built in playing environment can be an engaging way to facilitate learning in Science.

Source: http://www.eklavya.org/sciencepark1.html



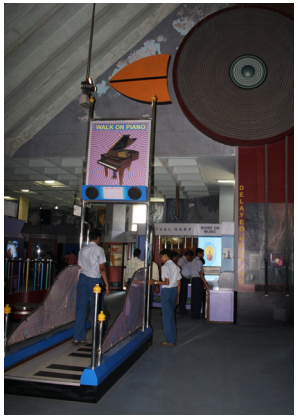






Multimedia

Different mediums of music, video, games and simulations can make it easier to illustrate difficult and complex concepts, enable inspiration and create more enthusiasm in the learning environment while being a flexible resource.



Science Museums

"...in formative period of childhood and youth, it is essential that people should come to museums and learn. Their minds will be affected by the objects which they see there. I should like this aspect of education through the museum to be developed."

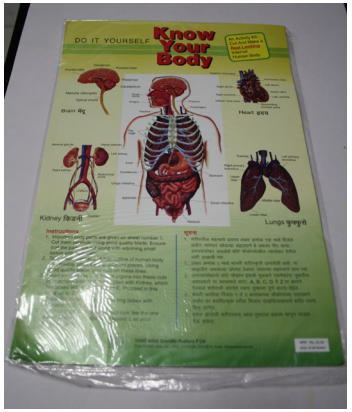
- Jawaharlal Nehru

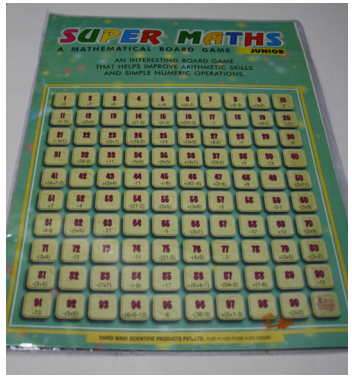
Interactive installations in Science Centres incorporate innovative ways to communicate science to enthuse, entertain, initiate, excite and bring the developments of science & technology for everyone available at one place.

Source: Nehru Science Centre, Mumbai

Build a project

The motivation to learn a mechanism and concept by making a project or a model encourages a child to explore basic principles as well as properties of different objects and materials.





Do-it yourself activities

One doesn't always need a laboratory to experiment with Science. Simple activities with easily available materials can create memorable projects by children.

Learning kits

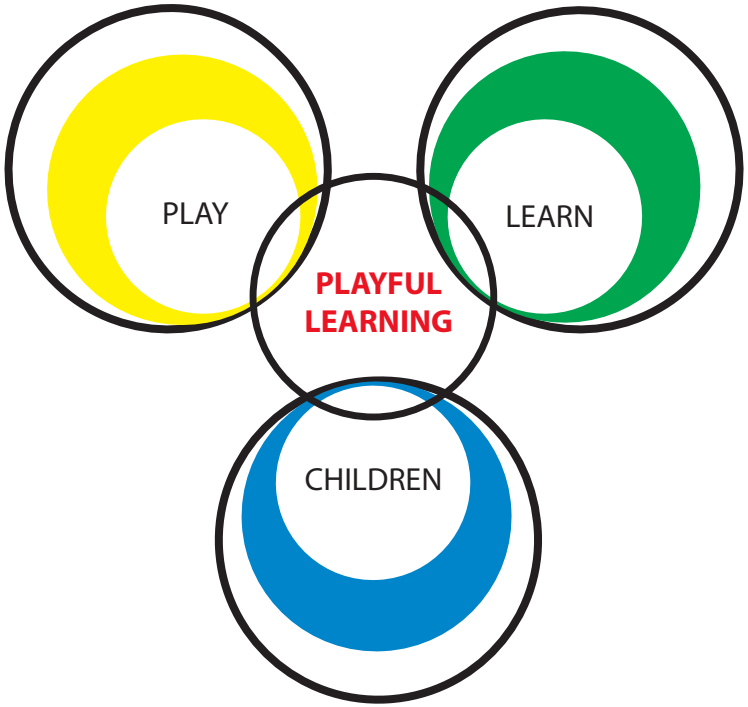
"The science kits have not only taught my children to be more discovery learners, but they have taught me as well. Science is all about discovering, trying things over again, and learning from our mistakes. We can't do that with a textbook."

Learning kits not only helps towards experential learning but can be easily adapted to any environment.

4. Design GOAL

4.1 Intent

4.2 Content

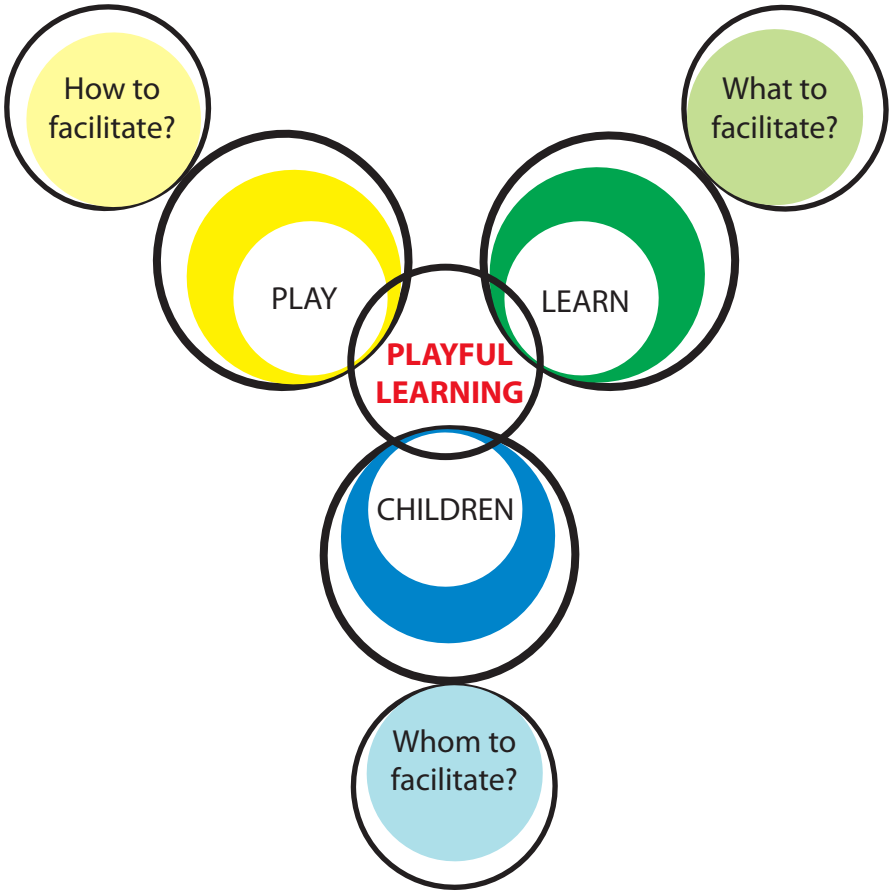


4.1 Intent

As has been studied and inferred from research base, children learn best when they are engaged and enjoying themselves.
The design intervention has to cater to two needs of learning i.e 'create' and 'understand'.

Design challenges to be achieved towards playful learning for children:
- **To make children learn as they play.**
- **To motivate them towards an activity.**
- **To facilitate collaborated learning.**

The design intervention has to cater to two needs of learning i.e 'create' and 'understand'.



4.2 Content

Content of light has to be facilitated to children of 11-14years age by playful learning.

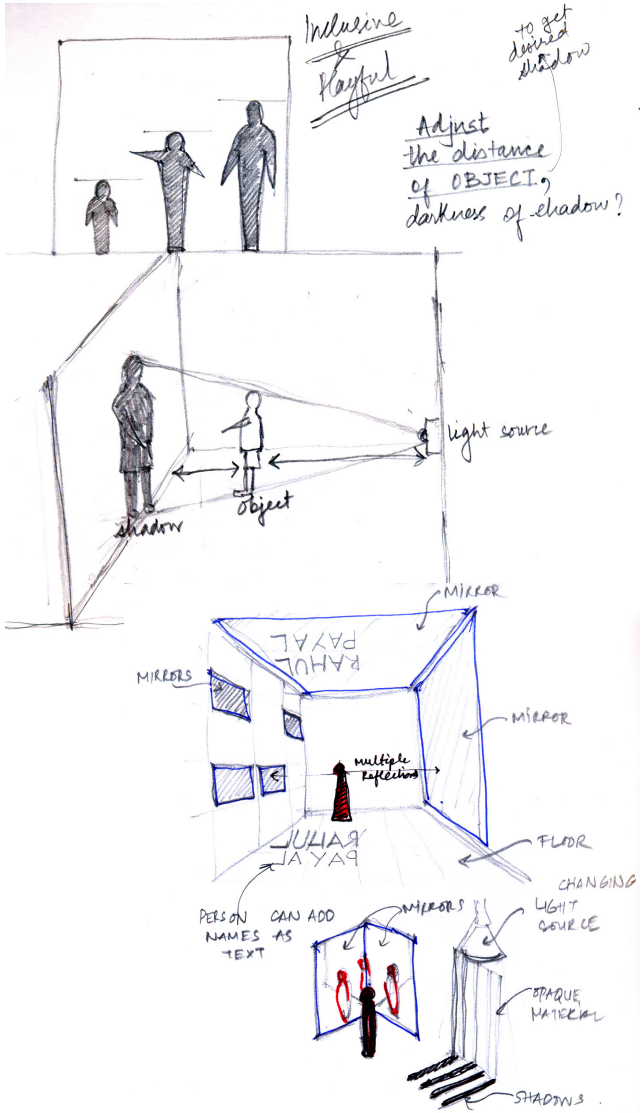
Each child is unique and each child's growth and learning rates differ from other children's.
Content of 'light' has to be designed:

- in a way that the child can learn according to his/ her involvement and interest. The design intervention should be receptive to a child's growth.
- to learn concepts of 'light' in an indirect way
- to combine with other concepts.

5. IDEATION

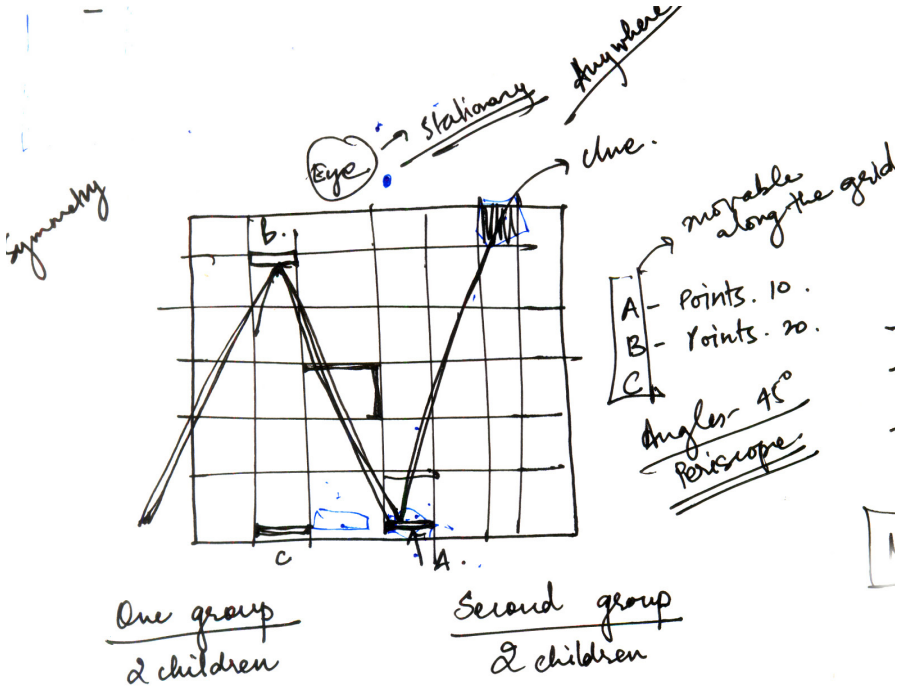
5.1 Concept ideas

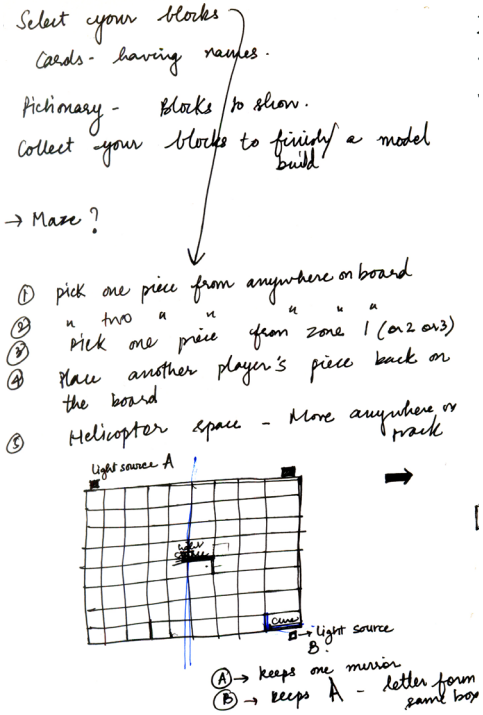
Based on the research and design challenges, design ideas were generated using different approaches and concepts.
These ideas focussed on providing direct oppurtunity to children where they can ask, check, record, reflect and learn one or more concepts of light.

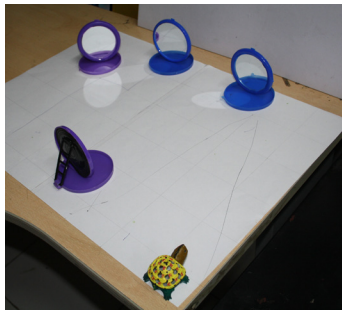


IDEA 1: Maze of light

This concept aimed at building an environment of materials on walls, ceiling and floor to play with light. As children explore the spatial experience of mirrors, light sources, colors, projectors and sensors would give an oppurtunity to children to interact with humane size materials.
This environment can become integral part of science centers, malls, airports, etc







IDEA 2: Decode my light

This idea aimed at the collaborated learning and need of motivation towards a task through a board game.
This game focussed around concepts of mirrors and reflections. One team would code text for the other team and other team has to decode it by moving multiple mirrors on the board.

Materials:

Light source
Mirrors - plane, concave, convex
Lenses - concave, convex
Screen
Objects
Colored papers
Colored filters
Scale

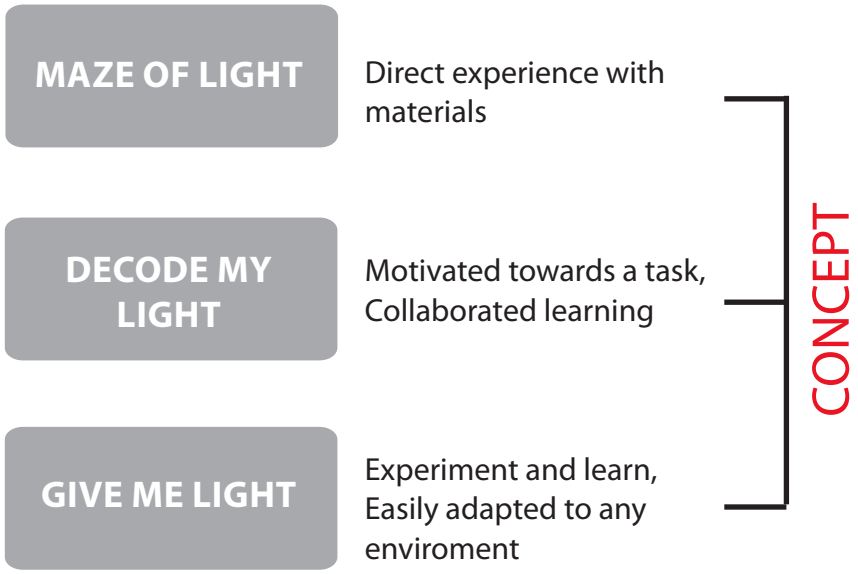
Black paper
Mirror/ Lense stand
Prism
Laser light
Build a Pin hole camera
Build a Kaliedoscope
Build a Periscope
Optical Illusions

Design challenge:

Experiments manual

IDEA 3: Give me light

This idea aimed at facilitating objects and materials to experiment with light with the help of a learning kit.
The kit can be easily adapted to any enviroment be it learning or home. Thus by providing different mirrors, lenses, light source and a guide towards different activities and experiments would motivate a child to learn and bring out the ability of observation in children.



5.2 Concept generation

The final concept thus emerged by integrating the key characteristics of all the three ideas which could help towards playful learning of light for children in Indian context.

The features adopted for design solution from the initial ideations are as follows:

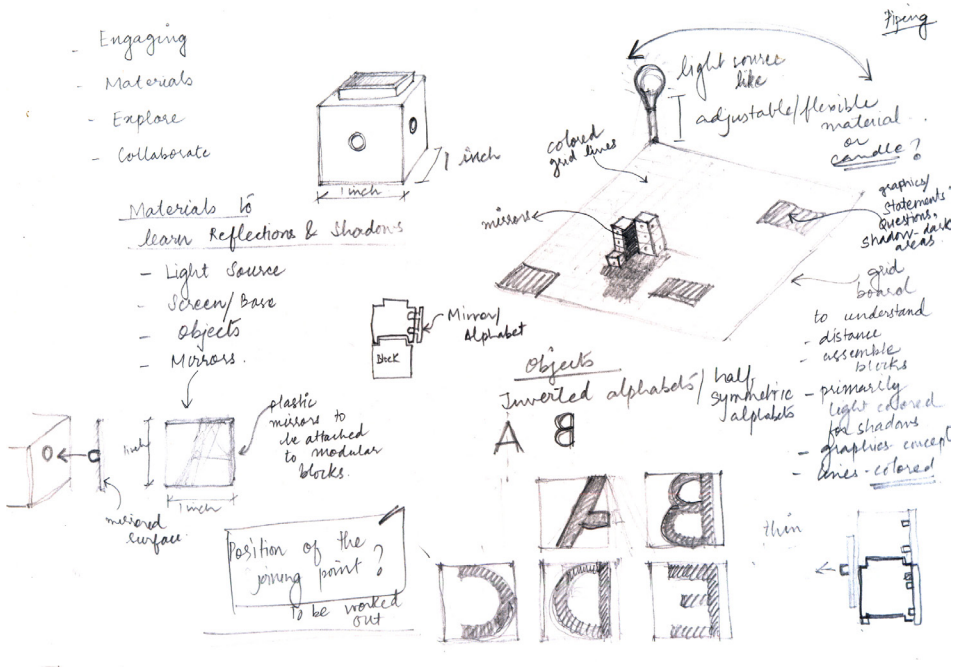
- It should provide direct experience with materials, objects and ideas .
- It should be easily accessible and adapted to any environment.
- It should to group of children together.
- It should be planned to build enthusiasm towards activity/ activities.
- It should focus on 'do' and 'learn' than just 'learn' .

6. FINAL concept

6.1 Concept development
- Concept features
- User Feedback

6.2 Final design
- Concept detailing
- Manual design

6.3 Playful learning vs formal learning

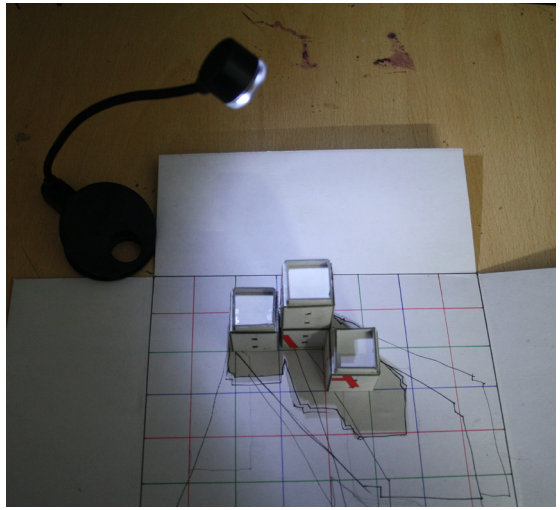


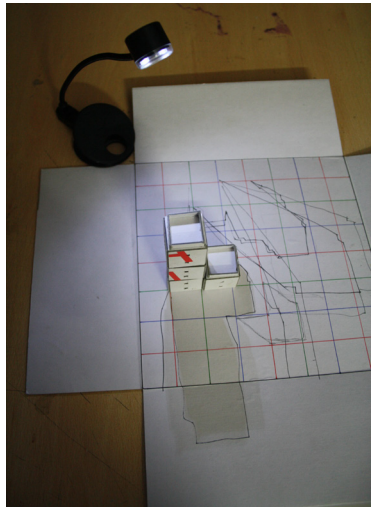
6.1 Concept development

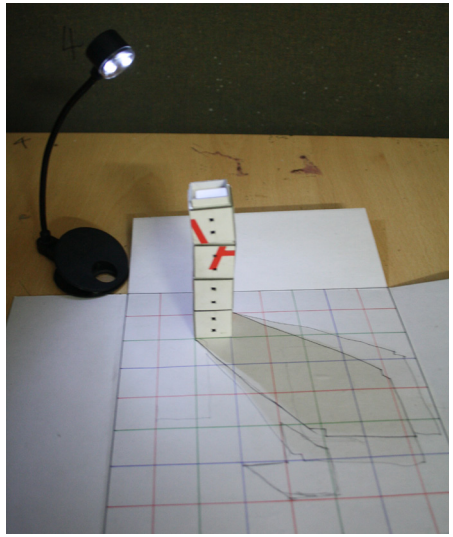
Give us light.
We will build with light.
We will play in light.
We will learn with light.

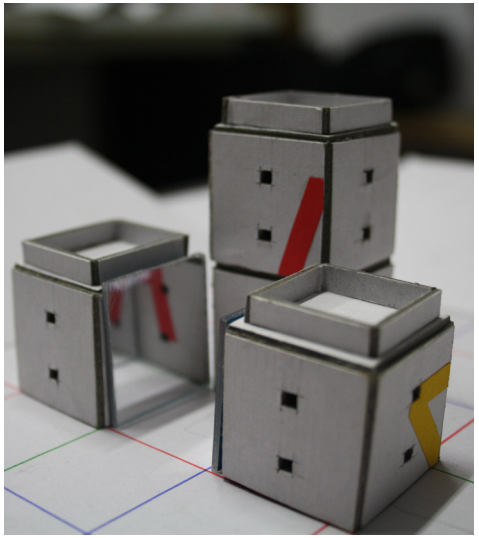
To facilitate children with hands-on experience in light, to play with reflections and shadows, the activity kit needs following things:

- **Light source (Daylight/ artificial)**
- **Screen/ Base**
- **Mirrors**
- **Objects**





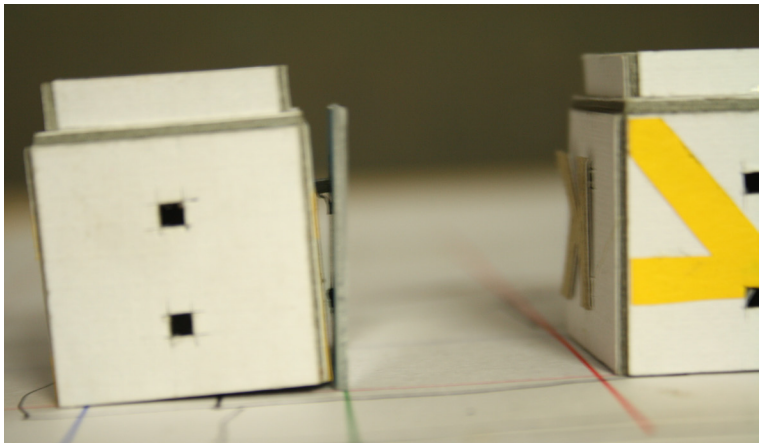


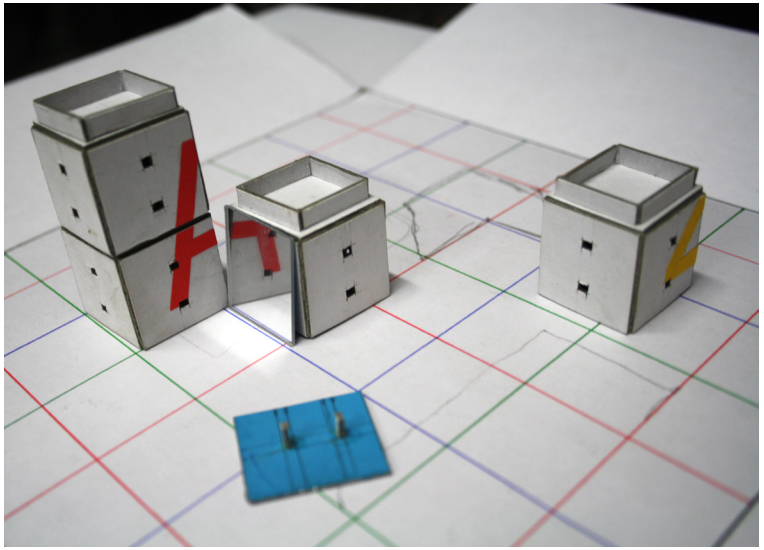


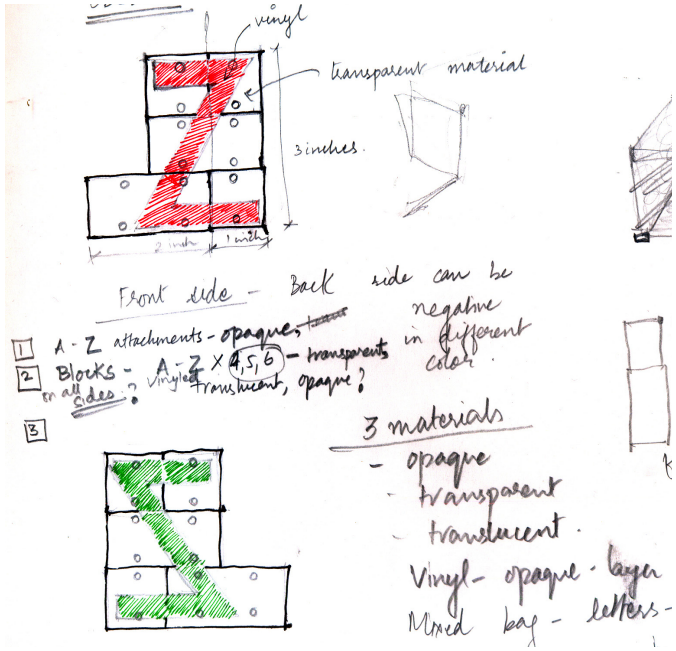
Concept features

To be able to play with mirrors and objects with a light source, a block has been designed on which mirrors and objects can be supported and attached to construct different activities.

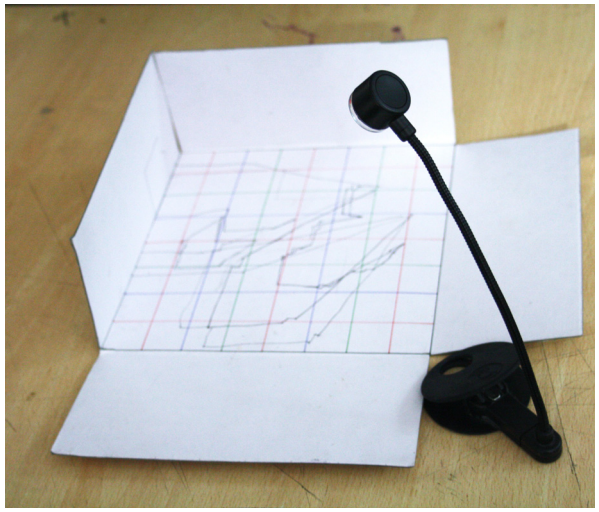
If we cannot see through an object at all, it is an opaque object. If we are able to see clearly through an object, it allows **light to pass** through it and is tranparent.
This concept can be easily realized by playing with blocks and objects in **opaque as well as transparent materials**.
Different materials give **shadows in different intensities**. The activities of shadow with these blocks would facilitate this concept.



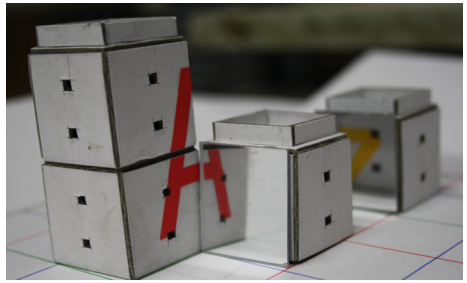


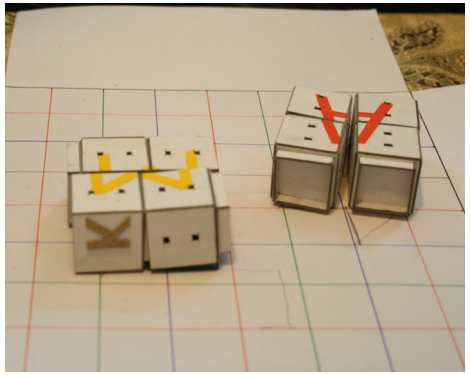


Alphabets has been chosen as the medium to let children explore with blocks. The symmetric alphabets can only be built with the **use of plane mirrors** by completing the alphabets.
'Right' appears 'left' and the 'left' appears 'right' in a mirror. **Objects of reflected alphabets** would be provided to encourage the use of mirrors.
Children can construct words and meanings by using these building blocks and objects of alphabets.



Objects create shadows with light. Different shapes create different shadows. To observe the play of shadows, a surface is needed. A **board as a base** would serve as a environment to **view shadows**.
The shadows change with distance of the light source. Also, images are at the same **distance behind the mirror** as the object is in front of it. The blocks designed as a **basic unit on a grid board** would help in learning this theory.



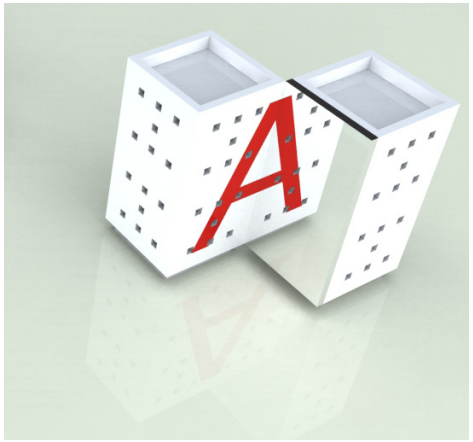


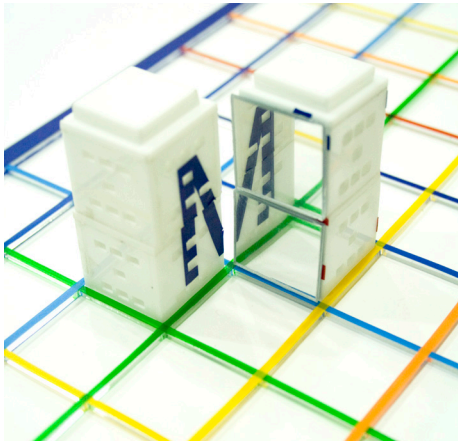
User feedback

The children of 10-11years of age were asked to play with rough blocks. They had no background knowledge in topic of 'light' from their school.

Observations from feedback:

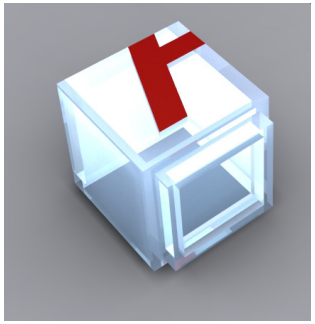
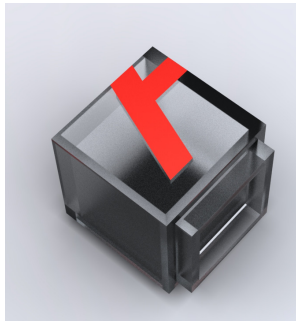
- Children at this age demand basic initial instructions to start playing with objects.
- Children were excited to play with blocks to interpret alphabets. Letter 'Z' was constructed as letter 'M'.
- Once, they explored the concept of using the plane mirror by exploration, they progressed to use multiple mirrors.
- The activity of coding/ decoding of shadows through blocks needs a flexible light source which can be attached to the board and worksheets would be needed to draw shadows.

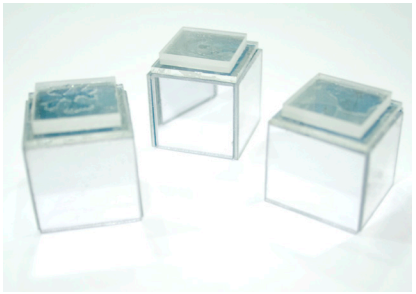
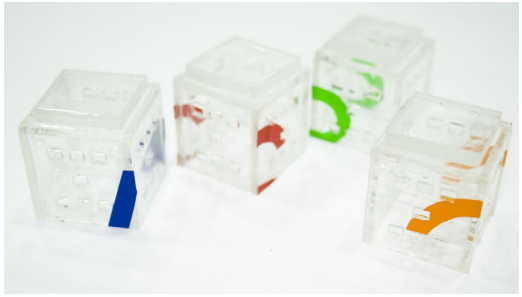
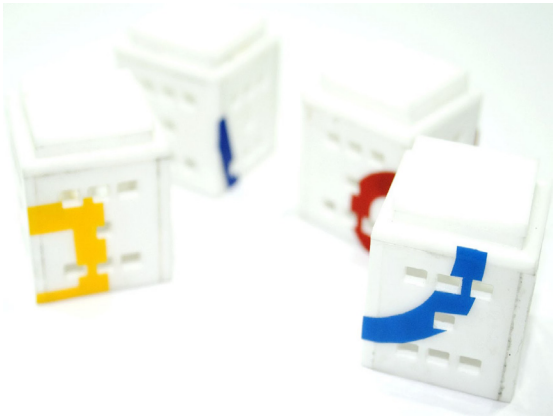
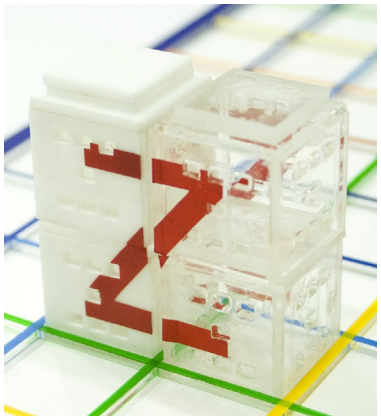




6.2 Final design

After feedback, the design detailing of activity kit called 'Image Play' was developed in terms of design of block, design of board and objects.
The kit is supported by a manual which will take care of more levels of learning.
Children can play and examine the concepts on their own at the first level, can play activities suggested in the manual at the second level and conduct activities suggested to know the laws at the third level.

Concept detailing

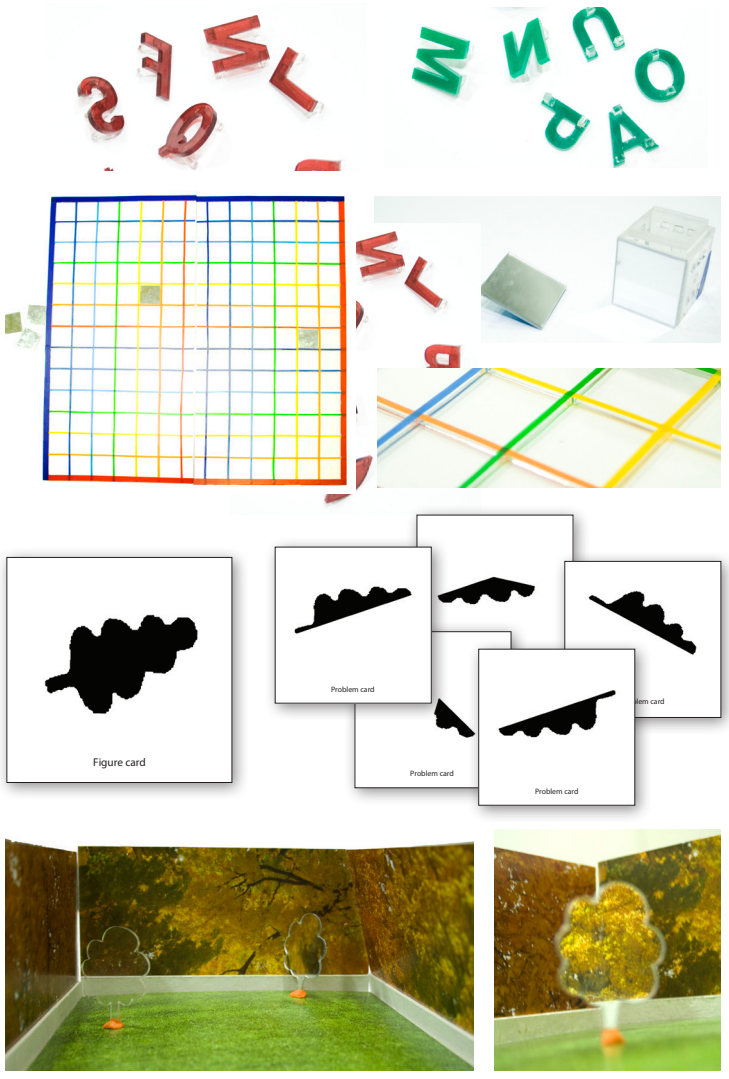
The elements of activity kit are majorly made in plastic for prototyping. The kit can be explored in terms of more sustainable materials to cut down on cost as well to be easily followed in an Indian context.
The elements of kit:

Blocks: Each alphabet from A-Z will be divided in 4 blocks. These 104 blocks are divided in two materials i.e. opaque acrylic called 'sugar' and transparent acrylic called 'ice'.
This will help in understanding of different shadows formed by different materials.

6 blocks are made of plastic mirrors on all sides.

Alphabets are divided in 7 categories of colors from VIBGYOR depending on their letter structure.

M	A	H	B	F	C	N
W	T	I	D	L	G	Z
V	U	O	P	K	Q	S
		X	R		J	Y



Objects: Mirror attachments to learn reflections and symmetry.

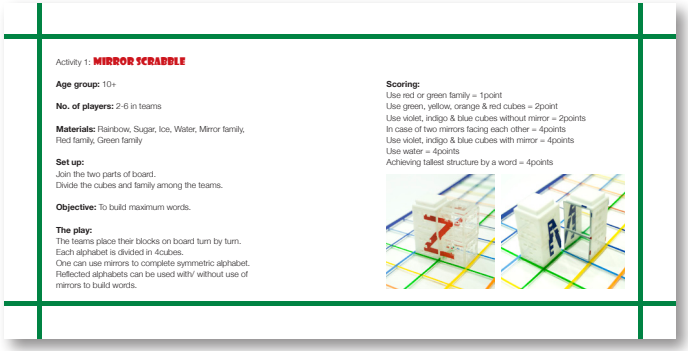
Red family and Green family:
Set of reflected alphabets as attachments.
Different shapes and color attachments to depict special alphabets (vowels, symmetric letters, shapes)

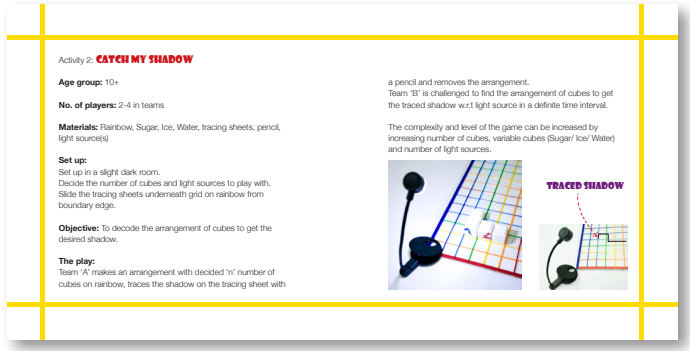
Most of the attachments are made in acrylic for prototyping.

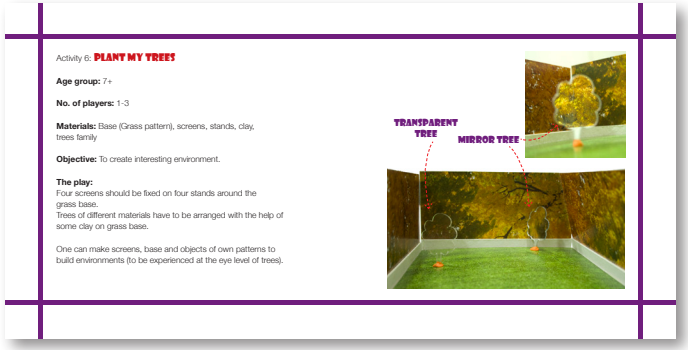
Grid Board: The grid board has been again done in VIBGYOR colors. It is prototyped in acrylic to have 2mm thickness and accommodate blocks into the grid.

Cards: Problem and figure cards based on 'Children, Mirrors & Reflection by Joe Elstgeest'.
Different cards have been designed where one has to use a mirror with a figure card to get the right problem card.

Screens and stands: A base with grass pattern and four screens (with stands with patterns of trees.
Cutouts of shapes of 'tree' in different materials - transparent, opaque and mirror to create interesting environment.







Manual design

The manual illustrates and details different activities, tasks and experiments that children can indulge in to play with light by using the same activity kit.

Activity 3: **HOW MANY?**

Age group: 7+

No. of players: 1-2

Materials: Mirror family for board, Mouse cards

Mouse card A:
How many mice can you make with:
One mirror?
Two mirrors?
Three mirrors?
More mirrors?

Mouse card B:
What difference(s) do you see when you 'multiply' A with B mouse?
Draw or describe:
The position of mirrors?
How the mice are sitting?

What more can you do and find out with mice and mirrors?

And what do you get when:
You mirror tiny mice?
Or a picture of yourself?
Or a pencil?
Or ...?
Or ...you can take anything.

Use word **'MOUSE'** to draw interesting compositions using two (or more) mirrors.

Source: Children, Mirrors & Reflection by Joe Elstgeest

Activity 4: **DRAW**

Age group: 7+

No. of players: 1-2

Materials: Mirror family for board, Problem cards

The play:
Draw the figures as you will see the when you place a mirror on the line.
Only after drawing can you check with your mirror ad see how correct you are.

Source: Children, Mirrors & Reflection by Joe Elstgeest

Activity 5: **WHICH ONE?**

Age group: 7+

No. of players: 1-2

Materials: Mirror family for board, Figure cards, Problem cards

The play:
You need one figure card and a set of problem cards.
With which of these cards and a mirror, can you reproduce the figure on the figure card?

Source: Children, Mirrors & Reflection by Joe Elstgeest

Fact 1: **OBJECTS OF DIFFERENT MATERIALS**

Materials: Sugar, Ice, Water, tracing sheets, light source, screen (back side of rainbow)

Set up:
Look at Sugar, Ice, Water, tracing sheets against light source.
Collect more such materials and observe them against light.

Learning:
If you cannot see through an object at all, it is an opaque object. (Sugar)

If you are able to see clearly through an object, it is allowing light to pass through it and is transparent (Ice)

There are some objects through which you can see, but not very clearly and are translucent (tracing sheets)

You can see reflection of objects in front of the mirrors (Water).

Sometimes, we see reflections of trees, buildings and other objects in the water of a pond or a lake.

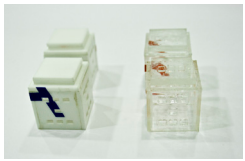
Fact 2: **SHADOWS**

Materials: Sugar, Ice, Water, tracing sheets, light source, Rainbow, screen (back side of Rainbow)

Set up:
Look at Sugar, Ice, tracing sheets against light source.
Observe the shadows formed on the screen.

Learning:
We need a source of light and an opaque object to see darkest shadow.

The intensity of shadows decrease from opaque objects o transparent objects.



Fact 3: **REFLECTIONS**

Materials: Sugar, Ice, Water, mirror family, light source, Rainbow, red/ green family

Set up:
Arrange the cubes on Rainbow.
Attach objects of red/ green family and mirrors to the cubes.
Observe the reflections of objects in the mirrors and Water through the light source.

Learning:
One can change the direction of light by letting it fall on a shiny surface.

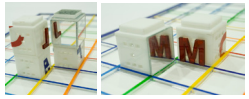
Images formed in the plane mirror are erect and of same size.

Distance of the image formed in the plane mirror is at the same distance as the object is in front of it (measure through the rainbow grid).

Multiple images are formed when two or more mirrors are used in different combinations.

Infinite images are formed when mirrors are in front of each other.

'Right' appears 'left' and 'left' appears 'right' in plane mirror. Only sides are interchanged; the image does not appear upside down (it appears erect).

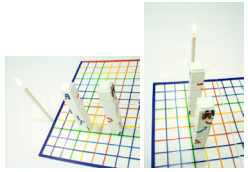


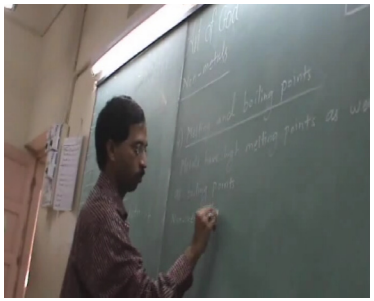
Fact 4: **LIGHT TRAVELS IN A STRAIGHT LINE**

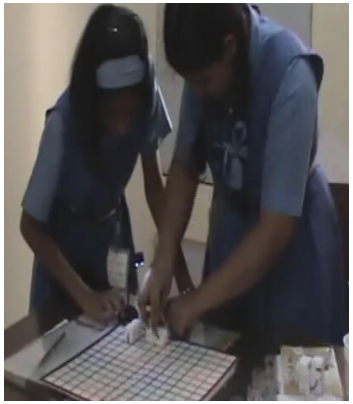
Materials: Cubes, red family, light source, Rainbow

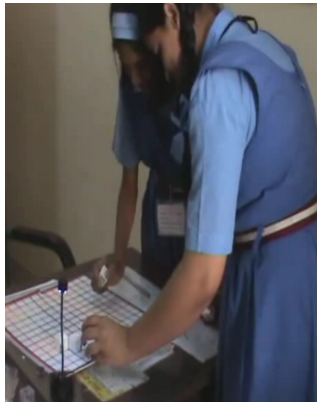
Set up:
Pile up two rows with equal number of cubes at a distance on Rainbow.
Keep the light source at one end of row1.
Close the 6 out of 7holes of top cube of both the rows using alphabets from red family to see the light source from the 7th hole.

Learning:
You can see the light source only when holes are in a straight line i.e. light travels in a straight line. That is why, when opaque objects obstruct it, a shadow forms.









6.3 Playful learning vs formal learning

The observations from a formal learning environment (IIT Campus School, Powai):

- Science is being taught by a teacher to a class of 40 children using a textbook and blackboard.
- The topic of the session is told to children at the beginning of the session.
- The teacher shows the materials in the class but doesn't encourage children to interact with materials themselves.
- Children are active and answers questions of the teacher in initial 10 minutes but loose interest afterwards.

The observations from playful learning through the activity kit:

- Children are inquisitive to find out how the elements of kit can be used together.
- They take initial time to understand the activities but once they do, they want to play the activity again.
- They enjoy playing in teams and hence, learn from each other.
- They enjoy the activity of shadow 'Catch my shadow' and came up with more observations from day-to-day life.

Children comparatively take time to learn in playful learning than formal learning but they understand, enjoy the process and learn without being passive towards knowledge imposed on them.

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Right to Education Bill (RTE)

Every child of the age of six to fourteen years shall have a right to free and compulsory education in a neighbourhood elementary school.

Duties:

- Appropriate Government and local authority to establish the school
- Sharing of financial and other responsibilities to be by Central and State governments
- Prevent discrimination against students belonging to disadvantaged group and weaker section
- Maintain records, provide infrastructure
- Appropriate Government to provide for pre-school education
- Parents and guardian to ensure child's admission

Responsibilities of School:

- Towards free and compulsory education
- No capitation fee (donations) should be charged
- No screening procedure for admission can be adopted
- Birth date specified by birth certificate is the proof of age for admission
- A child cannot be denied admission
- No child shall be expelled until completion of education
- No child shall be subjected to physical punishment or mental harassment
- No School to be established without obtaining certificate of recognition
- School Management Committee shall monitor the working of the school, prepare a School Development Plan
- Central Government has the power to amend Schedule

Responsibilities of Teachers:

- Attending school regularly and punctually
- Completing entire curriculum within the specified time
- Assessing the learning ability of each child and instructing accordingly
- Communicating to parents/guardians the progress of their child through parent-teacher meetings
- Pupil-Teacher Ratio to be maintained according to the schedule
- Vacancy shall not exceed 10% of the total sanctioned strength
- They shall not be deployed for non-educational purposes other than duties pertaining to election/disaster relief
- They are prohibited from engaging in private tuitions

Curriculum and Completion:

- To be made by an academic authority specified by the appropriate Government
- Every child completing his elementary education shall be awarded a certificate
- No child shall be required to pass any Board examination till completion of elementary education

Protection of Rights of Children:

- By national/ state commissions by monitoring, examining & reviewing the rights, inquiring into the complaints and taking necessary steps
- Redressal of grievances to local authority or State Commission for Protection of Child Rights Sharing of financial and other responsibilities to be by Central and State governments
- Constitution of National Advisory Council by Central Government to advise them on implementation of the provisions of the Act in an effective manner

Miscellaneous:

- The Central Government has the power to issue directions to the appropriate government to implement the RTE
- Prosecution for punishable offences can be instituted with the previous sanction of an officer authorised in this behalf, by the appropriate Government
- The appropriate Government has the power to make rules to implement RTE
- No suit or other legal proceeding shall lie against the Central Government, the State Government, the National Commission for Protection of Child Rights, the State Commission for Protection of Child Rights, the local authority, the School Management Committee or any person, in respect of anything which is in good faith done or intended to be done, in pursuance of this Act, or any rules or order made there under

Objections to the Bill

The bill makes compulsory the fundamental right to unequal and inferior education.

Duties:
- Lacks provision to compel the State to provide adequate funds
- States have a 3 year window to ensure appropriate schools come up, but the states are in varying degree of development

Responsibilities of School:
- Dilutes the Fundamental right of children below six years to nutrition, health and pre primary education by falsely equating with ICDS
- Disregards the right to secondary and higher secondary education

The 25% provision in private schools-
- Violates the right of the other 75% to free education
- Shifts public funds to private unaided fee charging schools
- Legitimises inequality through a multi layered school system

Responsibilities of Teachers:
- No guarantee of dignified salaries, training and professional development
- No provision for an untrained teacher to acquire minimum qualifications within 3 years after joining
- Discrimination of government school teachers by deploying them to census, election duties etc, making their students sacrifice their education

Curriculum and Completion:
- Hegemonizing education on universal qualities rather than equitable qualities
- No scope for fostering child's individuality and identity
- Fails to guarantee child's mother tongue as medium of education
- Contradicts its own objective of freeing a child from fear and anxiety, by assessment through exams
- Methods of teaching and assessment are not elaborated

Protection of Right of Children:
- By national/ state commissions by monitoring, examining & reviewing the rights, inquiring into the complaints and taking necessary steps
- Redressal of grievances to local authority or State Commission for Protection of Child Rights
- Constitution of National Advisory Council by Central Government to advise them on implementation of the provisions of the Act in an effective manner

Miscellaneous:
- 'Free' is not defined, whether it is only the fee or even other expenses of uniforms, books etc
- 'Compulsory' offers no scope for flexibility of choice, making schooling a mandatory provision
- 'Education' is largely aimed at striving for right to institutionalized teaching, which is schooling more than education to all
- Though SMC will consist of parents as well, their powers are not defined
- The schooling system generation has overshadowed the creation of knowledge through education
- The Bill shall extend to the whole of India except the State of Jammu and Kashmir

VISION & APPROACH

Non Institutionalized Teaching but learning environment for all
No exams no grades

VISION:
To lay the foundation for a system that provides for a holistic learning environment where children from the age of 6-14 from any social, economic, cultural or geographical background come together and learn fearlessly. Every child has the right and responsibility to chart his/her own path towards the future of their life at their own individual pace without any pressure from any external system or institution. It is this new approach to accepting and respecting a child's right and will to flourish to his/her fullest potential that will comprise of their education.

APPROACH:
Just by defining a vision without a working methodology will not present itself as a system. Therefore, systemic change is required by examining various aspects of Learning. Like,
Physical Infrastructure
Curriculum and Intellectual Infrastructure
Facilitators
Social and Physical Interaction
Evaluation Scheme
Ensuring Inclusion

The relevance of these aspects is realized by flaws and outcomes of present education system.
It is important to specifically look into the details of each aspect and act accordingly. At the same time, all these aspects are inter-related and are not mutually exclusive.

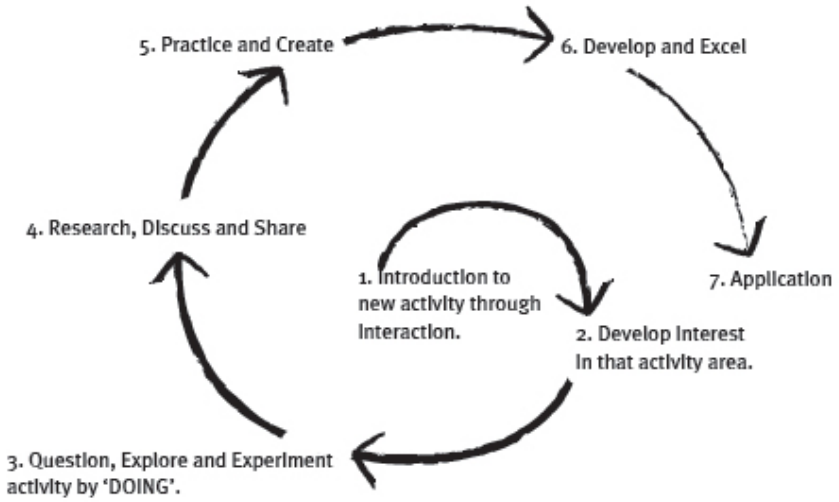
Since, there is no process like teaching in the new system of learning, the role of facilitators needs to be discussed at various levels.

Graduate Learning Process

Learning begins from the time one is born and it grows by interacting with different objects, people and places.
Exposure to various events in early years leads to absorption and questioning of different activities according to the child's fascination. This fascination leads to understanding, participation and involvement to the next level.
The dynamic process of self discovery and exploration extends to advance level of coordination, managerial and leadership skills and reasoning abilities.

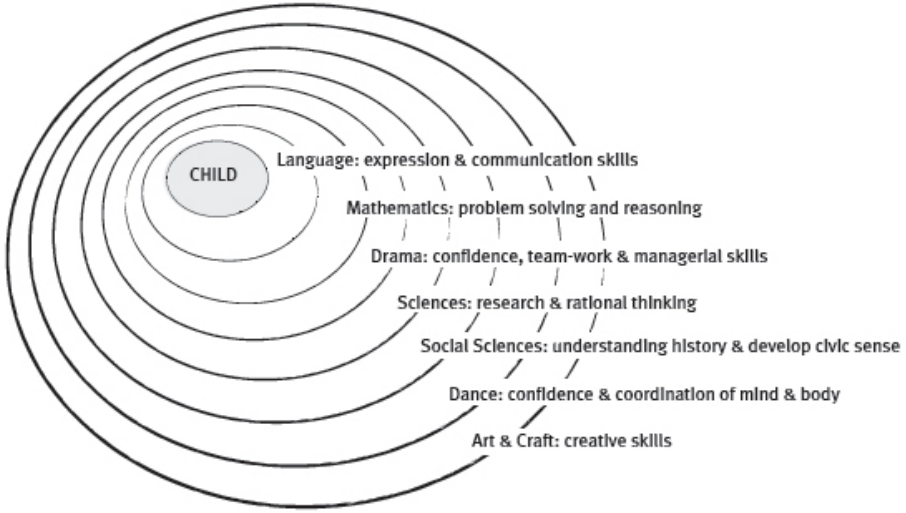
Spiral Approach

It begins with facilitator's (children, parents, friends, professionals etc) experiences introducing the activity to the child.
As the child observes, discovers and explores this interest, it grows on to become a skill and talent.



Concentric Approach

It begins with child's interest in various areas.
As the child involves himself in different subjects and elements parallelly, the consequent learning evolves his senses and qualities helping him to apply it in interdisciplinary learning.

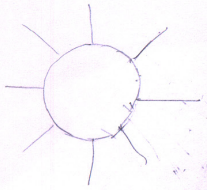


Name- Ruchita Bhatade
Std - VII

LIGHT

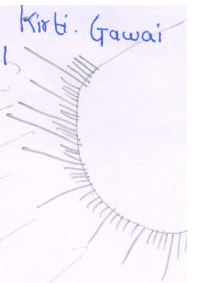
1) Sun light.
2) Tube light.
3) Candle light.
4) Moon Light
5) Lightning.
6) Lightning.
7) Torch light
8) Light year.
9) Head light.

Light :- Light is very important in our life. If light is not their we can't do anything. As we can't do any work in dark. Plants also need light to prepare food.



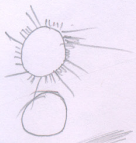
Plants need sunlight to prepare their food.

Name- Kirti Gawai
Std - VII



dight

Sun light



Moon light

light shading

light colour

Candle light ~~dinner~~

tube light

lightning

Lamp

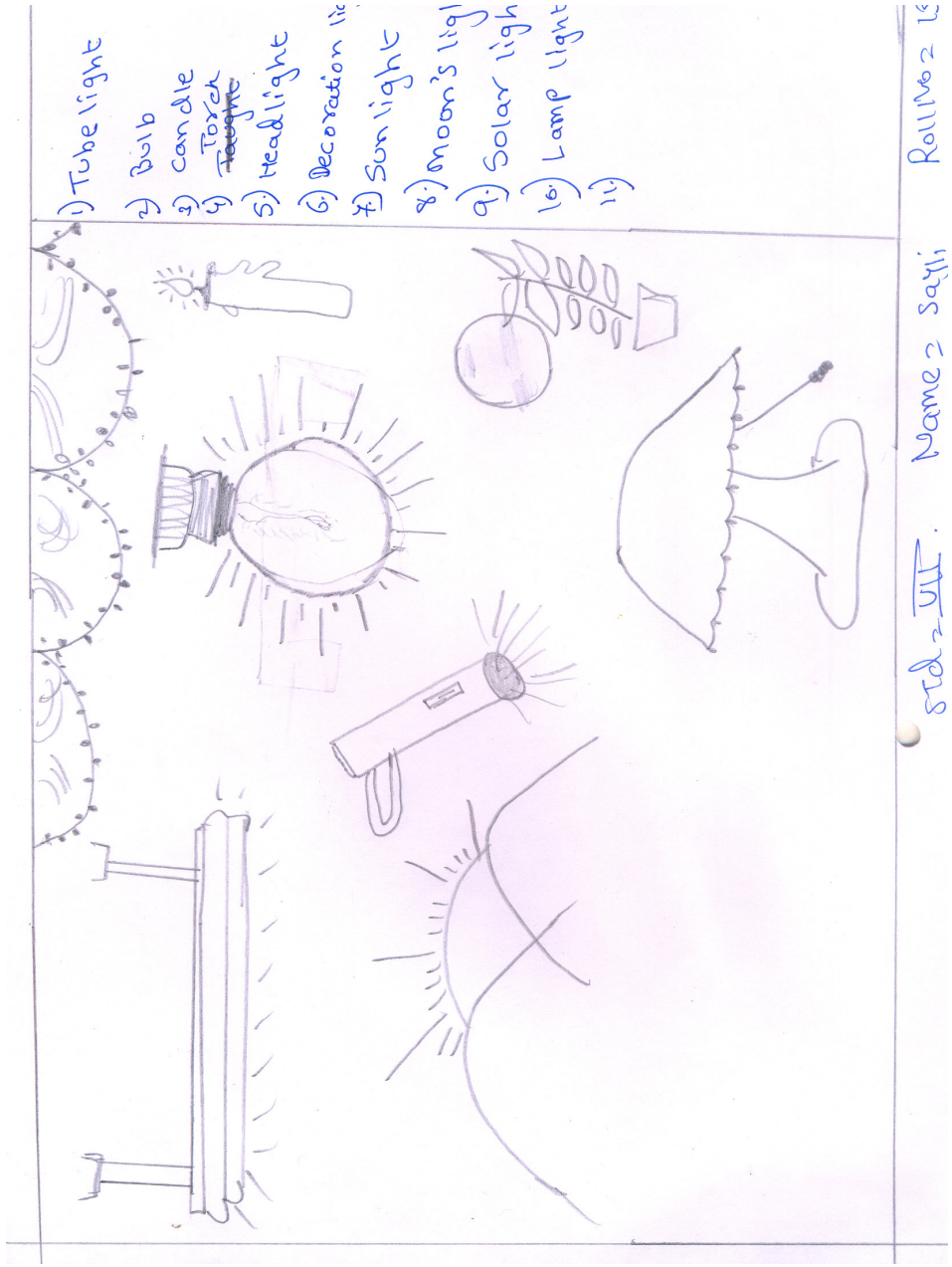
Torch light

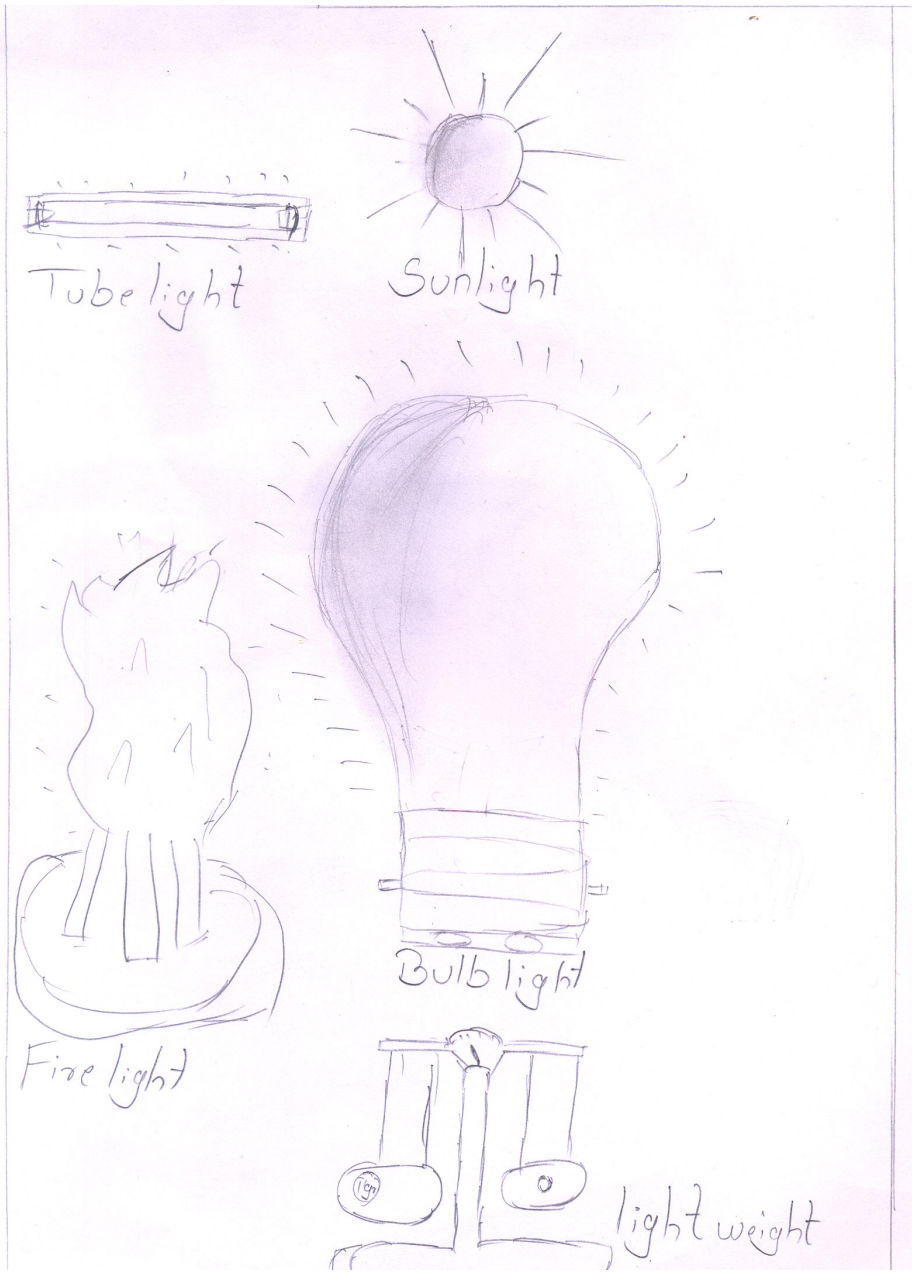
head light

Diwali festival of lights

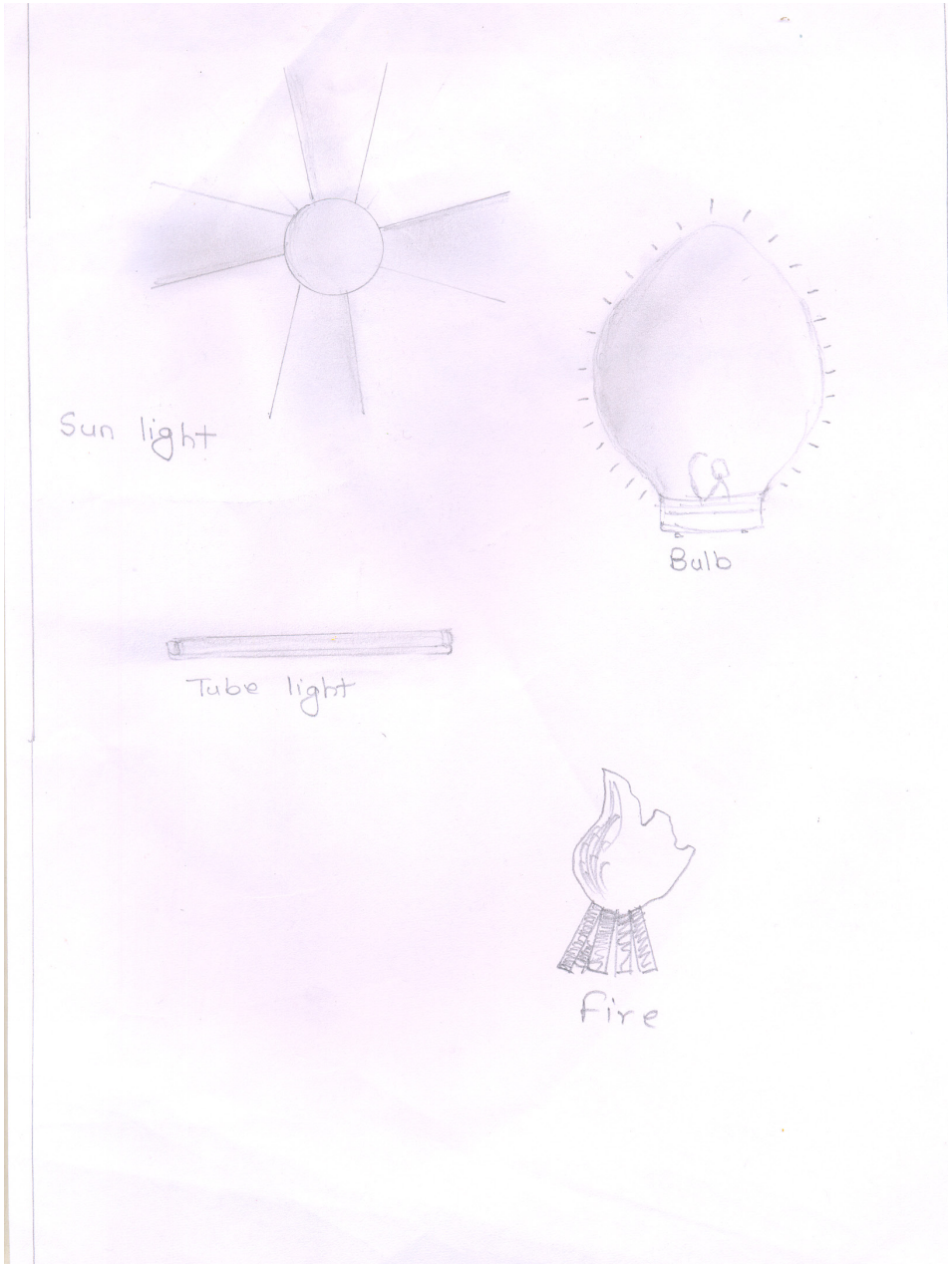
light means ~~light~~ very less weight

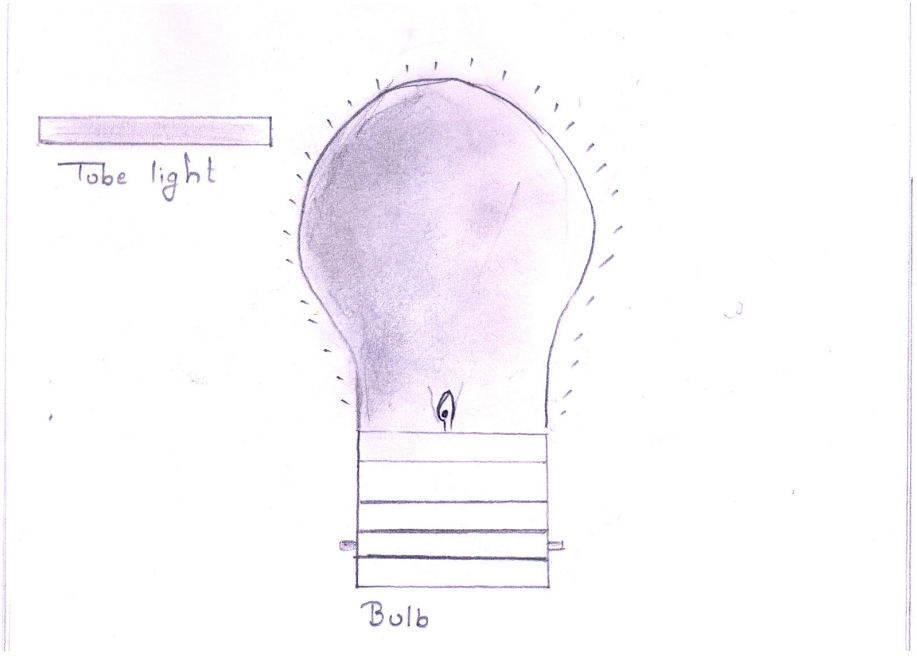
It is very important for ~~#~~ plants to have light ie sun light for preparing food





Annexure 3: Drawings by IIT Campus School children to articulate 'Light"





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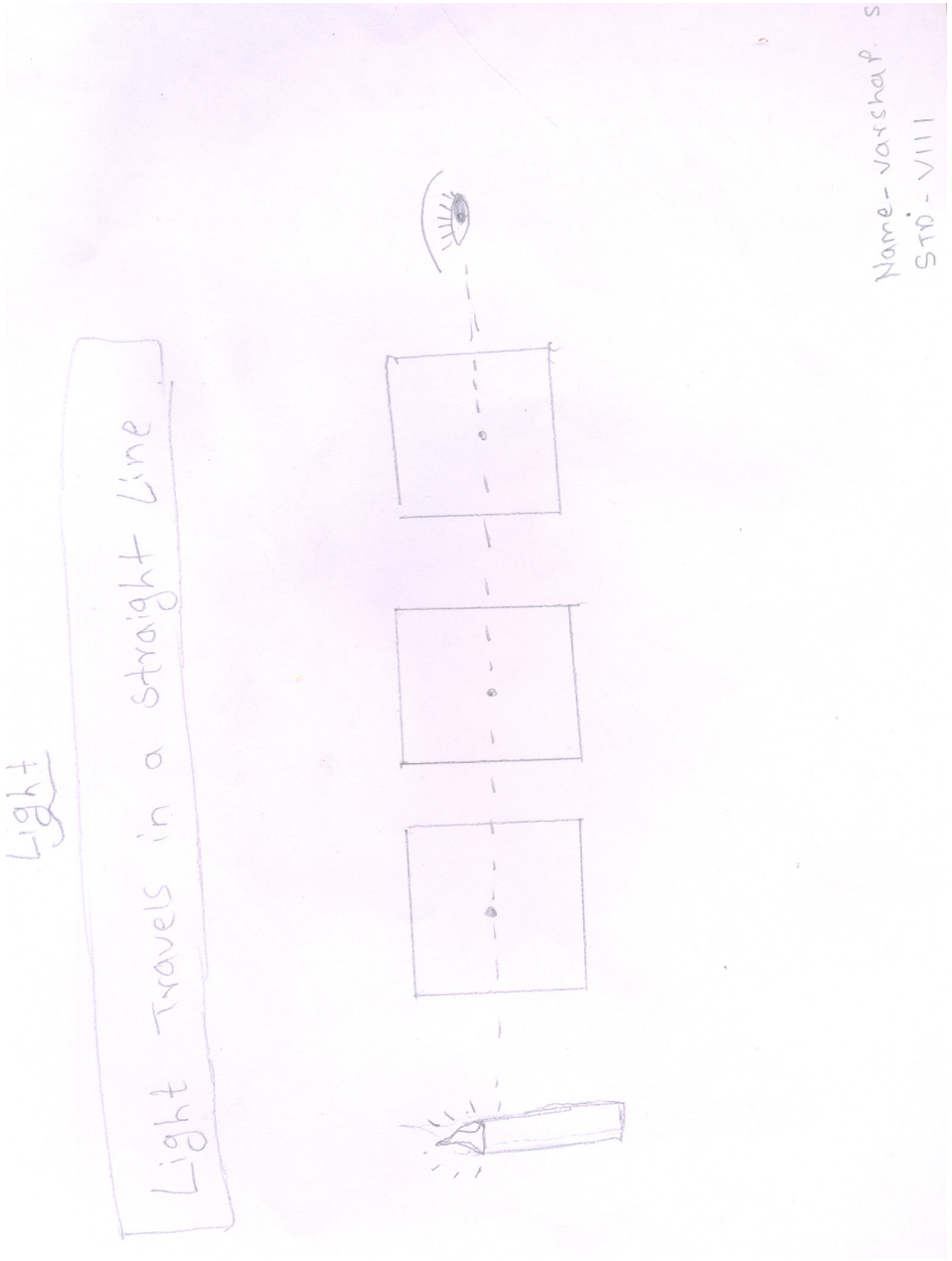

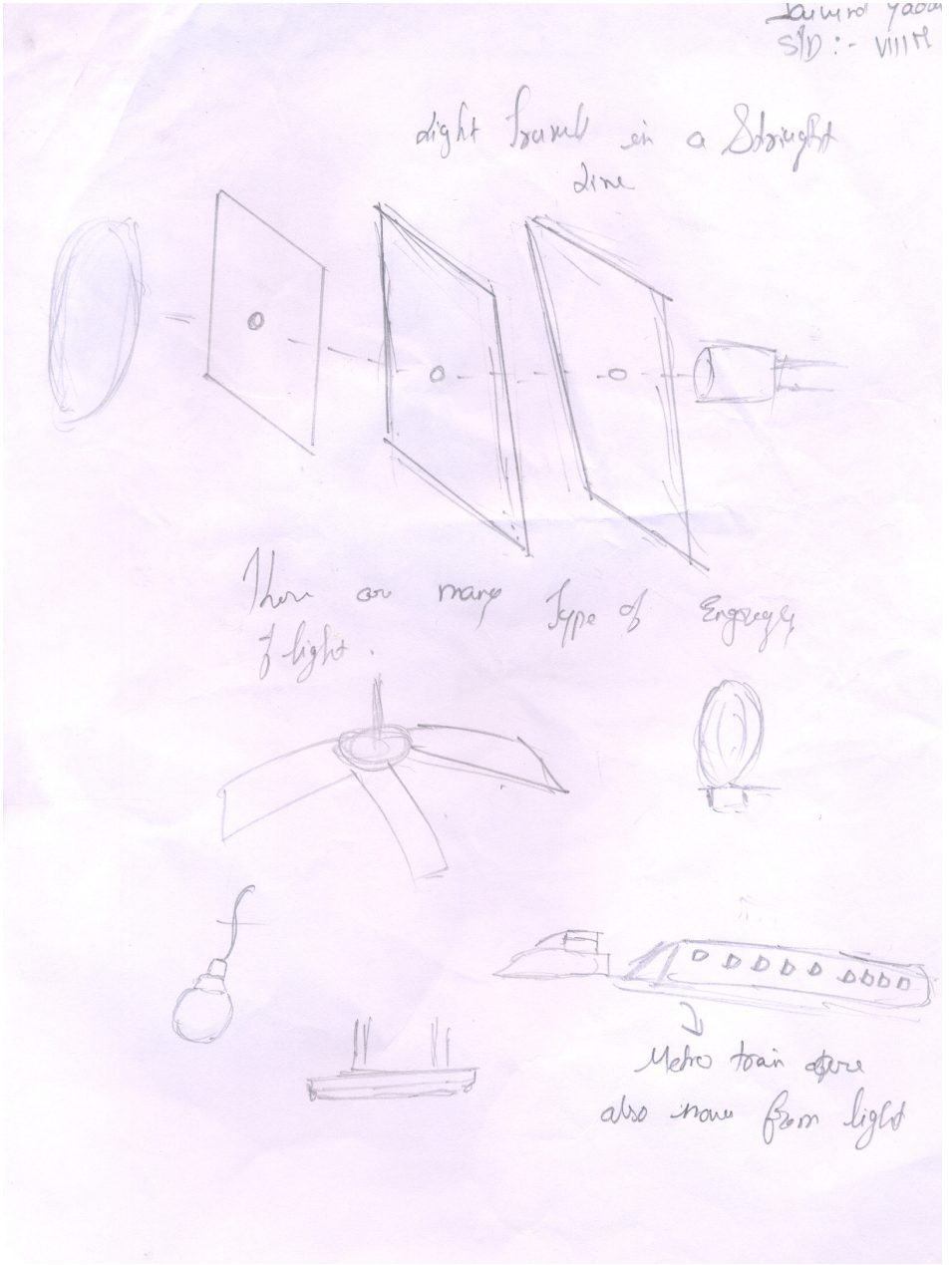

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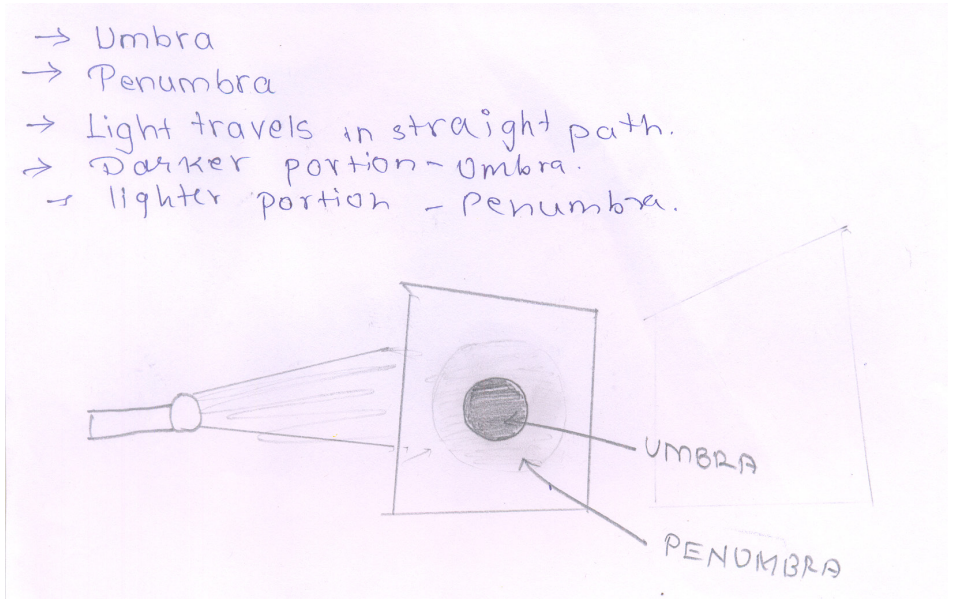
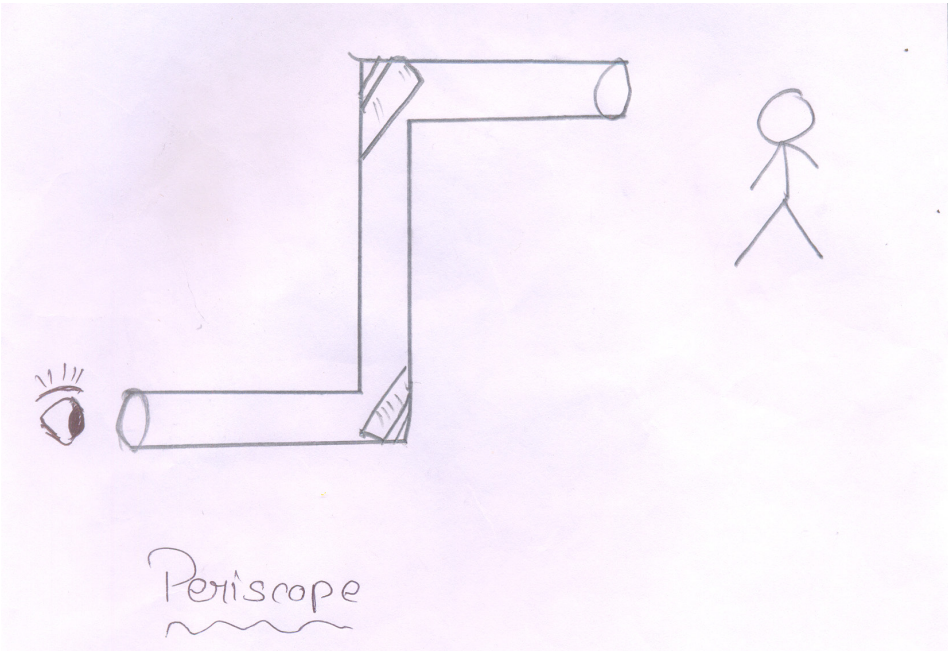
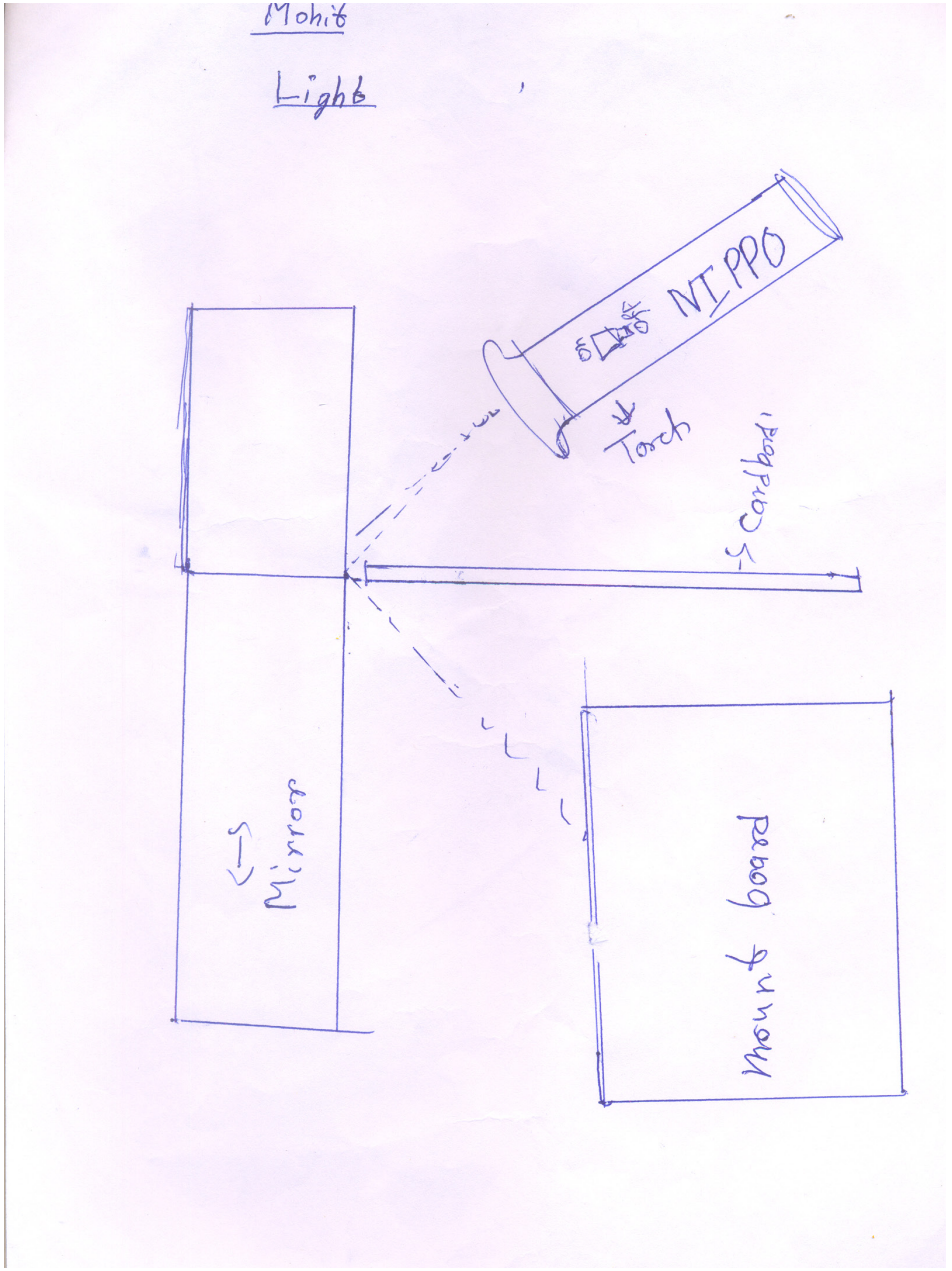




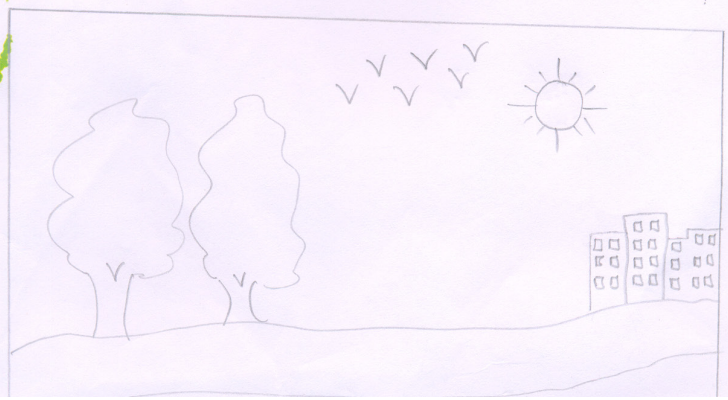


Annexure 3: Drawings by IIT Campus School children to articulate 'Light"

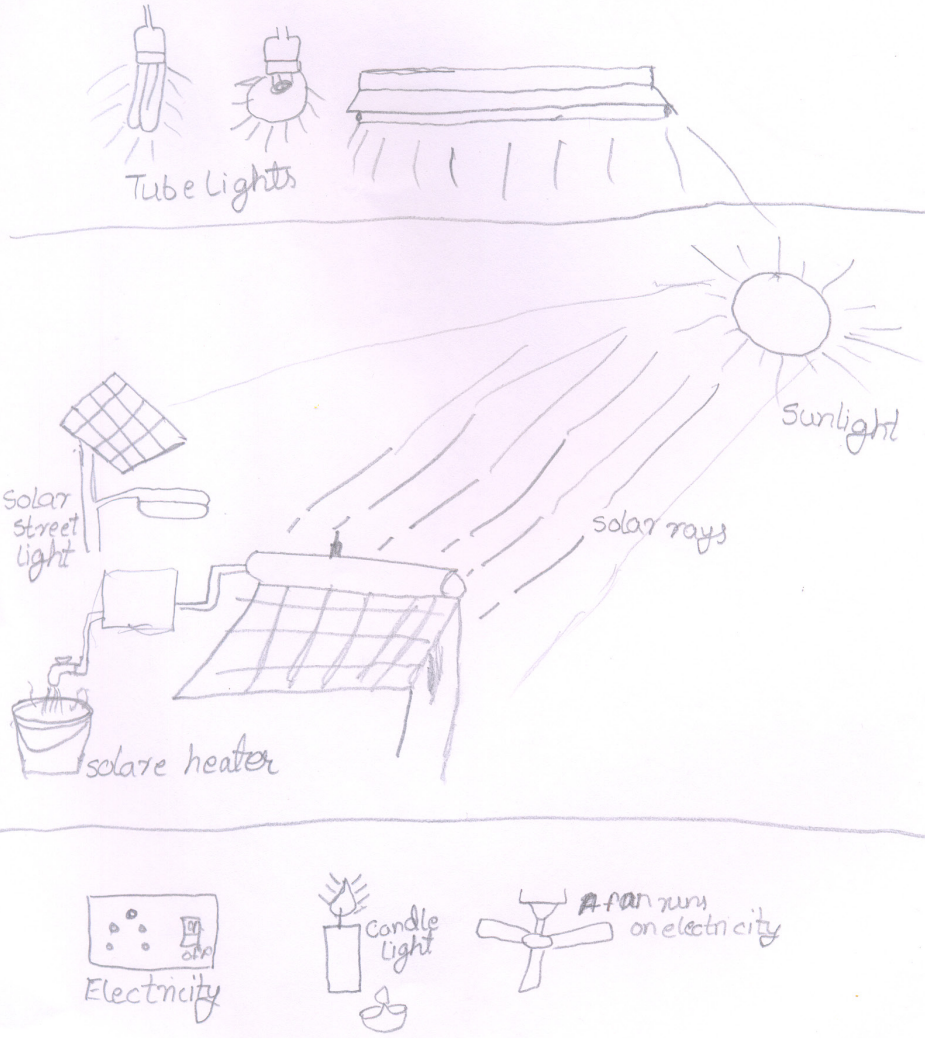
Name- Rishab. N.B
Roll No- 22
Class - VIII th Std

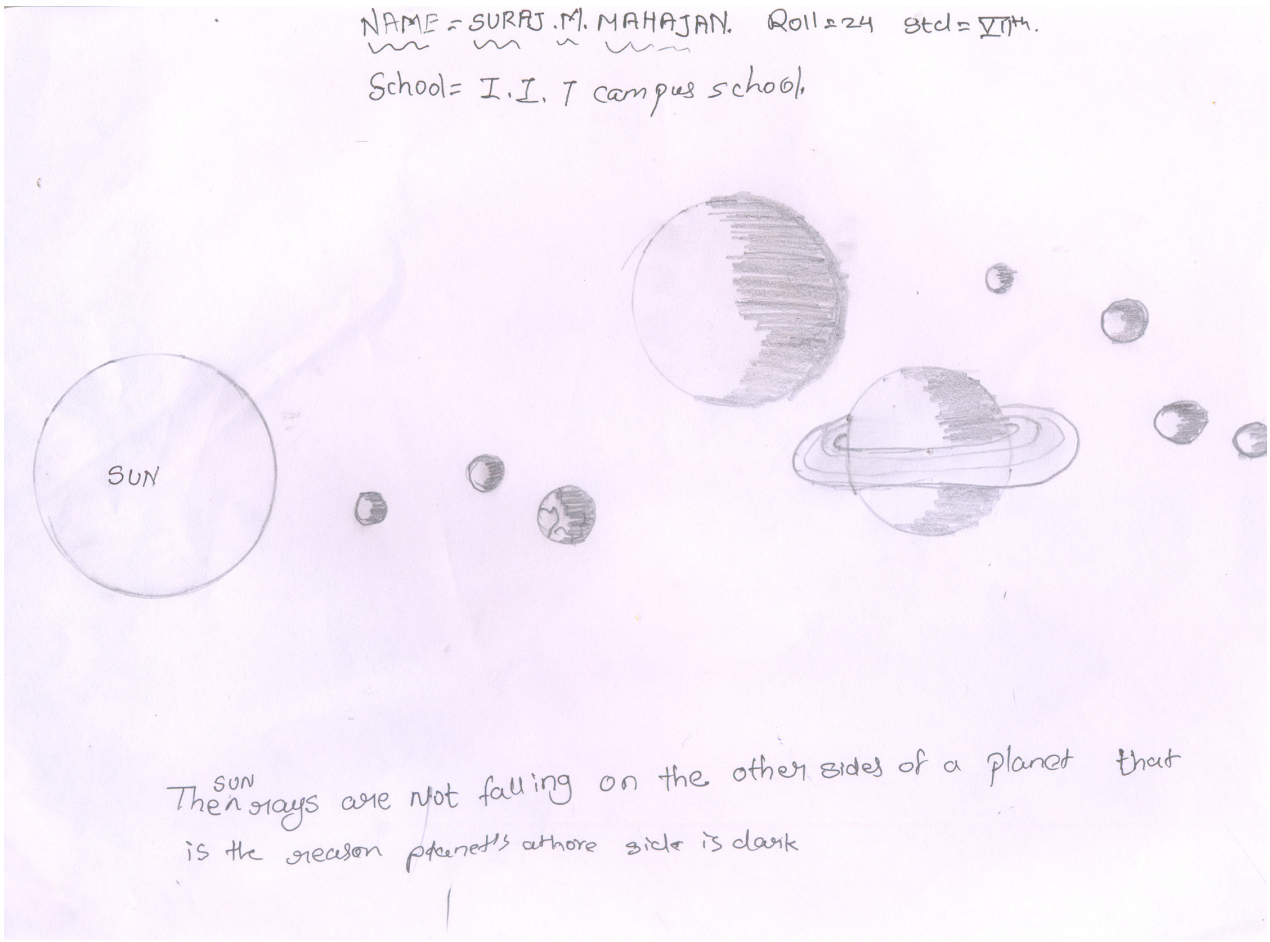
Sources Of Light

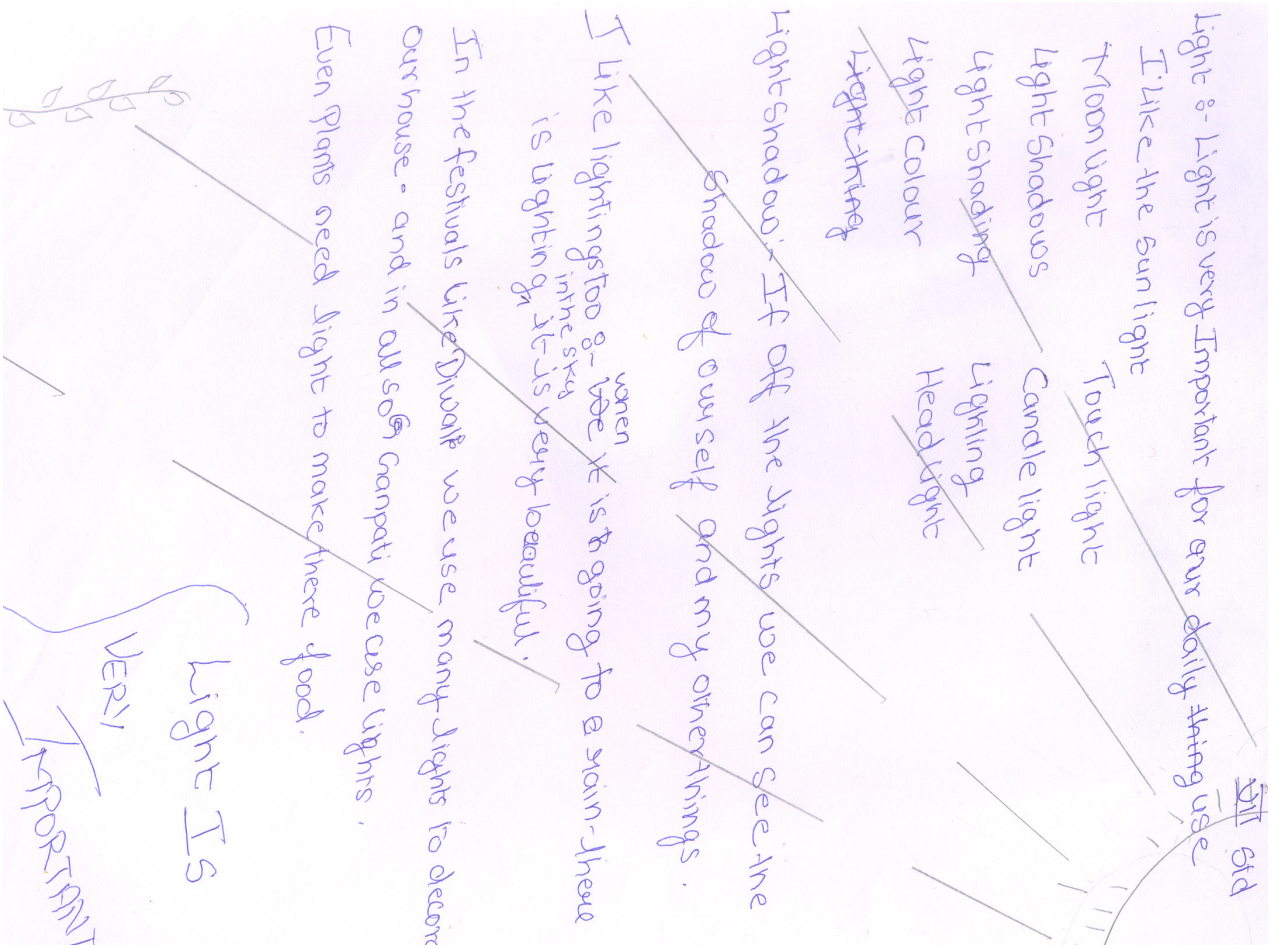
Discovery of light was a great help for the humans in day to day life. The source of light and energy is the sun. It is use ful in many ways. For escample - Plants get their food prepared with the help of sun light, due to the sun light we can heat our water, cook etc. Man has invented many things but the most important discovery was the electricity. In our house we use tubelights, lamps, fans, T.V etc. But now we should be very careful in using electricity. Because there is a lot of wastage of electricity due to the increase of population and the appliences we use.



My favourite subject : Science




NAME = SURAJ .M. MAHAJAN. Roll = 24 Std = VIIth.
School = I.I.T campus school
SUN
The SUN rays are not falling on the other sides of a planet that is the reason planet's athore side is dark


VII Std
Light :- Light is very important for our daily thing use
I like the Sun light
Moon light
Touch light
Light Shadows
Candle light
Light Shading
Lighting
Light Colour
Head light
Light things
Light Shadow :- If off the lights we can see the Shadow of ourself and my other things.
I like lightings too :- when is going to be rain-there in the sky is lighting it is very beautiful.
In the festivals like Diwali we use many lights to decore our house - and in also Ganpati we use lights.
Even plants need light to make there food.
Light IS VERY IMPORTANT