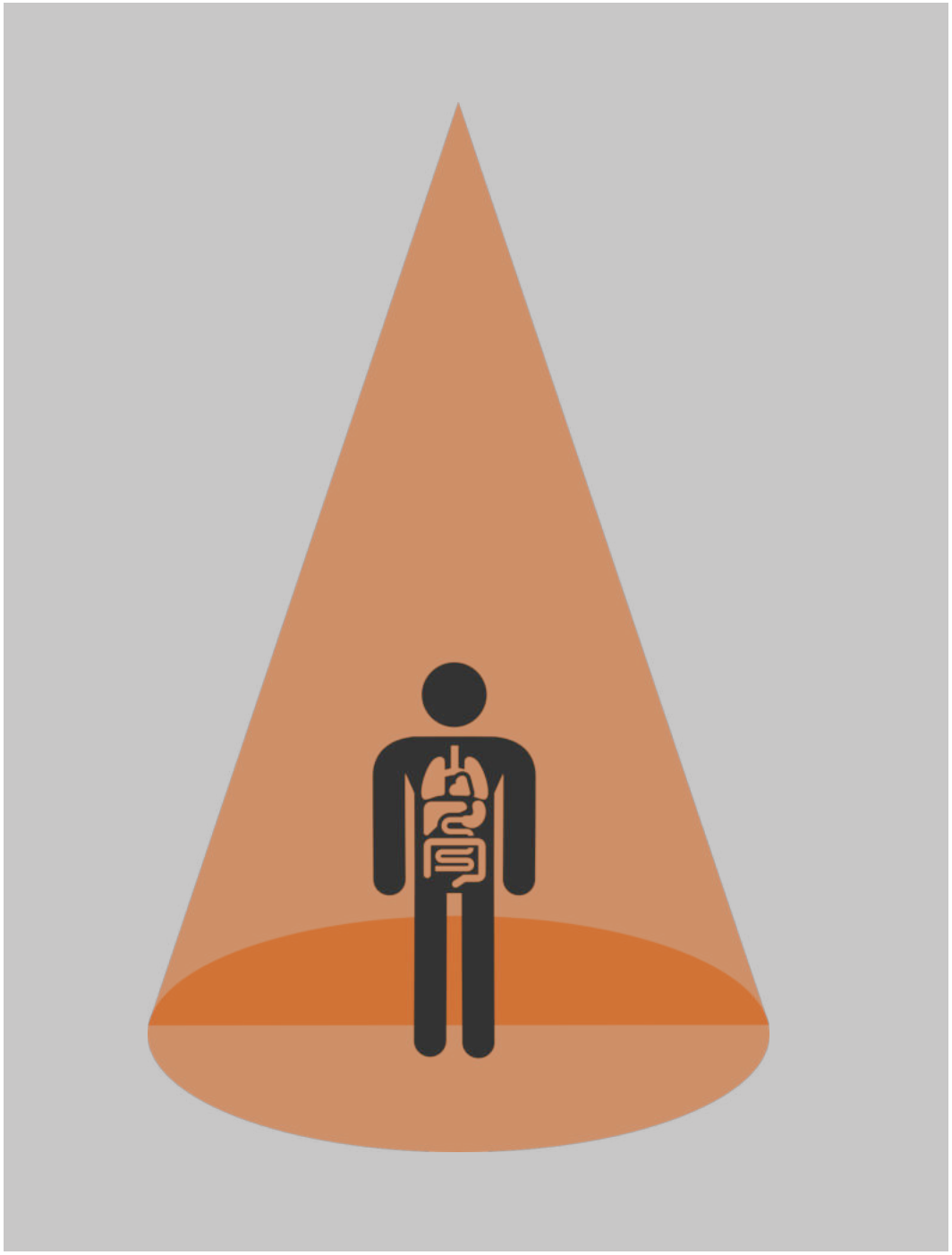

Interactive methods to teach
HUMAN ANATOMY

Sony Salma Priyadarshini | 146130013 | Guide: Prof P. Kumaresan

Industrial Design Project 3
Industrial Design Centre | IIT Bombay

Industrial Design Project 3

"Interactive methods to teach human anatomy"

By
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146130013
Mdes. Industrial Design
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It is approved as a partial fulfilment of requirements of a post graduate degree in Industrial Design at IDC, IIT Bombay.

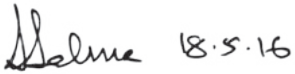
External Examiner:

Internal Examiner:

Project Guide:

Chairperson:

I declare that this written submission represents my own ideas and where other's ideas or words have been used, I have adequately cited and referenced the original sources. I also declare that I have adhered to all the principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any ides/source/fact in my submission. I understand any violation of the above will be the cause for a disciplinary action by the institute and can also issue penal action from the sources which has been thus not been properly cited or from whom proper permission has not been taken where required.



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I take this opportunity to thank the entire Industrial Design department for the success of the project.

I express my gratitude to my guide - Prof P Kumaresan for his consistent support and faith in the project and on me. The learnings from the project has been immense.

I am grateful to my classmates for contributing their valuable insights to this project. Special thanks to Hirom Ulema Meetei and Shreelekha Lakhsmipathy for their help, numerous discussions and support.

Design of interactive methods to teach human anatomy to children of age group 10-12 years.

The primary objective of the project is to provide a means to educate small children about the human anatomy in a fun and engaging way. Understanding human anatomy and physiology consists of major part of learning biology. Unlike subjects such as maths and physics, biology needs a larger part to be understood and memorised. The subject gets complicated further as the student goes to higher classes. Unless the students have a strong grasp of basics, they tend to lose interest in the subject.

Anatomy is linked with many other fields of study such as nutrition, keep good health, hygiene, physical education, sports etc. Understanding anatomy leads to clarity in other areas. Since most of the available materials are basically instructional, the project aims to facilitate the foundational learning of basic anatomical concepts in an alternative way where the child “learns through playing”.

The final product had a kit which contained the different systems of human body in a simplified form in layers. This kit can not only be for demonstration school but also as an examination tool. The design was scalable in sense that more layers of other systems could be added if wanted. The product is affordable, simple and child-friendly.

Psychology
Child Psychology
Context of Child Psychology

Psychology is the study of mind and behaviour. It uses specific principles to understand how individuals and groups behave. Psychology helps understand the role of mental functions in individual and social behaviour. It also explores the various physiological and biological processes that underlie cognitive functions and behaviours.

Psychology explores concepts such as perception, cognition, attention, emotion, intelligence, motivation, brain functioning, personality, behaviour, interpersonal relationships and other areas. Psychologists also study the unconscious mind. [1]

Child psychology is one of the many branches of psychology and one of the most frequently studied specialty areas. This particular branch focuses on the mind and behaviour of children from prenatal development through adolescence. Child psychology deals not only with how children grow physically, but with their mental, emotional and social development as well.[2]

In olden days not much importance was given to study of psychology of children. They were viewed as smaller versions of adults. Today, psychologists recognize that child psychology is unique and complex. Many have studies and have different approaches, opinions and perspectives when it comes to understanding child development. Experts also differ in their responses to some of the bigger questions in child psychology. They seek to find answers of question such as whether early experiences matter more than later ones or what plays a greater role in the development—whether its nature or nurture.

There can be both internal and external factors which affect the development of a child. Internal factors can be genetics, personal characteristics etc. External factors can be interaction and relationship of the child with his/her environment, culture etc.[2]

Some of the major contexts[3] that we need to consider in our analysis of child psychology include:

The Social Context: This includes family, friends and teachers at school and other peer groups. Relationships with peers and adults have an effect on how children think, learn and develop.

The Cultural Context: Children learn values, ways of living, thinking, customs through the culture they are exposed. This influences throughout the lifespan. Culture may play a role in how children relate to their parents, the type of education they receive and the type of child care that is provided.

The Socioeconomic Context: Social class can also play a major role in child development. Socioeconomic status (often abbreviated as SES), is based upon a number of different factors including how much education people have, how much money they earn, the job they hold and where they live. Children raised in households with a high socioeconomic status tend to have greater access to opportunities, while those from households with lower socioeconomic status may have less access to such things as health care, quality nutrition and education. Such factors can have a major impact on child psychology.

All three of these contexts are constantly interacting. While a child may have fewer opportunities due to a low socioeconomic status, good social relationships and strong cultural ties may help correct this imbalance.

Cognitive Theories
Piaget and Vygotsky's Theories
Comparison

Image-1

Cognitive development is a field of study in neuroscience and psychology focusing on a child's development in terms of information processing, conceptual resources, perceptual skill, language learning, and other aspects of brain development and cognitive psychology compared to an adult's point of view. In other words, cognitive development is the emergence of the ability to think and understand.[4]
Of the many cognitive development theories two major influential theories proposed by Piaget and Vygotsky were studied, analysed and compared to understand the various aspects of child psychology and development.

Image 2: Jean Piaget

Jean Piaget (1936) was the first psychologist to make a systematic study of cognitive development. His contributions include a theory of child cognitive development, detailed observational studies of cognition in children, and a series of simple but ingenious tests to reveal different cognitive abilities.

Piaget showed that children have a different way of thinking as compared to adult. They have a basic mental structure upon which all the subsequent knowledge and learning is based. There are three important components to Piaget's Cognitive Theory of Development:

1. Schemas (building blocks of knowledge).

2. Adaptation processes that enable the transition from one stage to another (equilibrium,assimilation and accommodation).

3. Stages of Development:

-The sensorimotor stage

The main achievement during this stage is object permanence - knowing that an object still exists, even if it is hidden. It requires the ability to form a mental representation (i.e. a schema) of the object

The pre-operational stage
During this stage, young children are able to think about things symbolically. This is the ability to make one thing - a word or an object - stand for something other than itself. Thinking is still egocentric, and the child has difficulty taking the viewpoint of others.

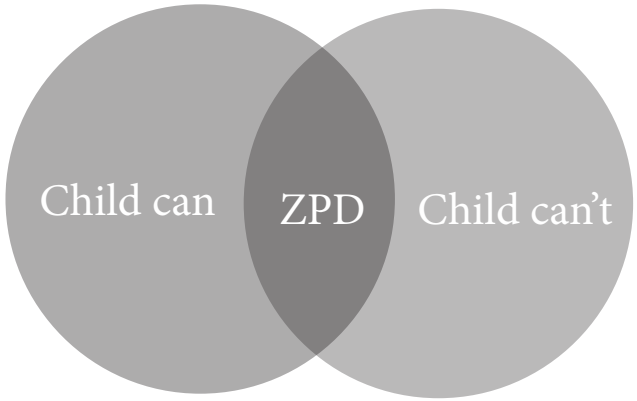
The concrete operational stage
Piaget considered the concrete stage a major turning point in the child's cognitive development, because it marks the beginning of logical or operational thought. This means the child can work things out internally in their head (rather than physically try things out in the real world).

The formal operational stage
The formal operational stage begins at approximately age eleven and lasts into adulthood. During this time, people develop the ability to think about abstract concepts, and logically test hypotheses.

Piaget has been extremely influential in developing educational policy and teaching practice. For example, a review of primary education by the UK government in 1966 was based strongly on Piaget's theory.

It was based on individual learning, flexibility in the curriculum, the importance of play in children's learning, the use of the environment, learning by discovery and the importance of the evaluation of children's progress - teachers should 'not assume that only what is measurable is valuable.'

Use of collaborative, as well as individual activities (so children can learn from each other), devising situations that present useful problems, and create disequilibrium in the child etc. are few aspects we can learn from Piaget's theories.



Zone of Proximal development

Image-3 : Lev vygotsky

The work of Lev Vygotsky (1934) has become the foundation of much research and theory in cognitive development, particularly of what has become known as Social Development Theory.

Vygotsky's theories stress the fundamental role of social interaction in the development of cognition Vygotsky, 1978), as he believed strongly that community plays a central role in the process of "making meaning."

Vygotsky argued, "learning is a necessary and universal aspect of the process of developing culturally organized, specifically human psychological function". In other words, social learning tends to precede (i.e. come before) development. Vygotsky has developed a sociocultural approach to cognitive development. He also believed that language develops from social interactions, for communication purposes.[5]

Two of the main principles of Vygotsky's work are :
The More Knowledgeable Other (MKO) and the Zone of Proximal Development(ZPD).

MKO: It refers to someone who has a better understanding or a higher ability level than the learner, with respect to a particular task, process, or concept.
ZPD: This is an important concept that relates to the difference between what a child can achieve independently and what a child can achieve with guidance and encouragement from a skilled partner.

For example, the child could not solve the jigsaw puzzle by herself and would have taken a long time to do so (if at all), but was able to solve it following interaction with the father, and has developed competence at this skill that will be applied to future jigsaws.

Vygotsky (1978) sees the Zone of Proximal Development as the area where the most sensitive instruction or guidance should be given - allowing the child to develop skills they will then use on their own - developing higher mental functions.[5]

Teachers can use information about both levels of Vygotsky's zone of proximal development in organizing classroom activities in the following ways:

- Instruction can be planned to provide practice in the zone of proximal development for individual children or for groups of children. For example, hints and prompts that helped children during the assessment could form the basis of instructional activities.
- Cooperative learning activities can be planned with groups of children at different levels who can help each other learn.

1: Piaget believed that the cognitive development is same across all cultures and is universal. Vygotsky states that development depends and is highly variable in different culture.

2: Vygotsky places considerably emphasis on social factors contributing to cognitive development. Vygotsky states cognitive development develops from social interactions from guided learning within the zone of proximal development as children and their partners co-construct knowledge. In contrast Piaget maintains that cognitive development develops largely from independent explorations in which children construct knowledge of their own. For Vygotsky, the environment in which children grow up will influence how they think and what they think about.

3: Vygotsky places emphasis on the role of language in cognitive development. For Vygotsky, cognitive development results from an internalization of language. According to Piaget, language depends on thought for its development (i.e. thought comes before language). For Vygotsky, thought and language are initially separate systems from the beginning of life, merging at around three years of age, producing verbal thought (inner speech).

4: According to Vygotsky adults are an important source of cognitive development. According to Piaget the source of cognition is the child himself whereas Vygotsky states that the social environment which includes the parents, teachers, peers etc. to play an important role in cognitive development.[6]

Image 4: Toys

Image 5 : Games

Image 6: Teaching Aid

TOY

A toy is an object for a child to play with, typically a model or miniature replica of something[7]. Toys usually expect the child to sit back and be entertained. It can be interesting to look at and listen to (such as musical mobiles or colourful rattles). They are usually passive but at times allow the child to grow in imagination and do activities such as story telling, role playing etc.

GAME

Game can be form of competitive activity or sport played according to rules[8]. It is structured form of play, usually undertaken for enjoyment and sometimes used as an educational tool. One of the most important part of game is that it involves multiple players and combination of goals, rules and challenge. This in turn helps in social and practical skills. They also serve as a form of exercise, perform an educational, simulational, or psychological role.

TEACHING AID

Teaching aid can be any device, object, or machine used by a teacher to clarify or enliven a subject[9]. They are the tools that teachers use them in the classroom such as flash cards,maps,cassette and charts etc. They are used by teachers to help learners improve reading and other skills, illustrate a skill, fact, or idea etc. They improve clarity of subject knowledge, might help in getting attention & interest of the learners.

Image 7: Teaching through videos

INTERACTION, INTERACTIVE LEARNING, INTERACTIVE ENVIRONMENT

Interactions are the exchanges that individuals have through words, facial expressions, tone of voice, gestures, body language, and physical activity whereby two parties communicate with each other. It can be as simple as waving hand or sitting for a conversation.

Although a good student teacher interaction is imperative to build such an environment, games, toys, teaching aids, hands-on activities can further assist in the process. Interactive learning is a more hands on, real-world process of relaying information in classrooms. Passive learning relies on listening to teachers lecture or rote memorization of information, figures, or equations. But with interactive learning, students are invited to participate by including interactive techniques such as think-pair-share, games, demonstrations, and role playing etc.

In addition to engaging students in. It helps in improving skills such as critical thinking. This is important for a child to explore, analytically reason, imagine, make decision etc.

There are various styles in which children can be taught. There are several methods and techniques which are used to teach kids. Children can be taught using blend of these styles.[10]

Few of the learning styles are as following-

Visual
Learning through pictures, images, and spatial understanding. For example through pictures, icons, charts, diagrams etc

Auditory
Teaching techniques that involve sound. For Example- Story telling, teaching through poems, rhymes etc.

Verbal
Learning through words, verbal and/or written. For example
-Copying down phrases and words, taking notes during lectures, reading out loud, discussions etc

Physical (Kinesthetic)
Learning through experience and rely on the sense of touch, learn through "doing". For example in this kind the children build, act out, and experience what they are learning. For example field trips, technology, and playing games etc

Logical
Learning through logic and reasoning. Giving the answer to 'why' question that might arise in the mind of the child.

Social (Interpersonal)
Learning through group interaction. This involves interpersonal communications in a group atmosphere. For example group project etc.

Solitary (Intra-personal) –
Individual teaching or self-paced learnings. For example self-study.

In the Indian education system (ICSE and CBSE), introduction to to human anatomy and physiology in biology happens in Class 7th. In advanced classes the complexity of the subject is increased and a much detailed study is carried out. Students usually are 10-12 years in standard 7th.

In the state board(Maharashtra State Secondary Education(MSSE)) the chapters on anatomy start at class 6 and 7. The advanced concepts of physiology are taught in class 9th and 10th.Where they are taught fundamentals of anatomy like organs, organ systems. Most of the Indian schools complement the study of human anatomy and physiology with charts or models. The charts being in 2D doesn't give a basic idea about the overlapping organs which is in 3D. Visualizing the structure in three dimension from the charts is challenging. Anatomical models are not interactive to engage the child/ student to learn the subject in a fun way.

Most of the available products are instructional and tends to make the subject as interesting as the teacher/ instructor can make it. In case of educational toys, Maths, Physics, Mechanics share a major chunk. There is huge gap when it comes to toys, games or teaching aids related to biology. Of all the topics biology covers human anatomy and physiology is one of the most complex.

Building a foundation before one can move into more complex detailing is extremely important. Hence there is in an increasing need in for products which can assist in teaching such complex topic. So there is a scope for products which could be used as teaching aids in schools to strengthen the concepts which are taught in classrooms.

The Greek philosopher Plato wrote that the future architect should play at building houses as a child[7]. There is immense variety of toys, learning aids and games available at the tip of fingers these days. Of the various available categories I have short-listed few according to the active involvement of the child with the product. Activities such as development of motor skills, application of logics and problem solving.

EXAMPLES

Action figures
Animals
Cars and radio controlled
Construction toys
Creative toys
Dolls

Electronic toys
Executive toys
Food-related toys
Model making toys
Games
Physical activity and dexterity
Puzzle/assembly
Science and optical
Sound toys
Spinning toys

Construction toys
Lego
Lincoln Logs
Meccano
Mega Bloks

Creative toys
Cleversticks
Colorforms
Crayola Crayons
Creepy Crawlers

Educational toys
Lego Mindstorms
Lego Mindstorms NXT
Little Golden Books
qfix robot kits
See ‘n Say
Speak & Spell

Games
Scrabble
Uno
Ludo
Twister
Monopoly

Physical activity and dexterity
Pogo stick
Radio Flyer
Roller Skates
Skip It
Slinky
Slip ‘n Slide
Soap-box cart
Space Pets
Toy weapon
Water gun

Puzzle/assembly
Jigsaw Puzzle
Mr. Potato Head
Puzzle
Rubik’s Cube
Tangrams

Science and optical
Chemistry set
Etch A Sketch
Kaleidoscope
Magic 8-Ball
Magna Doodle
View-Master
Wooly Willy

Nehru science centre | IIT Campus School, Powai

Image 8(left): Nehru Science Centre

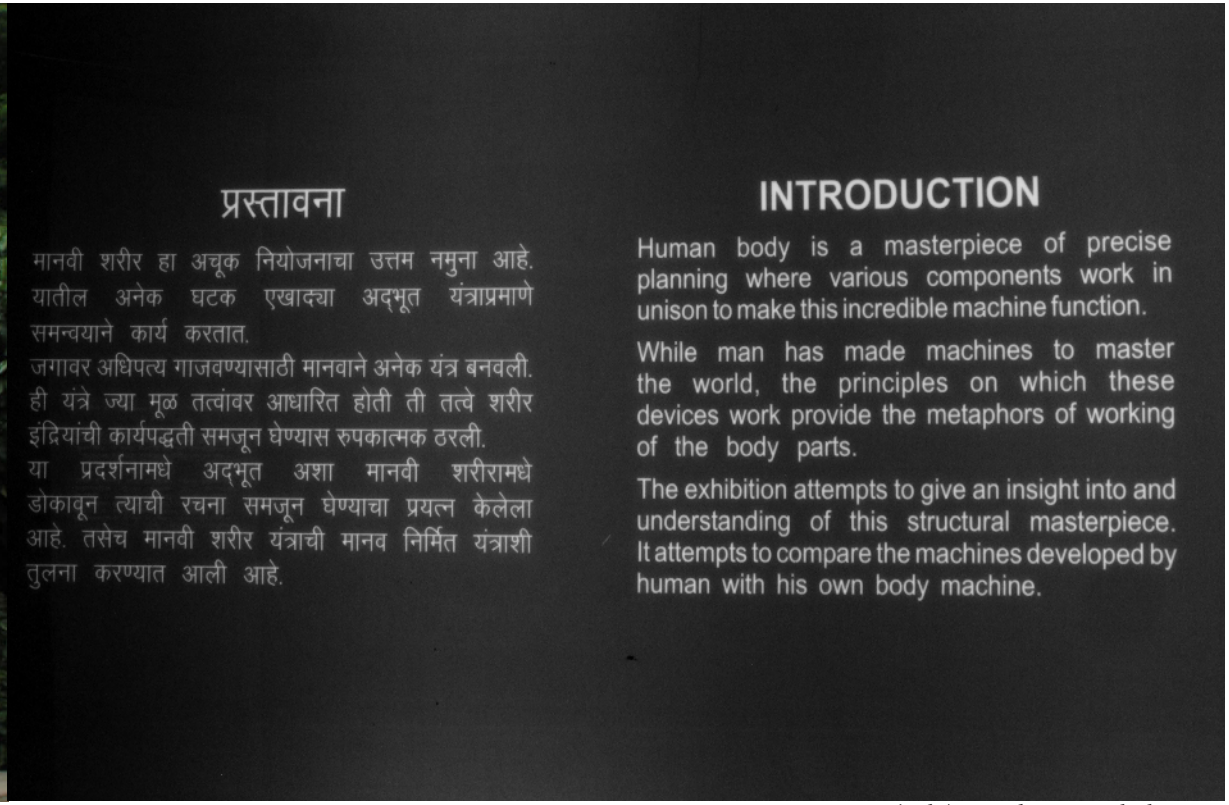


Image 9(right): Introduction at the human body section at Nehru Science Centre

In 1977, Nehru Science Centre(NSC), first conceived as a Science & Technology Museum in late sixties, took final shape as India's largest interactive science centre, to match the world trends in such public institutions. Nehru Science Centre, Mumbai, is India's largest interactive science centre, located in Worli. The centre is named after India's first Prime Minister, Jawaharlal Nehru. Nehru Science Centre, Mumbai has more than 500 hands-on and interactive science exhibits on energy, sound, kinematics, mechanics, transport, etc. installed in the science park & different galleries.

The museum has an entire section dedicated to exhibition of various installations related to the functioning of human body. The installations attempt to compare the machines developed by human with his own body.
Human body is indeed a set of complex and sophisticated functions. The exhibits lacked the playfulness of other departments. Mostly they were only visual. Based on the types of exhibits I would like to categorize it into two groups— active and passive. Active exhibits are were there was feedback as a result of some interaction by the user. The feedback could be in terms of sound, light, movement etc. Passive exhibits are usually the ones which were only visual.

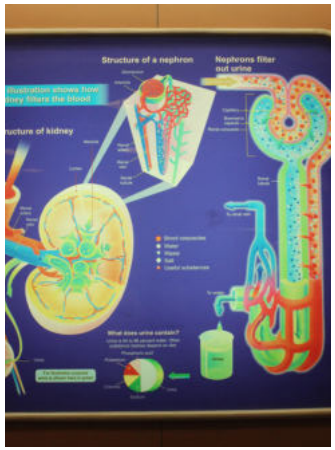
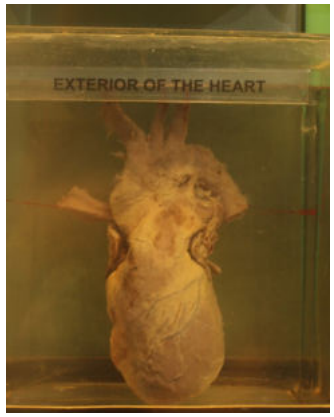



Image 10: Kidney model(left) and kidney diagram(right)



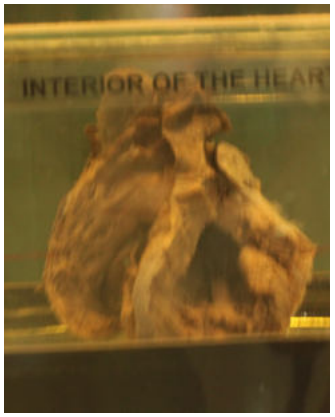


Image 11: Specimens of heart

Passive Exhibits

Interesting to look at and listen to (models, charts, specimens etc). User interaction is very limited.

Image 12: Artificial Limbs

Image 13: Parts of Tongue

Image 14: Structure of Amino Acid

Image 15: Skeletal Structure

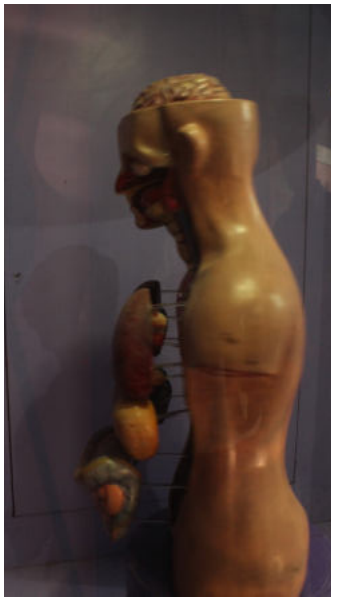



Image 16: 3D Model of Human anatomy

Image 17: Massive human heart model that allows visitors to walk into it and observe its bicuspid and tricuspid valves as it makes loud heart beats around.

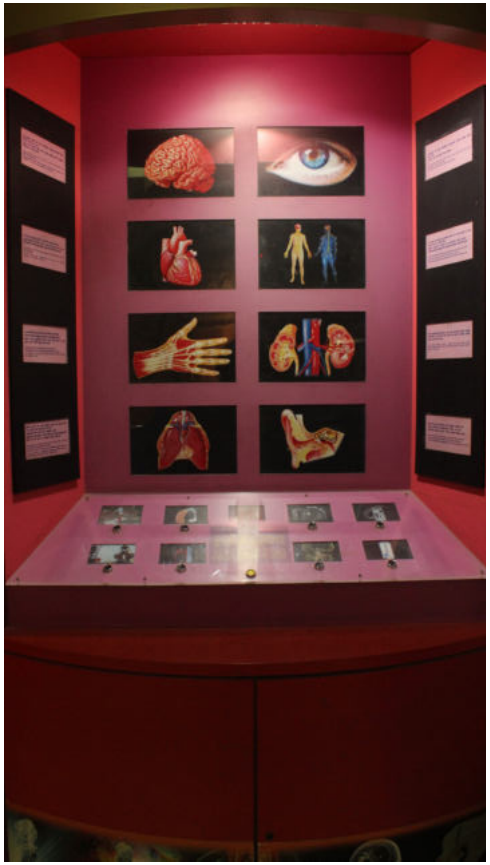


Image 18: A quiz based installation to match body parts with a mechanical product which has similar functionality

Image 19: An installation where touching different parts of the brain produced various actions in other parts of the body

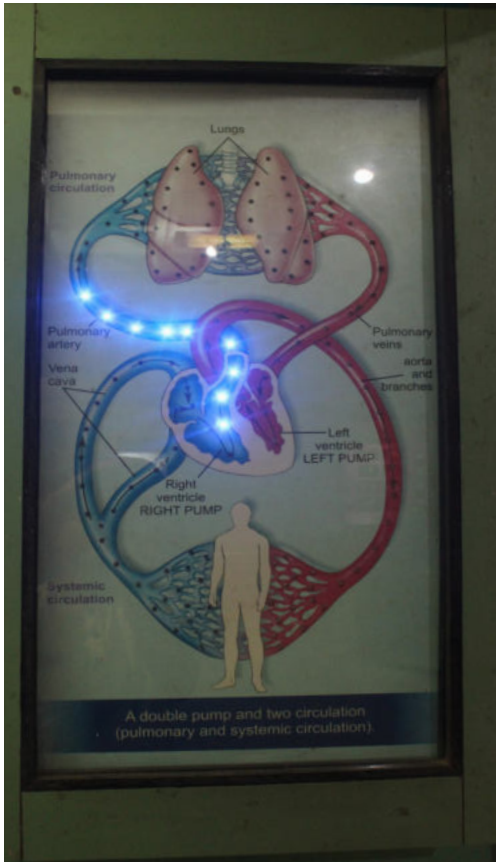
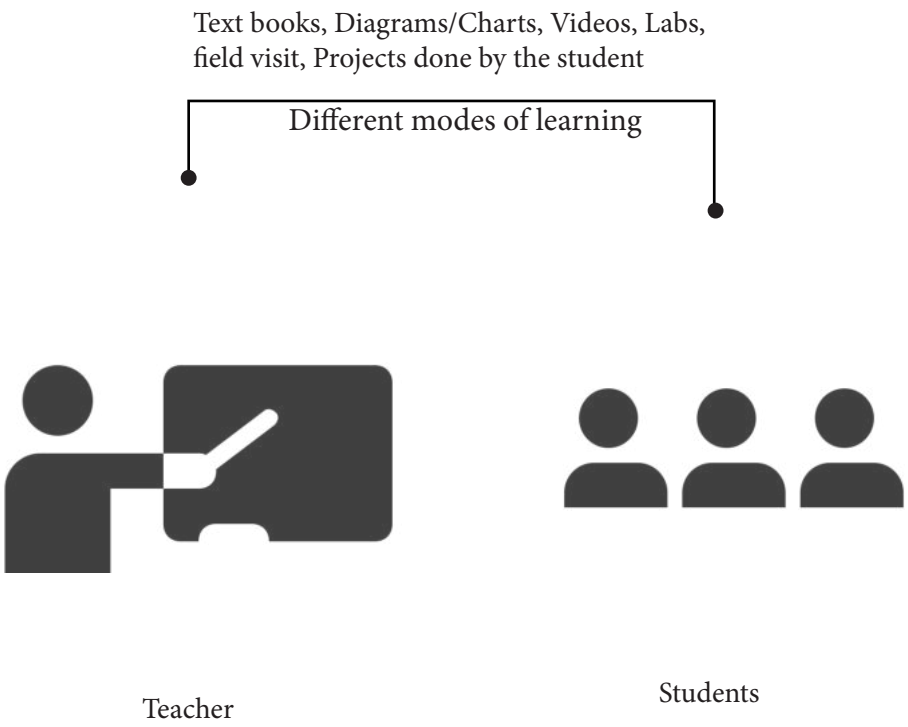


Image 20: A light installation showing the flow of blood through different colours of led.

Active Exhibits

Requires some degree of manipulation and participation. Allow to be creative, to use problem solving skills or to produce different outcomes, tends to be more interesting and educationally beneficial.



Introduction to anatomy in schools happens in class six. The teacher complements the class room theories with models such as skeletal system or anatomy charts which is usually placed in the biology lab. Other than this exposure to other means to study of anatomy is very few. Sometimes the students are taken to the science museum for study tour.

Current modes of learning in class

Classroom physical environment affects morale and student learning. It should enhance the ease in which a teacher could deliver the subject.

In campus school each class had an average strength of 30 students. There are several modes by which a teacher tries to get across the information to the students. The modes of teaching anatomy in the class included the traditional media such as - teaching through school prescribed text-books, use of anatomy charts, videos and sometimes a visit to the science lab. A part of exercise also includes preparing hand-drawn diagrammatic charts by the students. These charts are then put up in the class walls.

The schools usually use a standard textbook series as prescribed by the school board.

Advantages
Textbooks provide organized units of work. A textbook gives all the plans and lessons to cover a topic in some detail. A textbook series provides you with a balanced, chronological presentation of information. Good textbooks are excellent teaching aids. They're a resource for both teachers and students.

Shortcomings
-May fail to arouse student interest. It is not unusual for students to reject textbooks simply because of what they are—compendiums of large masses of data for large masses of students.
- Some students cannot read or understand important concepts.
- A textbook is only as good as the teacher who uses it. Textbook is just one tool, perhaps a very important tool. Teachers over-rely on textbooks and don't consider other aids or other materials for the classroom

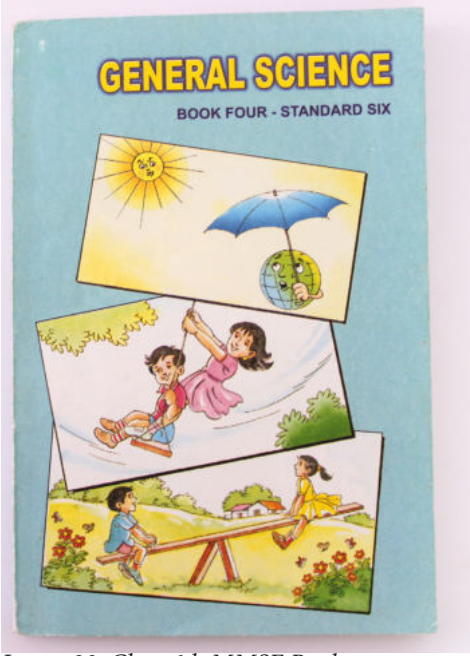


Image 20: Class 6th MMSE Book

Board: Maharashtra State Secondary Education(MSSE)
Book name: General Science - Book 4
Class: 6th | Size: around A5

Chapter name: Organ Systems
Covers Digestive and Respiratory systems in brief

The few concepts which are introduced in the chapter are-
-Parts of digestive system such as mouth, teeth, oesophagus, stomach, intestines.
-Secretions of each organ
- The functions carried out by the organs
- Parts of respiratory system such as nose, trachea, alveoli and the basic functions.
- Includes activity to understand respiration

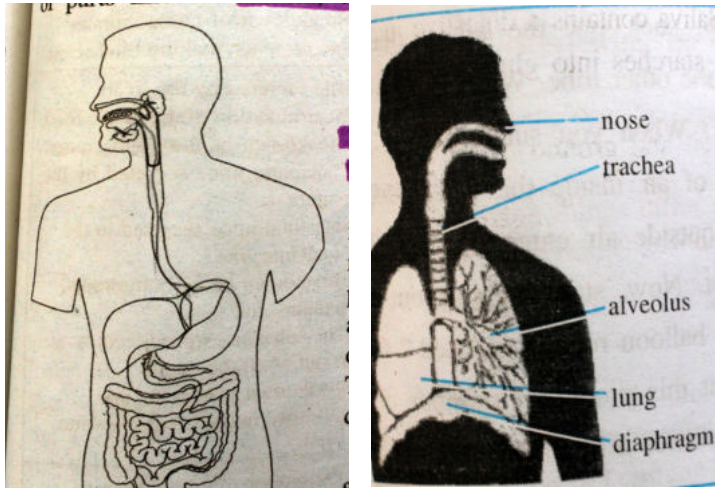


Image 21: Digestive system(on left) and respiratory system (on right)

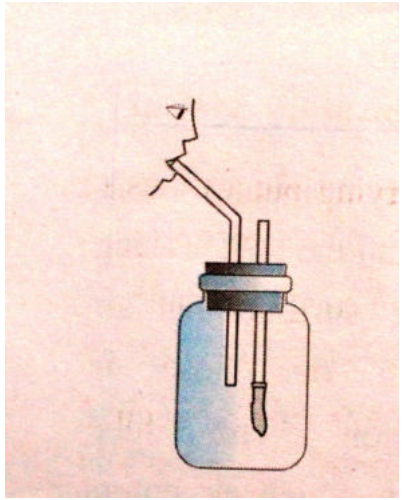


Image 22: shows an activity to demonstrate how lungs work using a plastic jar, plastic straw and balloon

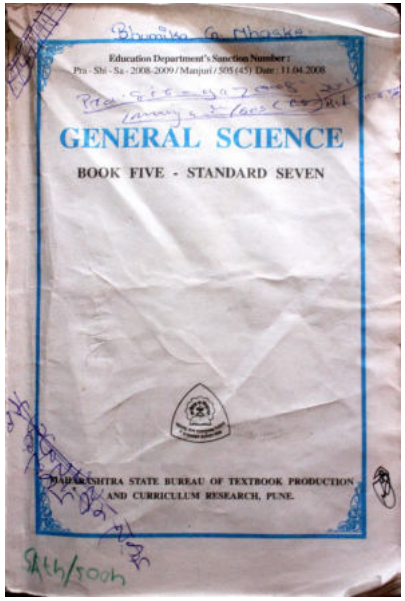


Image 23: Class 7th MMSE Book

Board: Maharashtra State Secondary Education(MSSE)
Book name: General Science - Book 5
Class: 7th | Size: around A5

Chapter name: Circulation of Blood
Covers Function and Structure of circulatory system, Blood Groups & Excretion

Chapter name: Food and Nutrition
Covers Concept of Nutrition & Digestive system

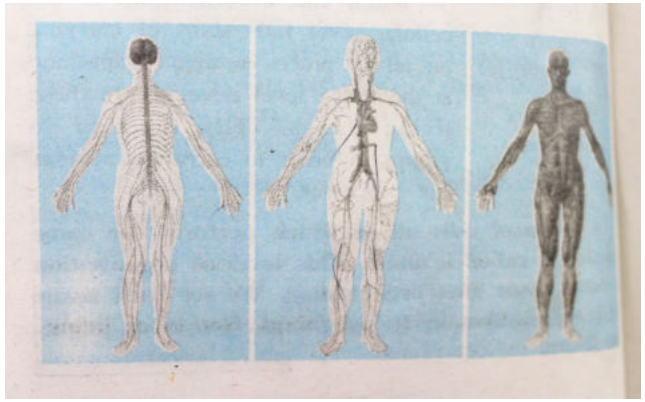


Image 24: Diagram shows different systems in the body. The images are small and of poor picture quality

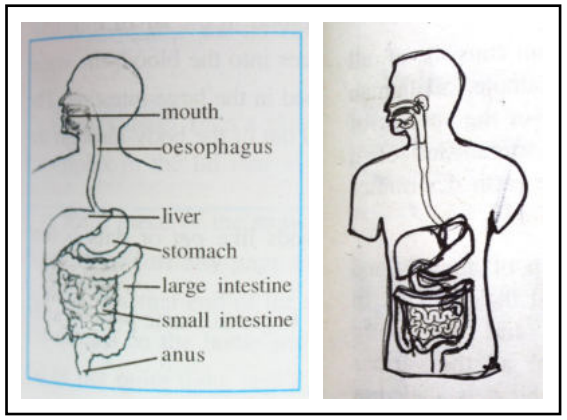
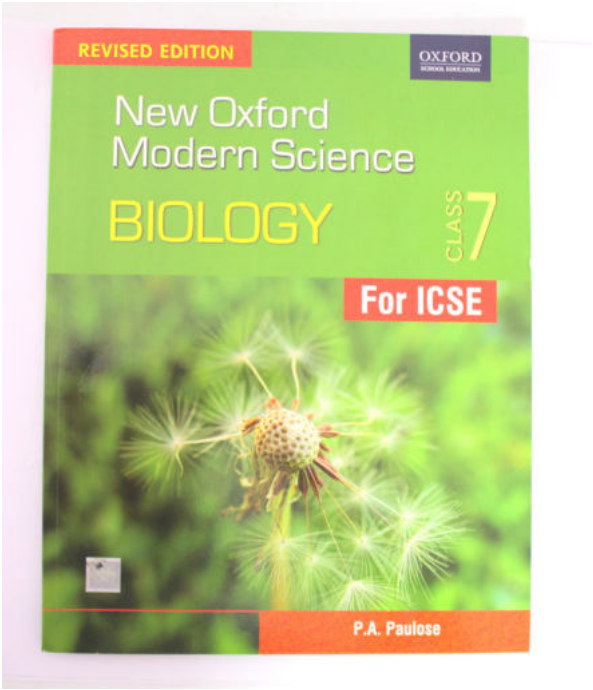


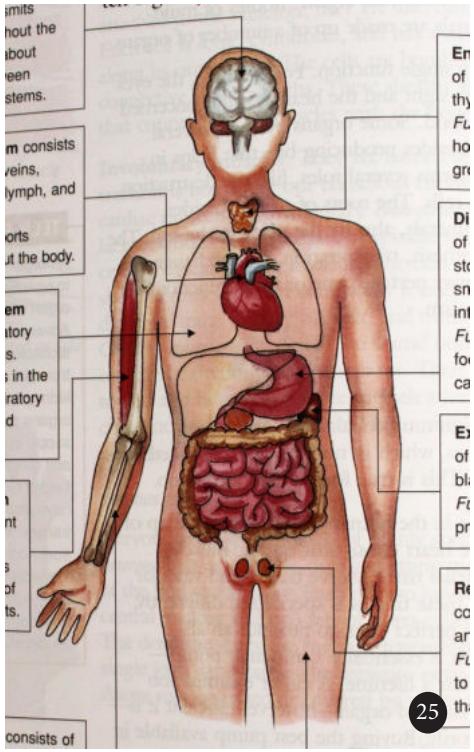
Image 25: In the diagram on the left, the digestive system is printed wrong in the book. On the right we can see a corrected image done manually by the teacher.

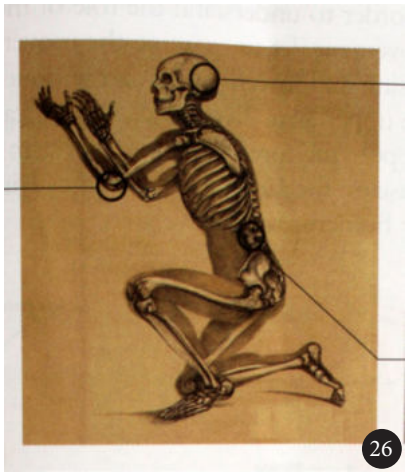


Indian Council of Secondary Education (ICSE)
Book name: New Oxford Modern Science (Biology)
Price: Rs 202
Size: A4

Chapter name: Organization in Living Things
Covers Organ Systems - Small Brief of each system is given with one diagram showing most of them in part.

Chapter name: Life Processes - Movement in animals and plants
Covers Skeletal Systems, Joints





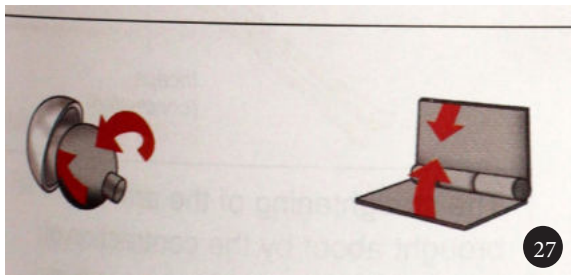
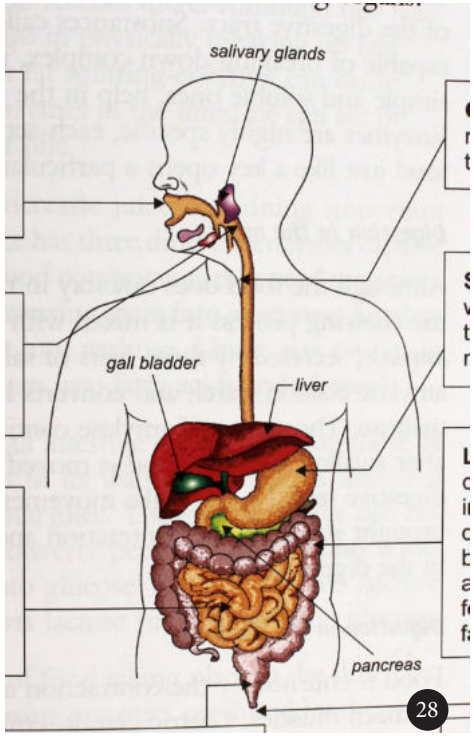


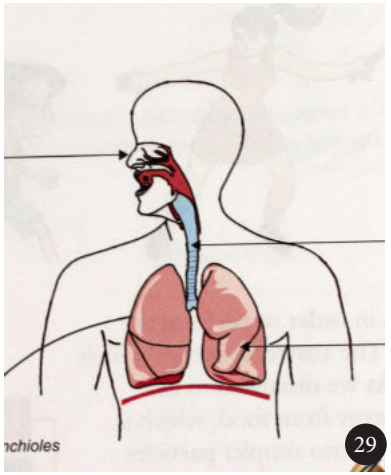
Image:25-Shows major organs of the body in overview
Image:26-Shows skeletal system
Image:27-Shows analogy various types of joints

Chapter name: Life Processes - Ingestion, digestion, absorption and assimilation
Covers Teeth, Human Digestive System – has good looking colour diagrams

Chapter name: Life Processes – Respiration, Excretion
Covers Lungs, Kidneys
Activity: To find if the exhaled air contains carbon dioxide
Activity: To prove exhaled air contains water vapour

shows that they differ in the following aspects:
- Size: MSSE(A5), ICSE(A4)
- Quality of images: MSSE has low quality , monochromatic and small images as compared to the ICSE book.
-Content: Less topics covered in MSSE in the same class as compared to ICSE.





Images 28: Shows digestive system
Images 29: Shows respiratory system
Images 30: An activity to show presence of carbon dioxide in exhaled air.

Image 31: A model of skeletal structure

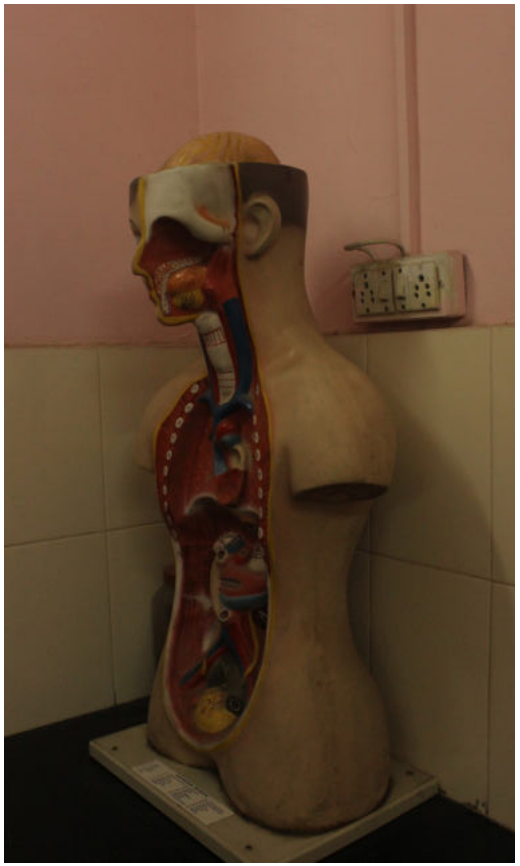


Image 32: A model of human torso

Models / Charts

Visit to the lab was supplemented with classroom studies. The students were taken to the biology lab to see specimens, charts and models. For teaching anatomy the school has a demonstration model of human torso, a skeletal system and charts.

Advantages

Enhances the knowledge gained in the class as the information is provided in a more tangible form. Lessons taught in the class is reinforced in when demonstrated in labs.

Shortcomings

- The models are costly hence there is only one sample of it.
- The teacher usually uses the models and demonstrates. The students observe what the teacher does. The teacher might not be able to hold the interest of all children.
- Since there is only a single model the teacher takes the role of the presenter. The student don't interact with the models.

Image 32: Students taking survey at Campus school

The survey was done during the end of the academic year and onset of final exams. This was beneficial because the students have already been through chapters and have experienced various modes of learning.

Number of participants: 65
Age group: 11-13 years
Class: 6th and 7th
School: Campus School, IIT Bombay

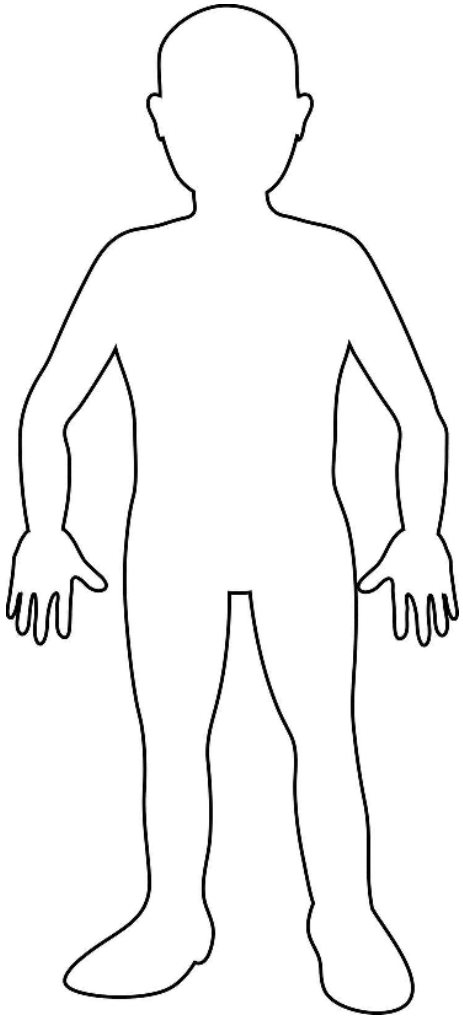


Image 33: The outline inside which the kids had to draw

A simple test was conducted to understand what the students think is inside their body. A A4 sized paper with an outline of a human body was given to students of class 6th and 7th. The outline was given for two things-first that the student does not spend time in drawing the human body and secondly the outlines can be used as reference to draw .

Task:
Draw what you think is inside your body.

Materials Provided:
A4 Sheet with the outline of a human figure

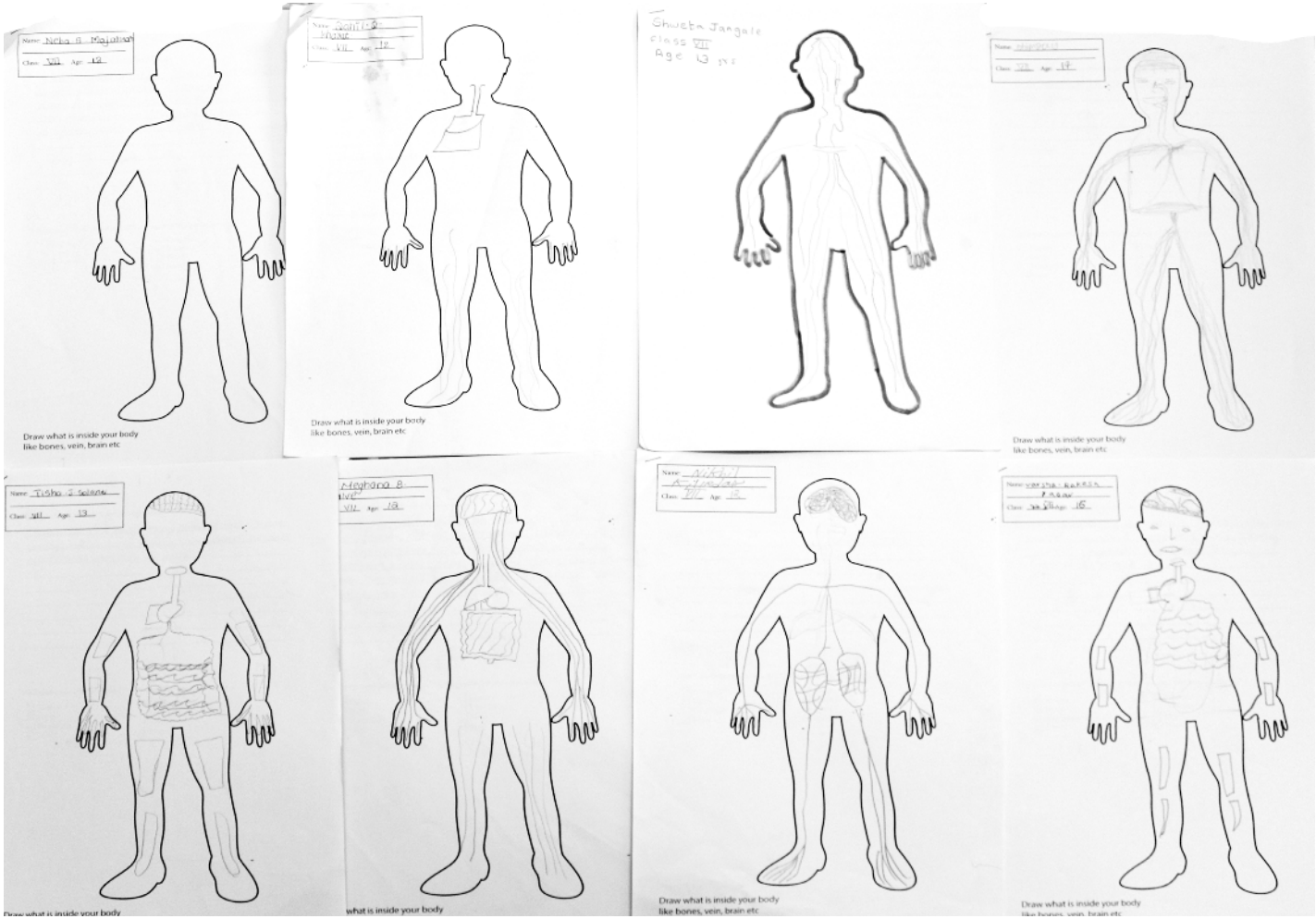
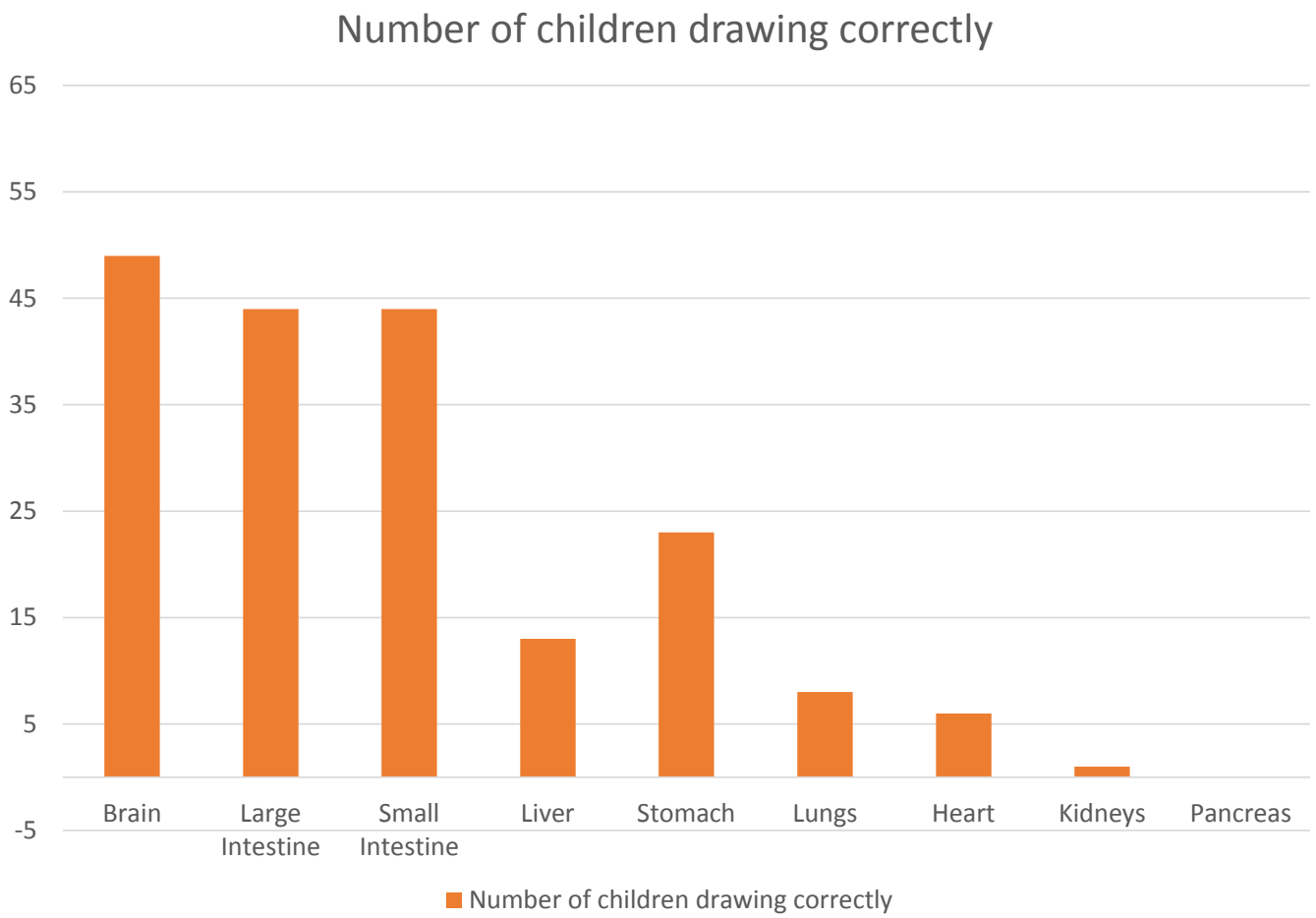


Image 33: Sample of images what children drew

Most student drew digestive system because they had been taught about digestive system as part of their academic course in school. 35% of the students correctly drew the systems but failed to label all the organs. Around 55% of the students failed to correctly draw the organs. Since. Around 10% of the students did not draw anything at all.
Not every child could draw in a clear, legitimate way. So one-to-one questions were asked to the students by keeping the survey sheet as reference. While some could name few organs, most had very less or no idea regarding the human body.


Number of children drawing correctly
65
55
45
35
25
15
5
-5
Brain
Large Intestine
Small Intestine
Liver
Stomach
Lungs
Heart
Kidneys
Pancreas
Number of children drawing correctly

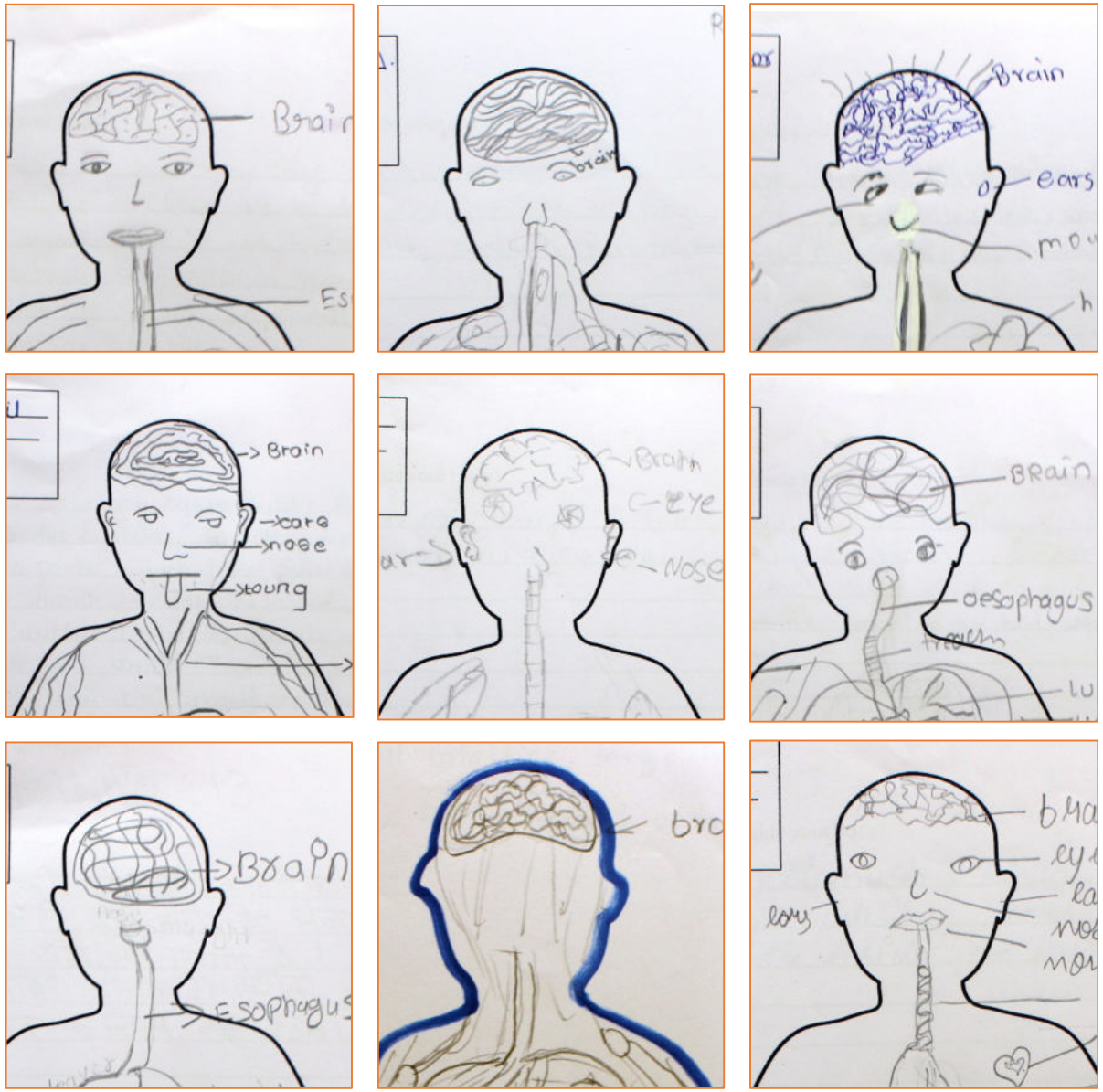


Image 34: Sample images of 'Brain' from survey

Organ: Brain

Criteria: Must be at the right position

Number of students who drew right: 49

Analysis: Children seem to know it very well that the brain lies in the head, maybe due to its representation in popular culture (advertisements, aphorisms, etc.) or due to the fact that its not competing for space with any other organ

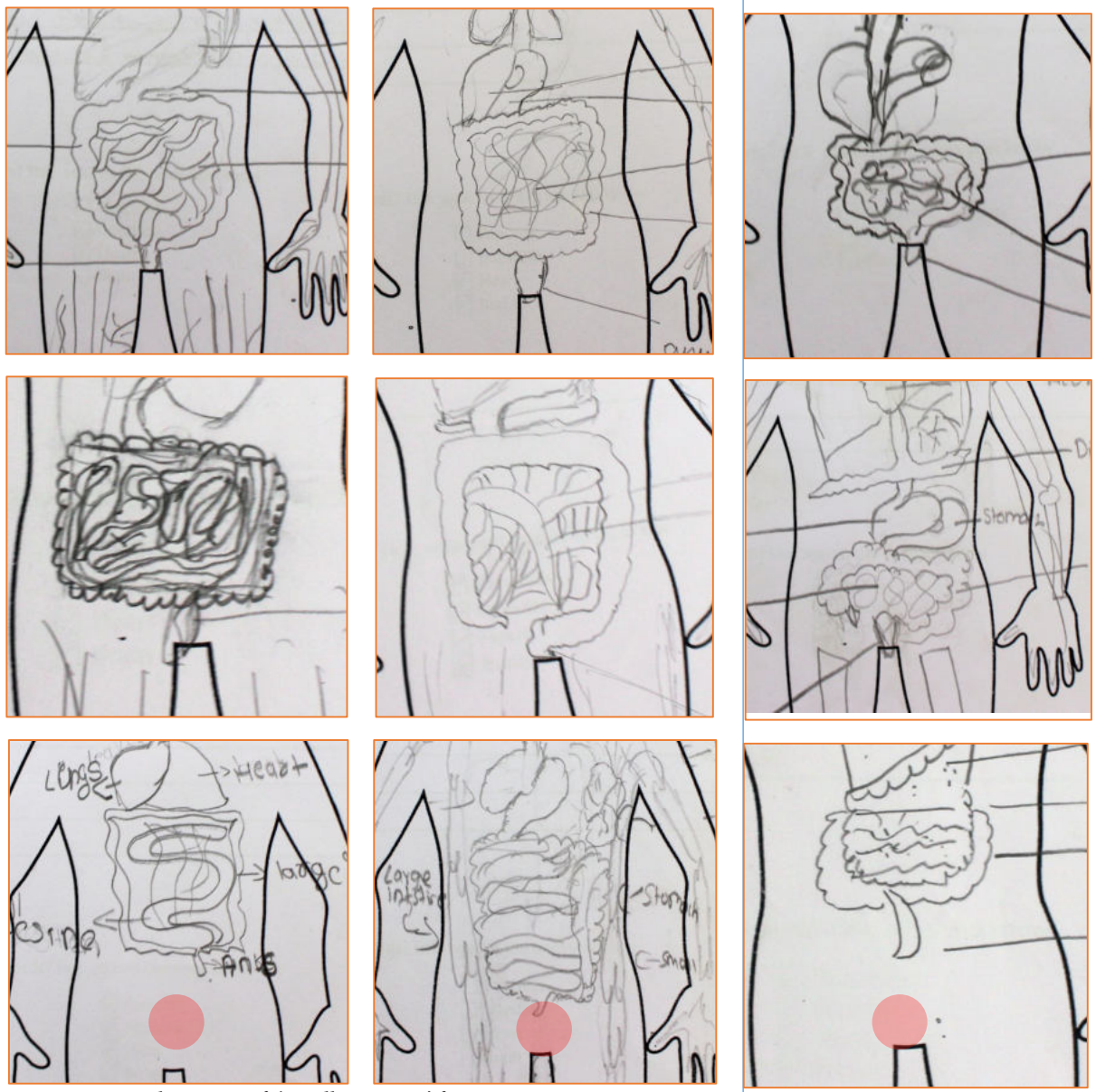


Image 35: Sample images of 'Small intestines' from survey

Organ: Large intestines

Criteria: Right position and exiting to the bottom

Number of students who drew right: 44

Analysis: Children seem to be very clear about the shape of the large intestines. Its shape is very simple, almost box-like, which makes it easier for children to memorize.

Also, it is important to remember that it is related to a daily activity, so they have an anchor in mind.

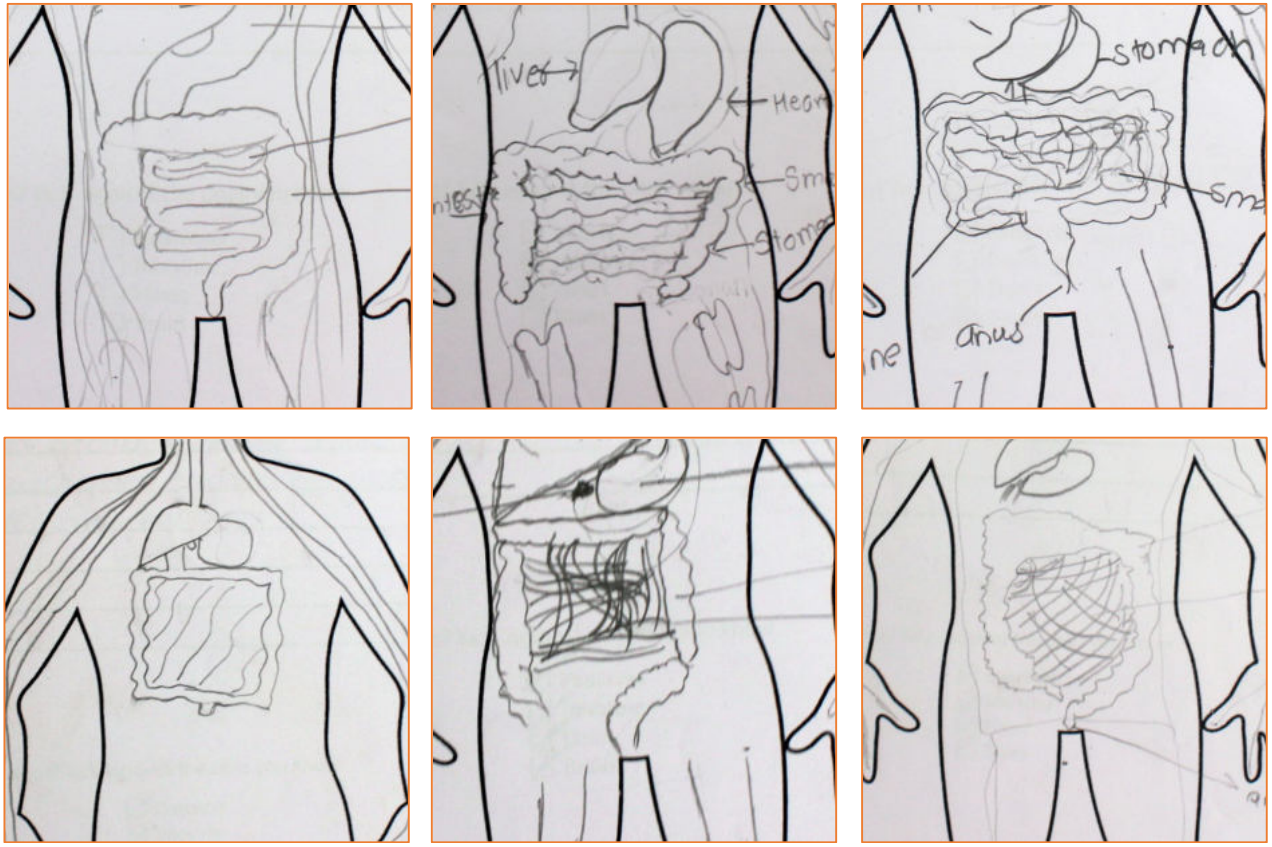


Image 36: Sample images of 'Large intestines' from survey

Organ: Small intestines

Criteria: Must be at the right position

Number of students who drew right: 44

Analysis: Everyone who has drawn the large intestines seemed to have an idea as to where the small intestines lie. However, all of them perceive the, as a jumbled, broken mess rather than a continuous pipe which connects to the large intestines.

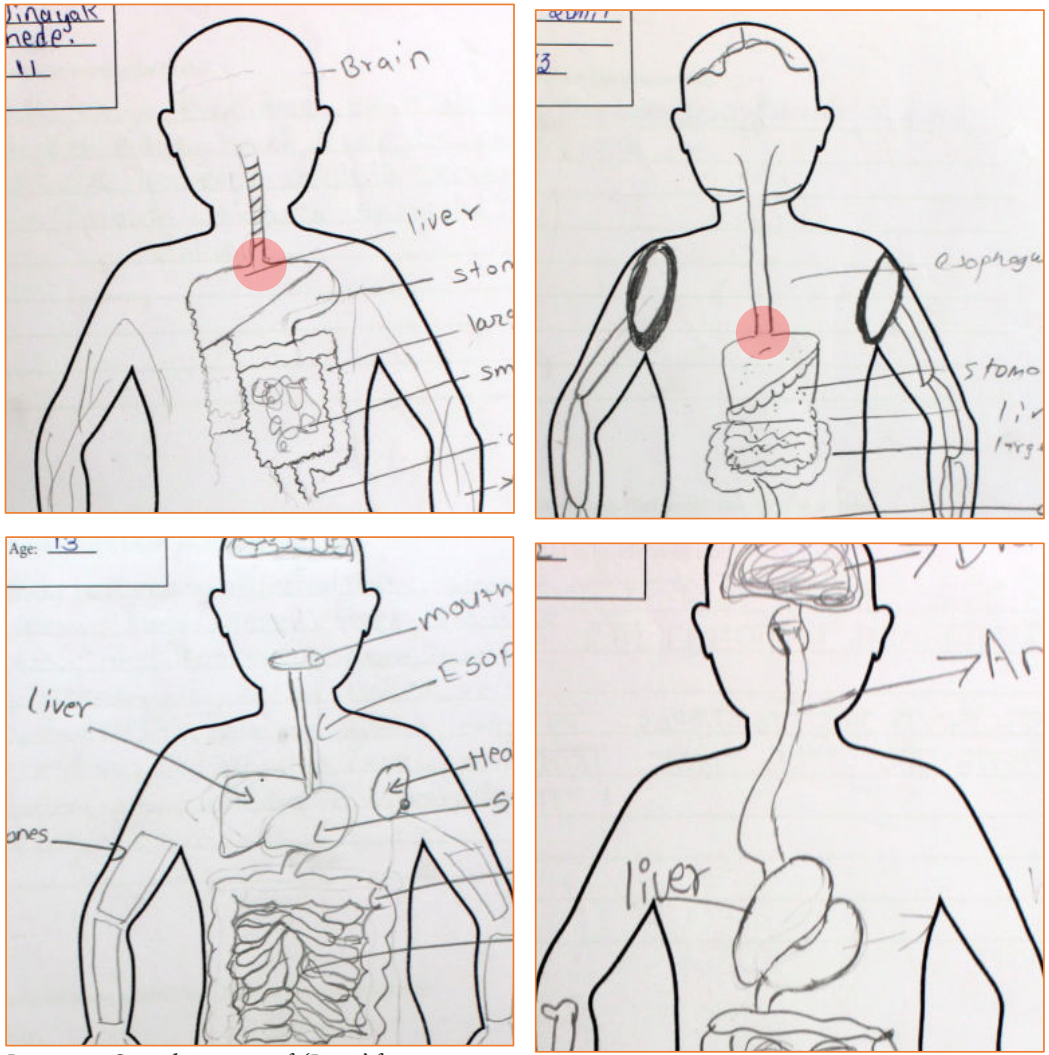


Image 37: Sample images of 'Liver' from survey

Organ: Liver

Criteria: Right position, The oesophagus should not be connected to the liver

Number of students who drew right: 32

Analysis: A large number of children seem to remember the liver – maybe because of its simple triangular shape and large size in textbook diagrams.

However, in most places, the liver is shown as overlapping the stomach and children seem to interpret it as if the oesophagus is draining into the liver instead of the stomach.

Image 38: Sample images of 'Heart' from survey

Organ: Heart

Criteria: Right position

Number of students who drew right: 8

Analysis: Because the heart is positioned in a place with lots of other organs overlapping (trachea, oesophagus, lungs, diaphragm, etc.), there seems to be a general lack of understanding of how all these things fit together.

Also, the representation of the heart in popular culture as a symbol seems to have an impression upon the children.

-The more complicated the figure it is, more it is uncertain in the child's mind

-Children seem to be confused between the liver , stomach and pancreas

-Because children are taught about the different organs systems separately, they struggle to fit in all of them at the same time in a cohesive manner.

When each organ system is taught, it is taught as if the rest body is a blank canvas. This approach should be modified such that when each new organ system is introduced, it is shown how the new organ system is positioned in respect to the previously introduced organ systems.

The following are missing in the current methods of teaching anatomy.
- Te body is in 3D and most materials available are in 2D. Even if it is in 3D, they are mostly passive models.
- Less interactive
- Overlapping organs cannot be understood with 2D charts
- Working model
-Interdependence of various physiological system

What Industrial design can do?
-Abstraction of the models
(Rather than having an precise form, we can abstract and make the forms simpler for introductory courses)
-Introducing games or gamifying teaching
-Introduce working models

The market for educational toys is dominated mostly by maths, physics, word-making based products. The following section lists few of the toys, games and teaching aids which helps in learning anatomy.

Most of the examples are products manufactured abroad. They are usually very costly and hence less reachable when placed in Indian context. Indian market has very few aids for teaching anatomy like charts or models.

The available products can be divided into two categories- instructional (models. charts) and non-instructional (games, toys)

The examples which are shown in the following pages are mostly in a non-Indian context.

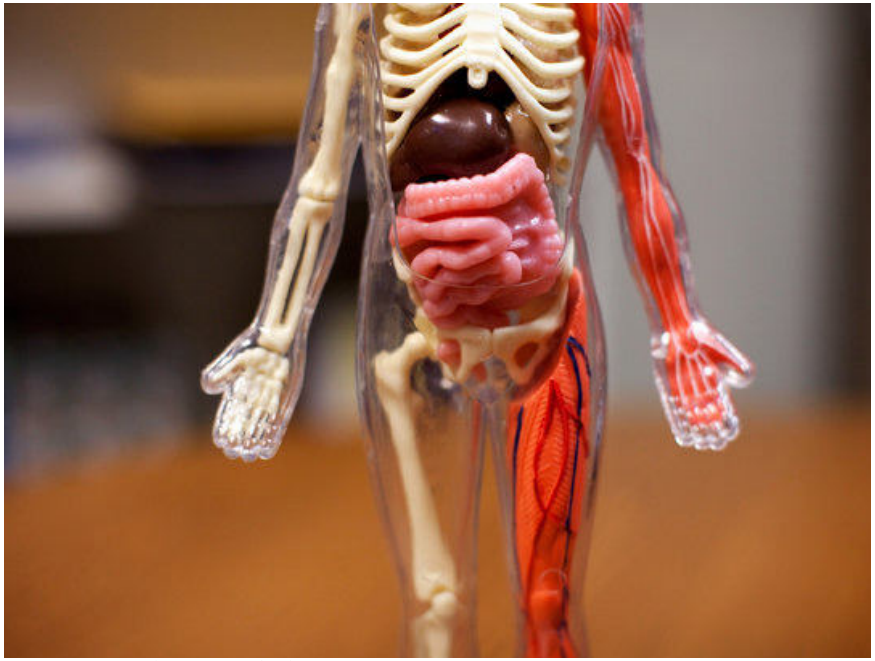


Image 39: Squishy Human body

Squishy Human Body

It teaches kids about human anatomy as they disassemble and reassemble the organs, bones, and muscles of this human anatomy model. The product also contains a book which illustrates different systems of human anatomy.

Advantages – 3d in nature, needs solving, tactile feedback in form of text of the product

Disadvantages – Organs not held in place, Too small and delicate for children, expensive (Rs. 2000)

Image 40: Build your own body skeleton

Build your own Human Skeleton

A life-sized model (1.80 m) can be built using the Cardboard kit. With anatomical labels in English and Latin, the paper joints that will bend and straighten. It can be used for demonstration purposes at school and college. It contains a detailed step-by-step instructions with ready cut shapes with indentations for the folds (no need for scissors or glue).

Advantages – 3d in nature, needs solving, Life Sized

Disadvantages – Very time consuming, made from paper so is not long lasting, Too complex and delicate for children, expensive (Rs. 21,500)

Image 41: Soft toys from 'I heart guts'

I Heart Guts

"I heart guts" makes plushies of internal organs. Although most of these toys are used as gifting items for patients, it can make an interesting and amusing toy for a child. The company makes toys of organs like heart, liver, intestines, kidneys etc.

Advantages – 3d in nature, child friendly

Disadvantages – Not interactive or educationally engaging, parts are disjoint and without any apparent connection

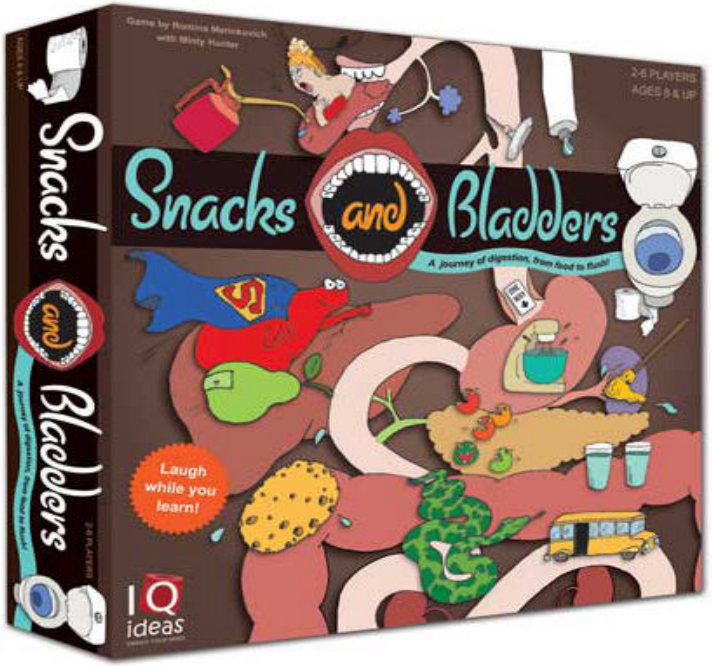


Image 42: Board game- Snacks and Bladders

Snacks and Bladders

Snacks and Bladders™ is a wonderful exploration of the human body and the food we eat to fuel it. It teaches to correctly identify body parts and make wise food choices. It is for 2-6 players or teams. Engages children through clever text & hilarious illustrations. Teaches anatomy, human biology, diet & nutrition in a fun and accessible way

Advantages – Child Friendly and educative, engaging

Disadvantages –Expensive (approx. Rs. 3500)

Image 43: Hape, wooden puzzle

Hape - Your Body
Layer Wooden Puzzle

These wooden puzzles present the structure of a child's body on five layers- a clothed external appearance, naked skin, muscles, organs and skeleton.

The puzzles are 28 pieces in total, 7 pieces per layer. The lower left side of the puzzle base has cutaway thumbnail views of the child's upper body across the five layers as a key to the layer order. The puzzle pieces get smaller with each successive layer so they don't quite fit if placed out-of-order.

Advantages: Teaches different layers of systems, Puzzle

Image 44: Anatomy felt set

Anatomy Felt Set

This is human anatomy felt set used around the world in schools and homes to help kids and adults learn more about how their body and organ systems work.
Different organs and how they fit together to create organ systems can be learnt with this set. Overlay the pieces to see how different systems fit together and learn how the inside of body works.

Advantages – Child Friendly, Overlapping organs

Disadvantages – No feedback of correctness, Expensive (approx. Rs. 1600

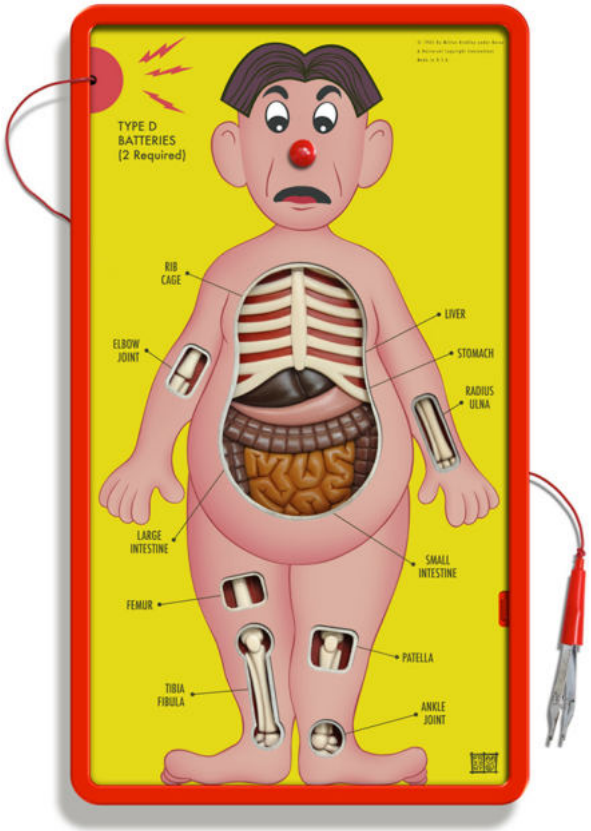


Image 45: Operation board game

Operation Game

Operation is a battery-operated game of physical skill that tests players' hand-eye coordination and fine motor skills. The game's prototype was invented in 1964 by John Spinello, a University of Illinois industrial design student at that time. Classic electronic skill and action game challenges to operate on patient. Includes game tray with Sam "patient" and tweezers, 22 cards, 11 funny ailment parts and instructions.

Advantages – Child friendly, auditory feedback

Disadvantages – No connection with school curriculum

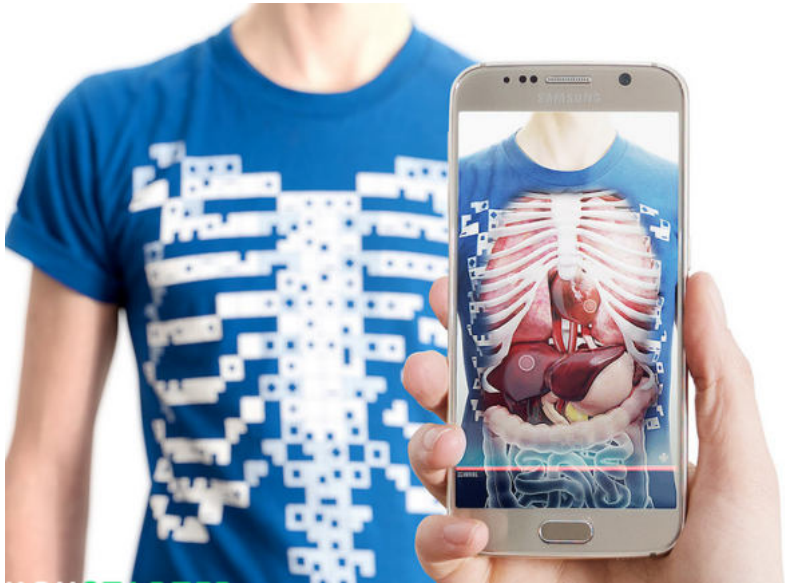


Image 46: A virtuali-tee

Virtuali- Tee

With this t-shirt one will be able to see body's internal organs, including a beating heart.
If paired with a virtual reality headset like Google Cardboard, one can take a virtual tour and get a 360 degree look at a person's insides in augmented reality.

Advantages – 3d representation, Animated models, Interactive

Disadvantages – Entry barrier (smart phone)

Image 47: Digestive model from Arvind Gupta's toys

Working model of Digestive System

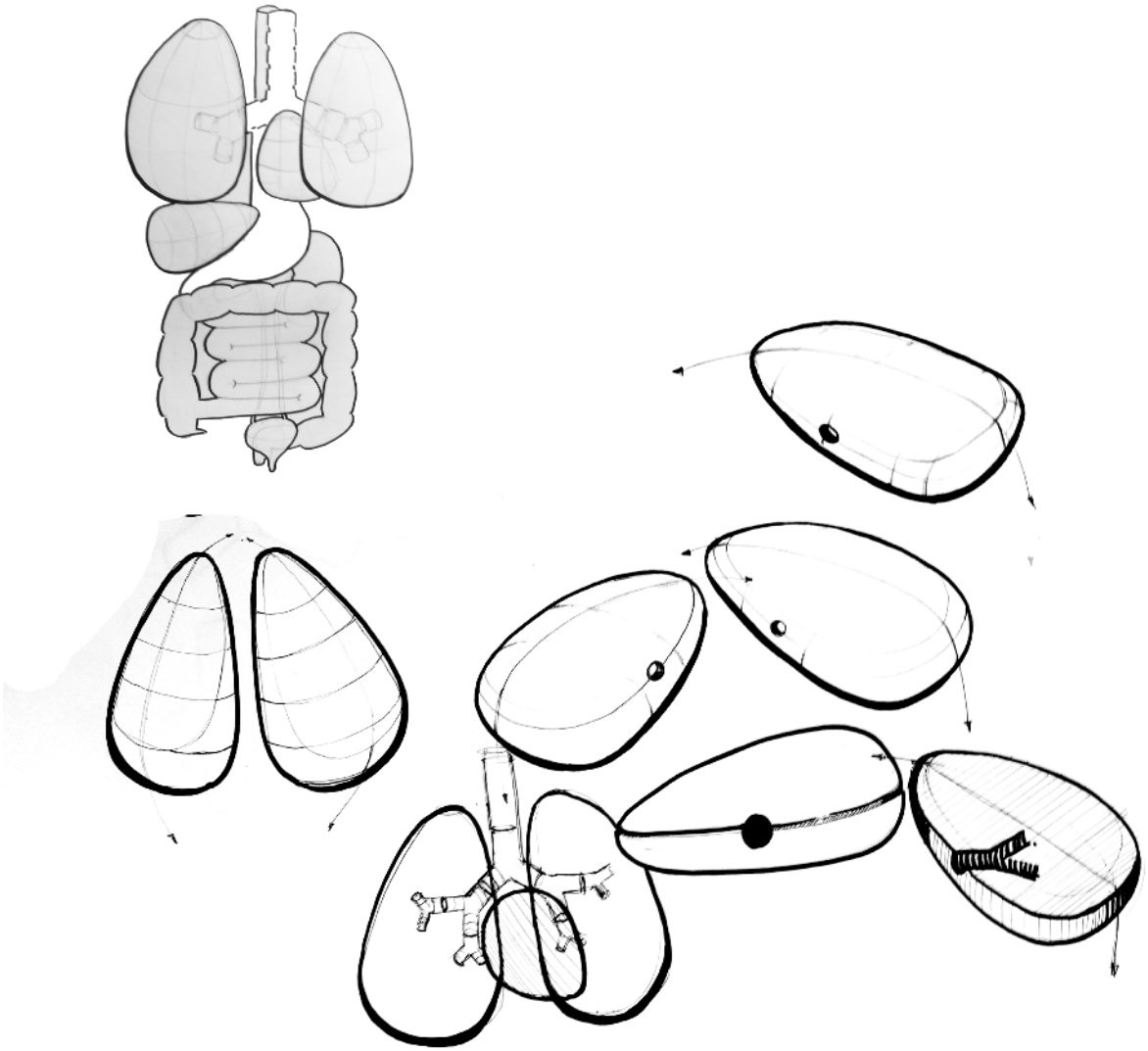
This model is devised by Arvind Gupta's "Toys from trash". It shows different parts of the digestive system along with a very simple working mechanism of it. Children tend to retain more and promotes more creative if they are provided with activities which makes them use their motor skills.

The product and the kind of interaction with it has with the user(s) determines the nature of the product. If the product is to be owned and played by a single user it can be a toy , whereas if it is to be used by multiple users it could be a game.

Products for individual. In this case the product will be used by a single user. The interaction is solely between the product and its user.

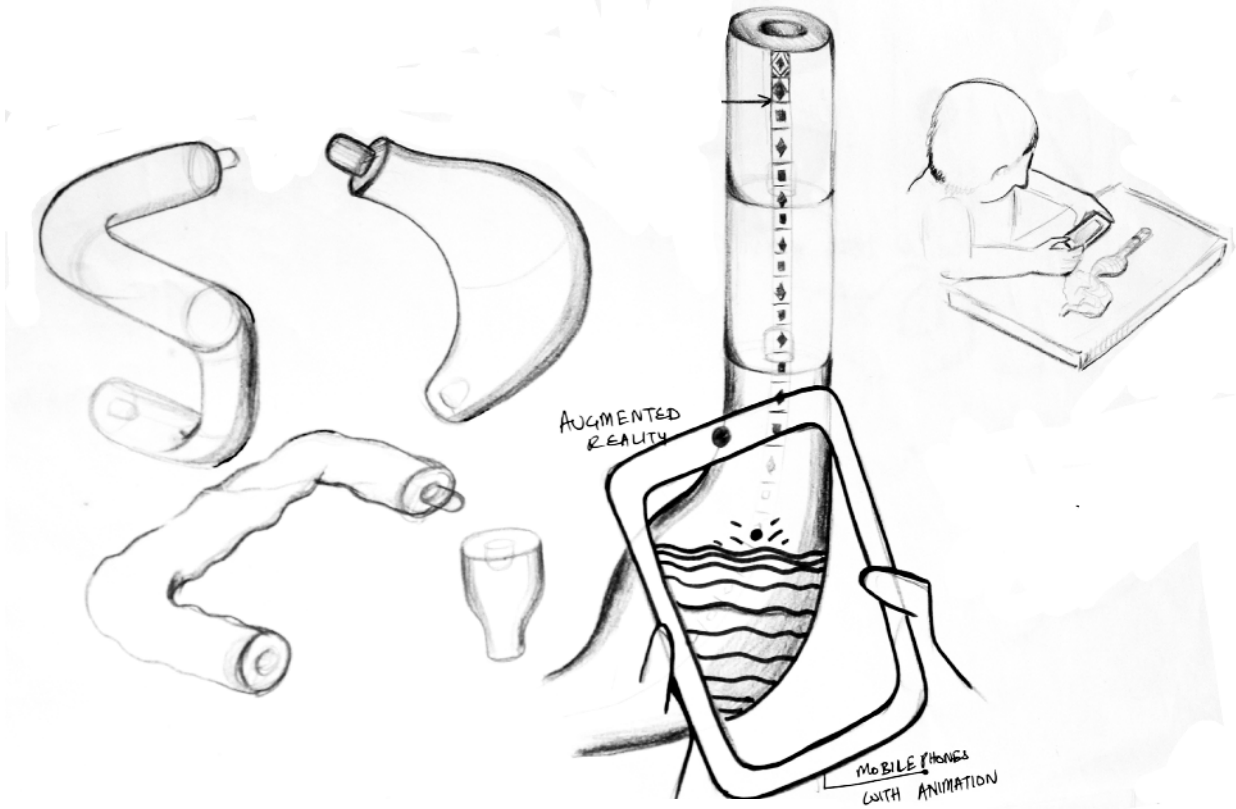
Products to be used in group. Assists in social, cooperative learning. The user has to interact with other users to fulfil a goal.

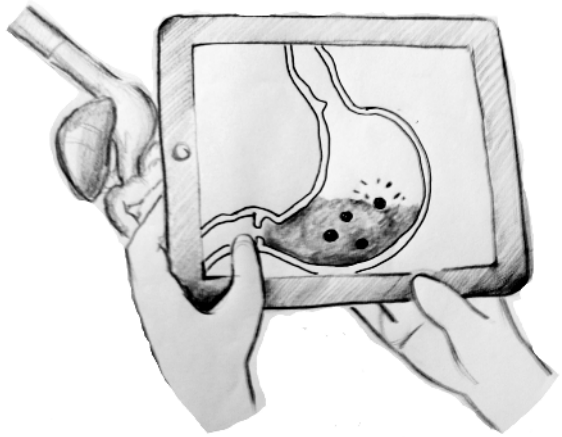
Products to with the help of a MKO(More Knowledgeable Other). Although the child is the primary user, an MKO(teacher/ parent / sibling) is the secondary user who assists or instructs the primary user in using the product.



3D ANATOMICAL MODEL

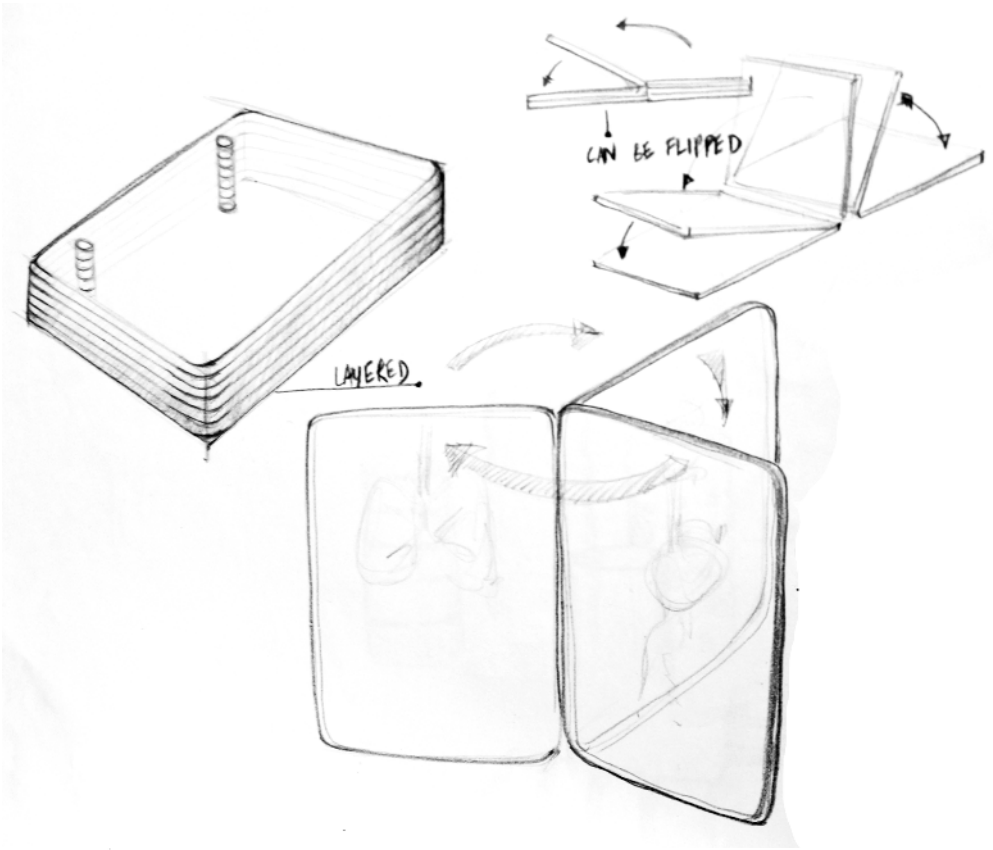
Making a 3D anatomy system using modular pieces of organs. All the organs would be abstracted and can be fit with each other to complete the set. (The sketches on the left shows explorations for a pair of lungs)

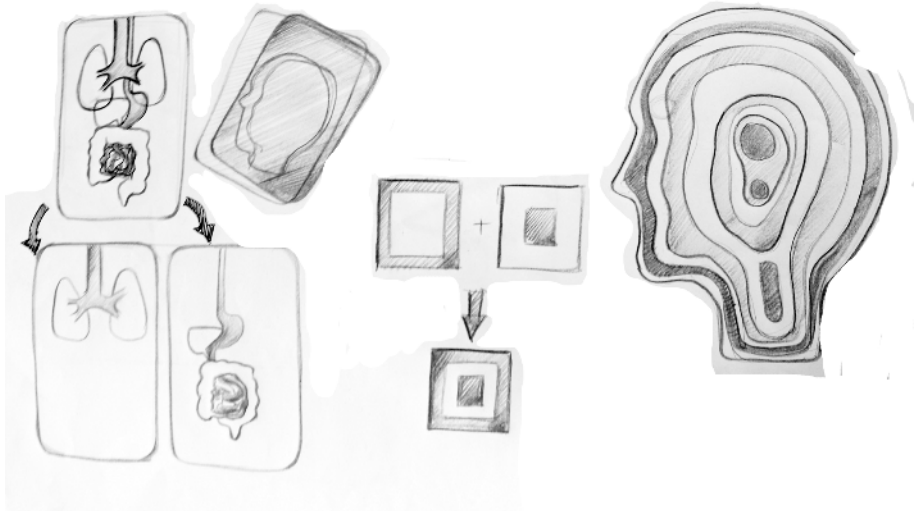




AUGMENTED REALITY BASED MODEL

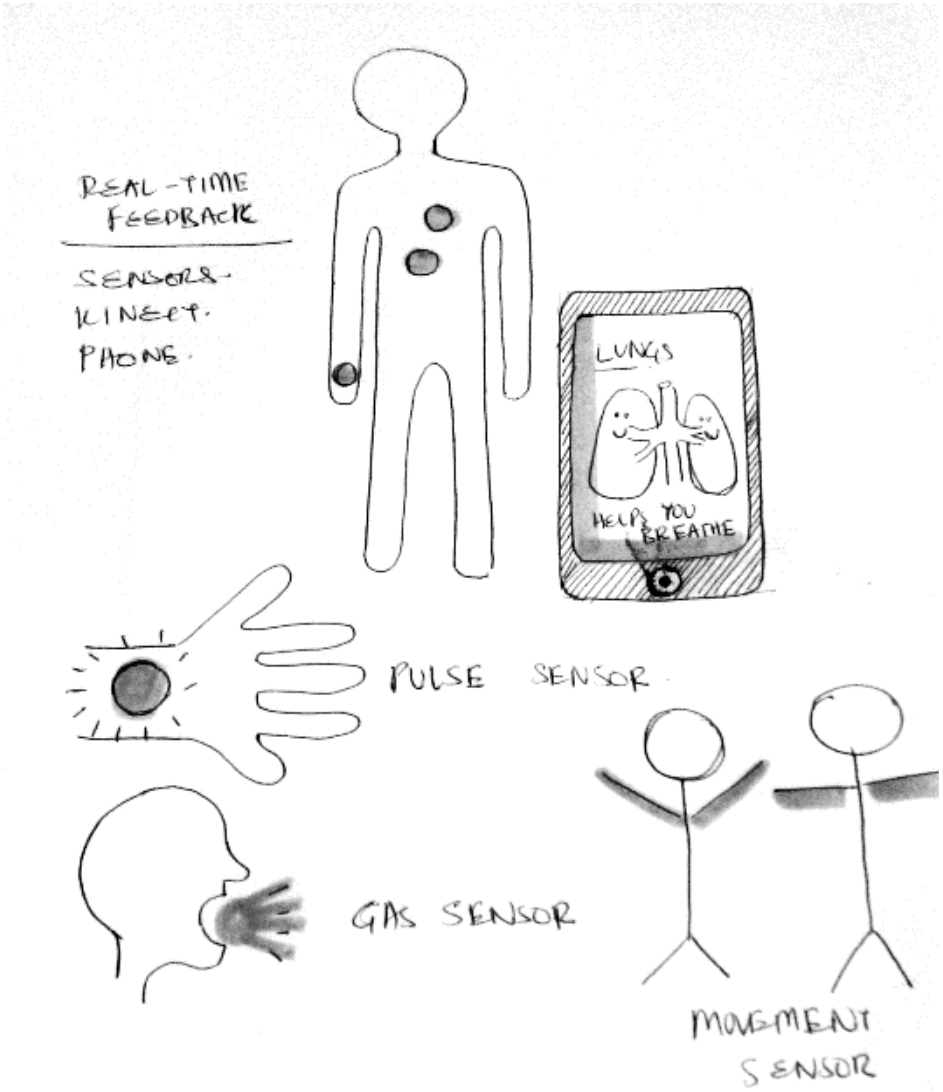
Use of augmented reality. The 3D organ puzzle can come with an software. The software would overlay animations to show functionalities inside the body.





ORGAN SYSTEMS VIEWED AS LAYERS

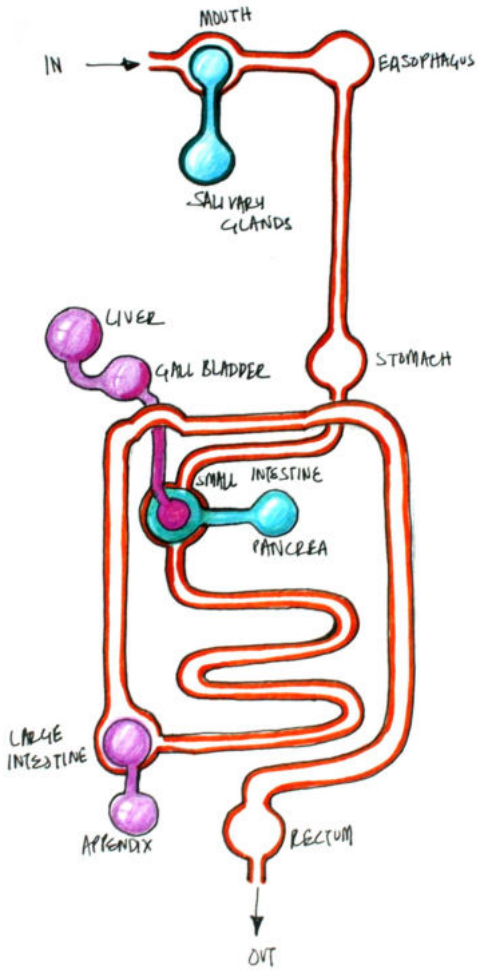
Use of layers to represent various systems. These layers can be used separately or combined with others

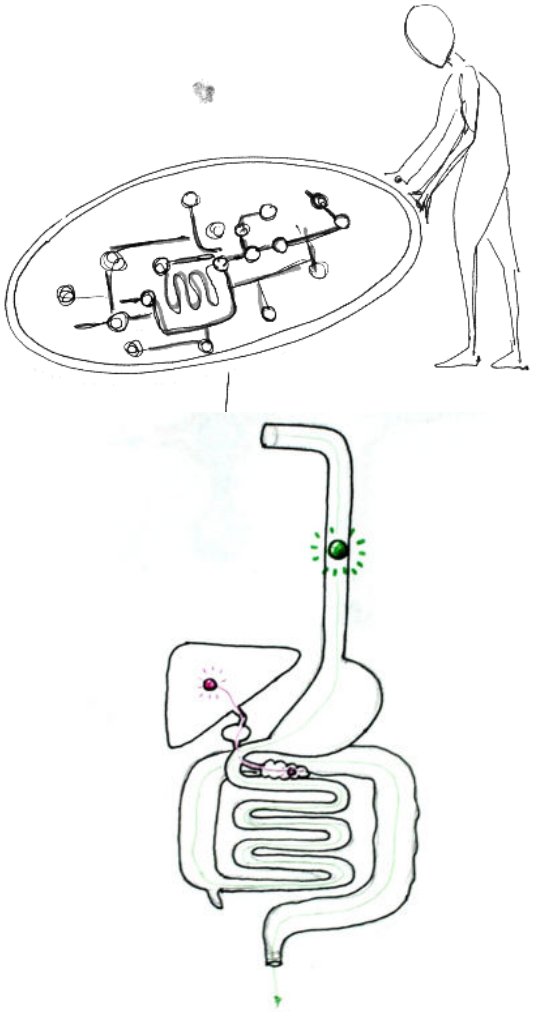


REAL TIME VISUALIZATION OF BODY FUNCTIONS

Sensors detect parameters in the body such as pulse, breathing, movement, etc and shows the internal function corresponding to the same.

For example, pulse detection can be hooked up to a virtual, animated model of the human heart and the pulse can be synced with beating the virtual model.

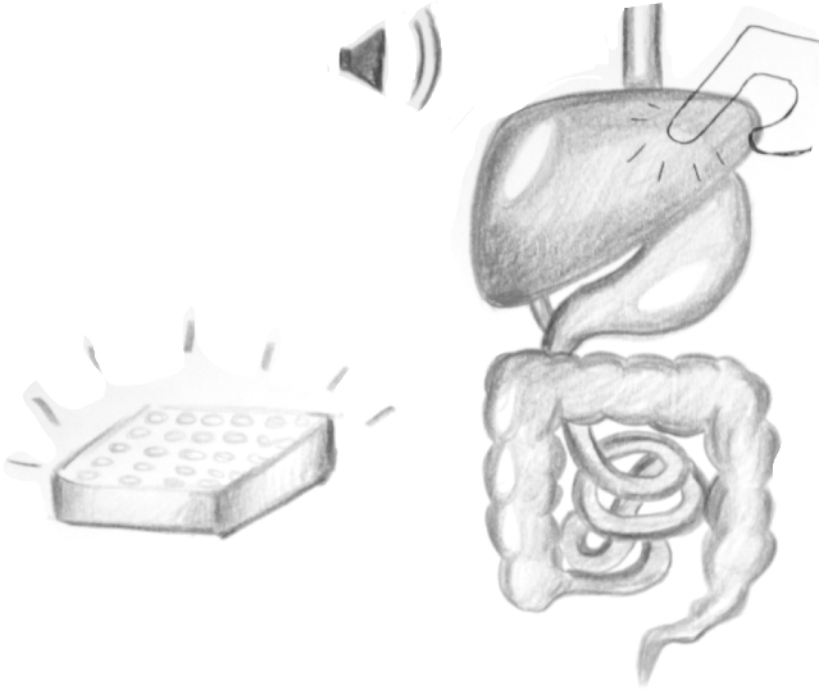




DIGESTIVE SYSTEM MODEL USING MARBLES

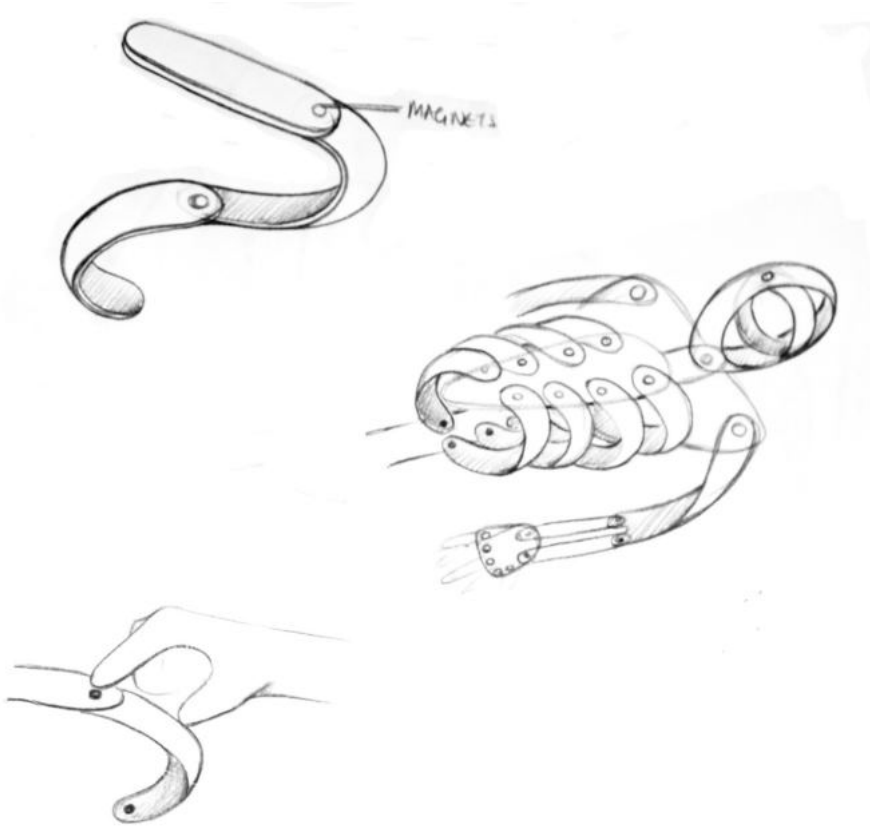
The model involves a pathway and a marble. The marble needs to move through the proper path of the system.

The model can be interactive, in the sense that it can be rocked in certain directions to make the marbles move as per the user or it can be a fixed pathway.



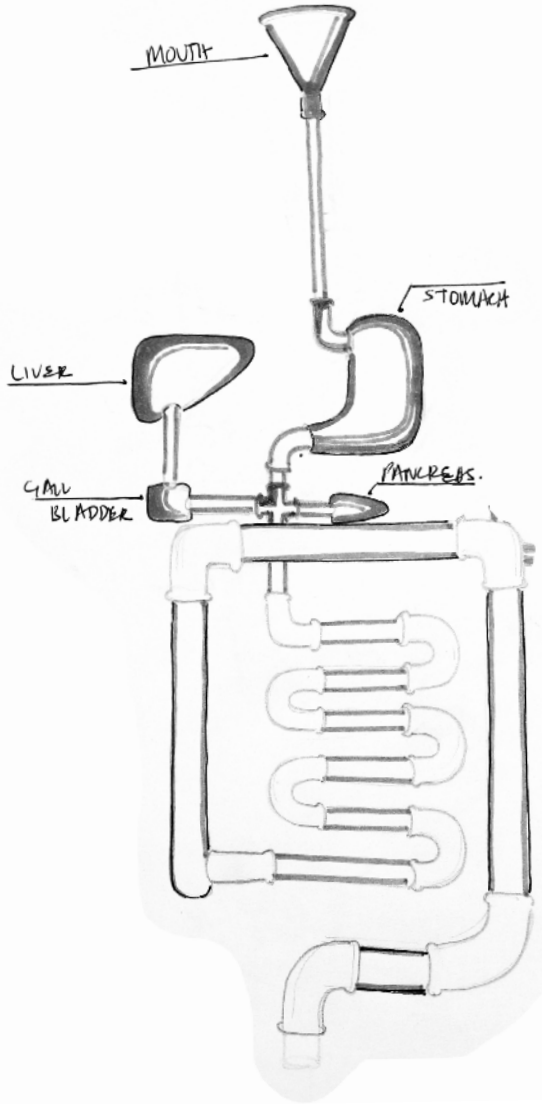
TOUCH FEEDBACK MODEL

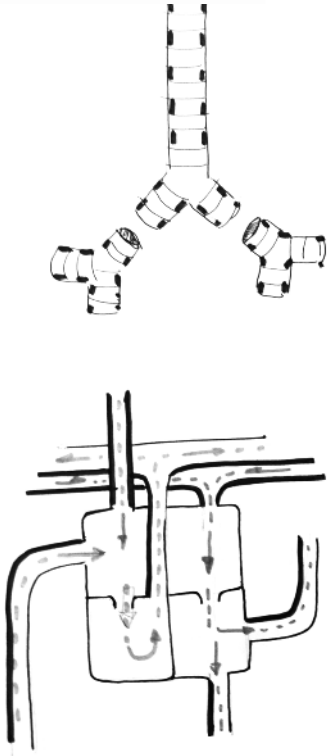
The model is touch sensitive throughout and can detect which body part has been touched and can play/show a relevant audio clip or video clip.

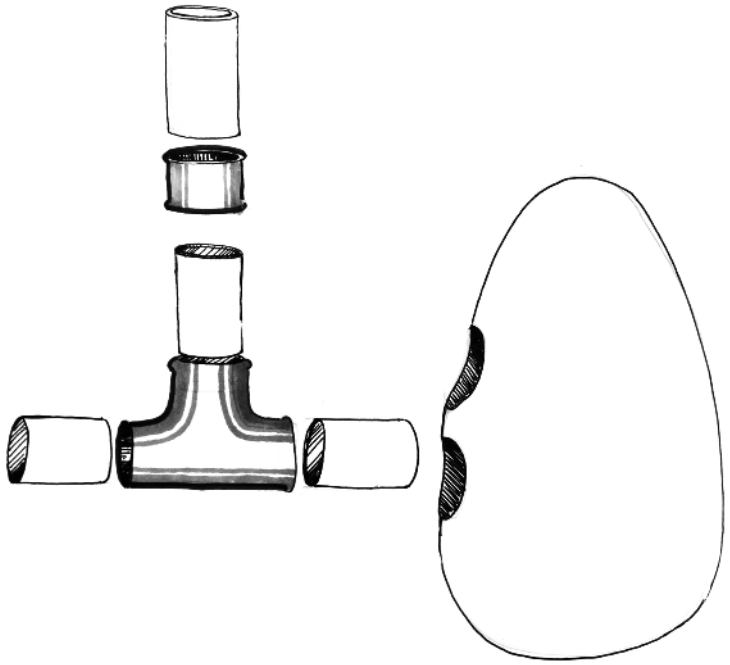


SKELETAL MODEL FROM MAGNETIC STRIPS

The idea is to construct a simplified version of a human skeleton using magnetic strips.
The organs can also be attached to the magnetic poles.

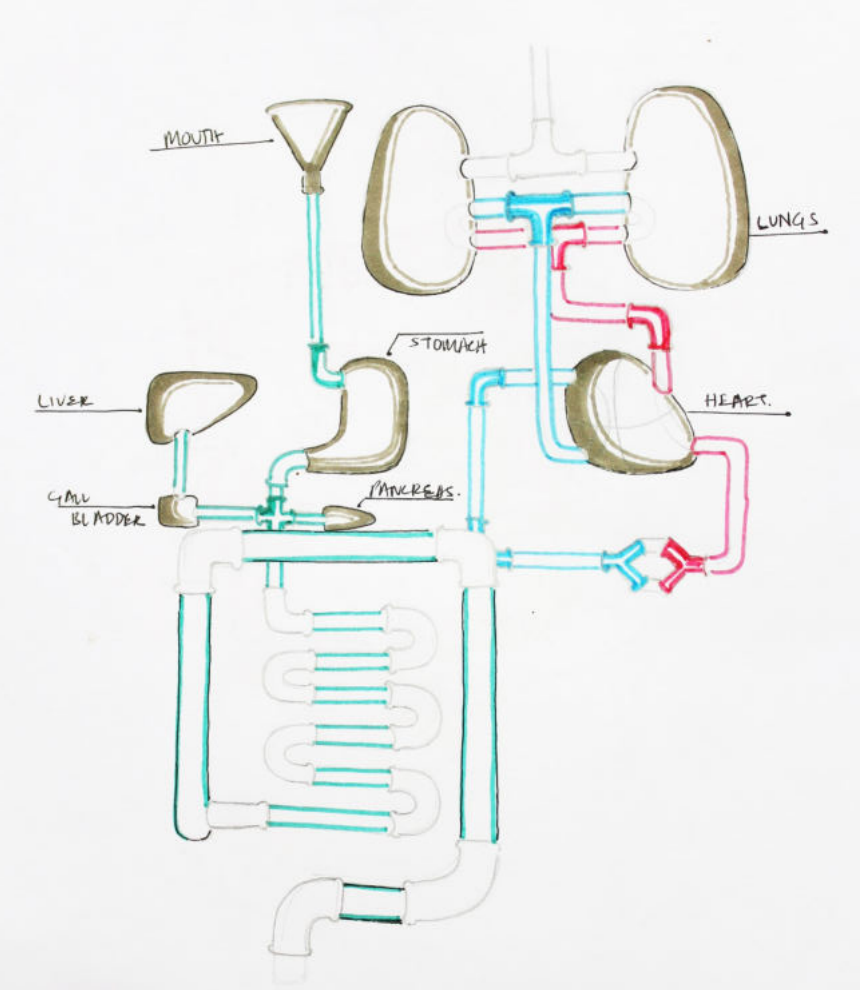






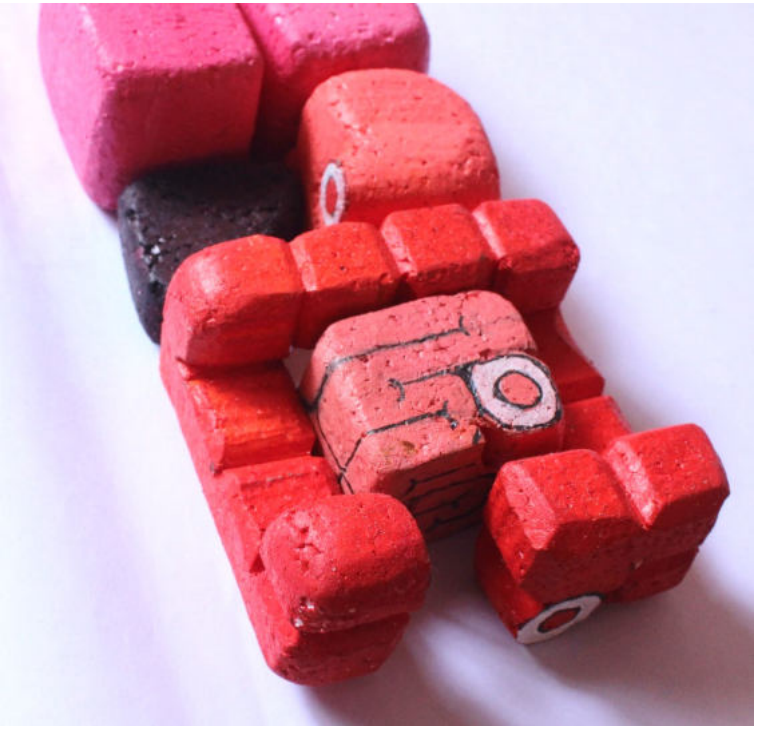
The whole body system to be represented in form of a teaching aids is divided into 3 parts- organs, pipes and joineries. These parts can be combined to make a different systems of human anatomy.

The puzzle contains different organ systems (left has two and right has 4) which will become visible once the elements are flipped into the correct positions.



Teaching through construction

This model consisted of three types of parts - the organs, the joinery and pipes. The idea is that children use these parts to put together complete organ systems with connections.

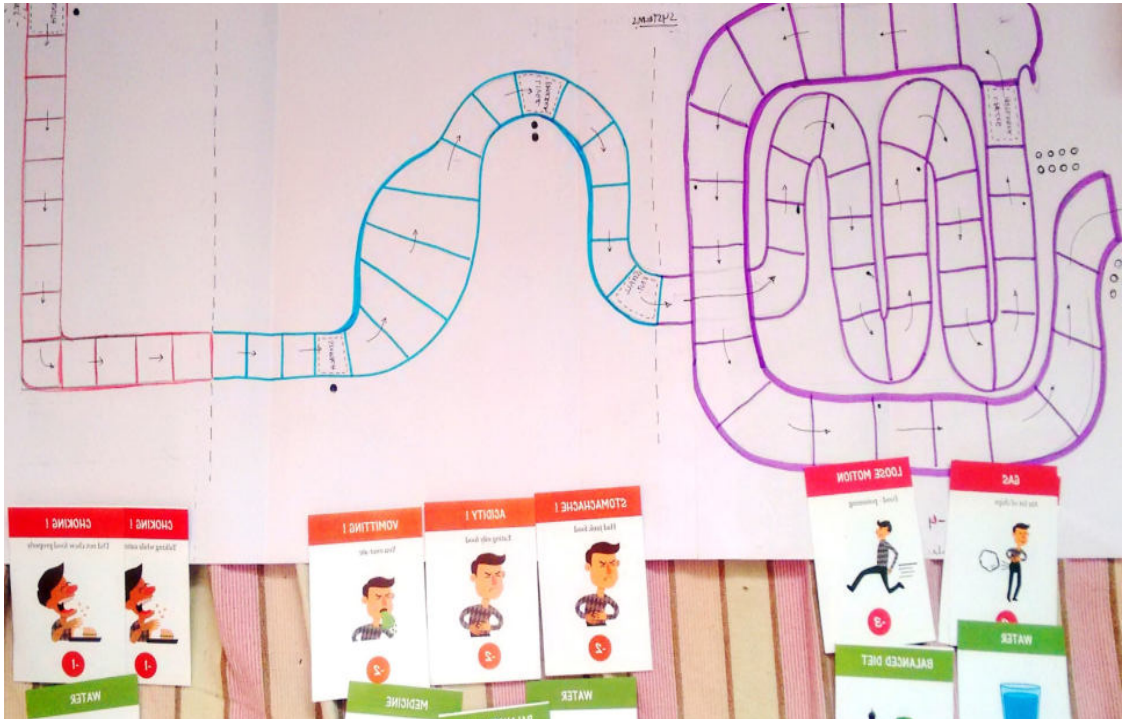


Organ system blocks: This model is an abstracted version of the human anatomy in which each organ is treated as a cuboid.

Only distinguishing factors and colours are retained in the models

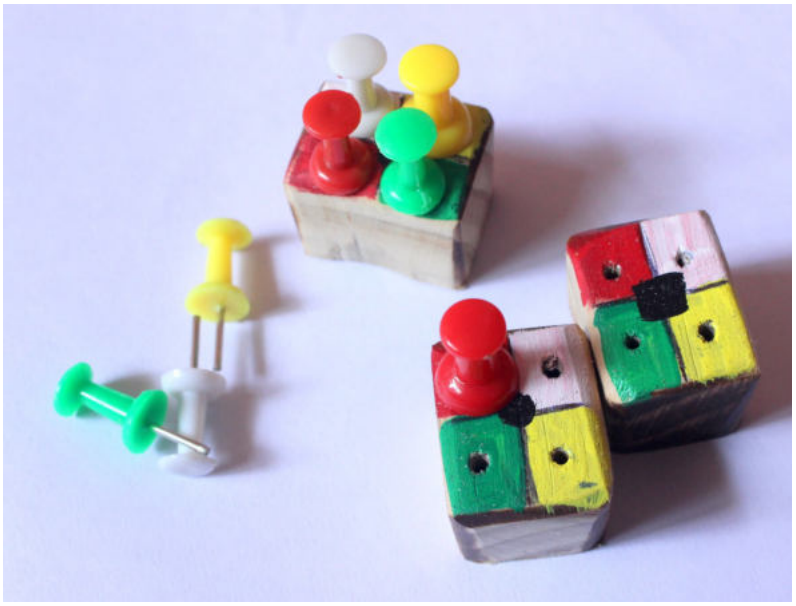
The organs are in two symmetrical parts- a transparent casing on top and a detailed version in bottom. The opaque part shows the detailed insides of the organ. The two parts give a 3D structure to the organ.

Inflatables: Each organ is made in a way which can be inflated to get a 3D form. Once used it can be flattened and stored.

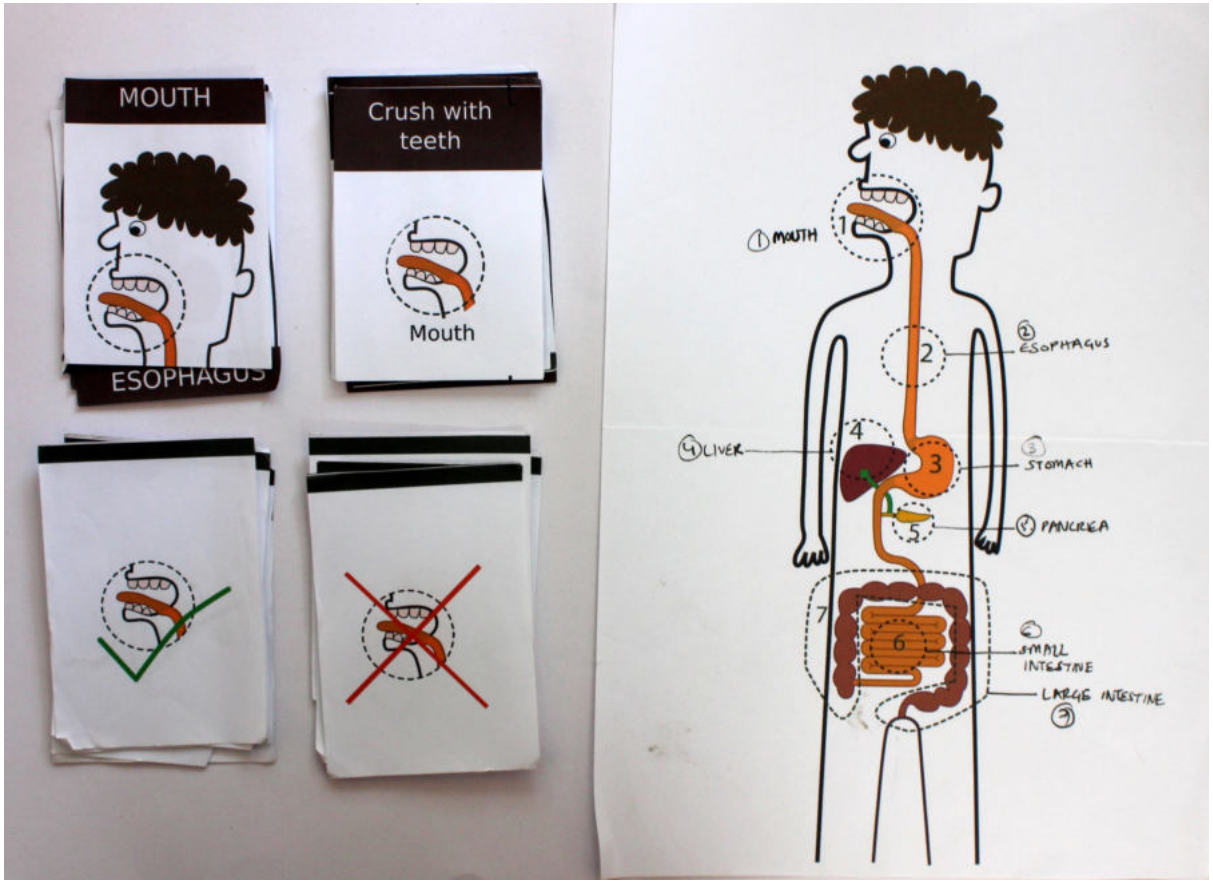


DIGESTIVE SYSTEM BOARD GAME
This is a dice-ruled game with strong card-game elements. The idea is that the player is an object in the digestive tract trying to get to the end while competing with other players.

The cards are dealt to hasten yourself and slow down other players (there is a zonal mechanic to regulate which cards can be played at what time)



GAME ELEMENTS ADDED LATER
To give more information about the different additives to the food in the digestive process, the player piece was redesigned to be a carrier of secondary materials. Each pin represents different materials such as enzymes, digestive juice etc.



DIGESTIVE SYSTEM CARD GAME
This is a card-game meant to teach the sequence of organs which perform digestion of food along with their individual functions.

Asha centre
Age: 9-10 years, Standard 4th and 5th

Game-1
-Learnt the sequence of organs while playing
-More interested in challenging each other than finishing/ winning the game.

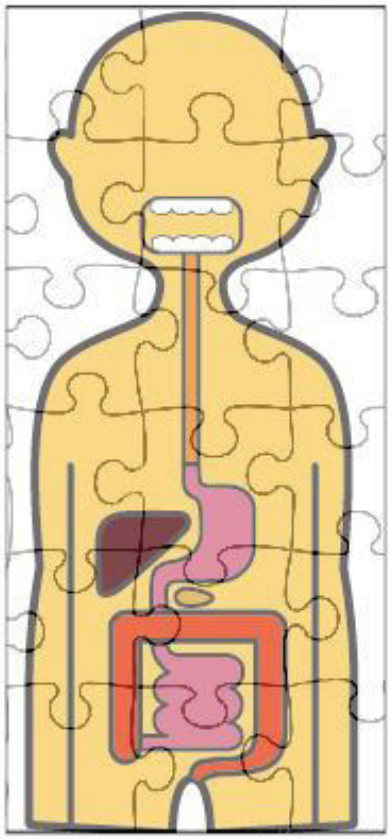
Insights
- More learning should be embedded
- A better and quicker way to end the game has to be figured out.

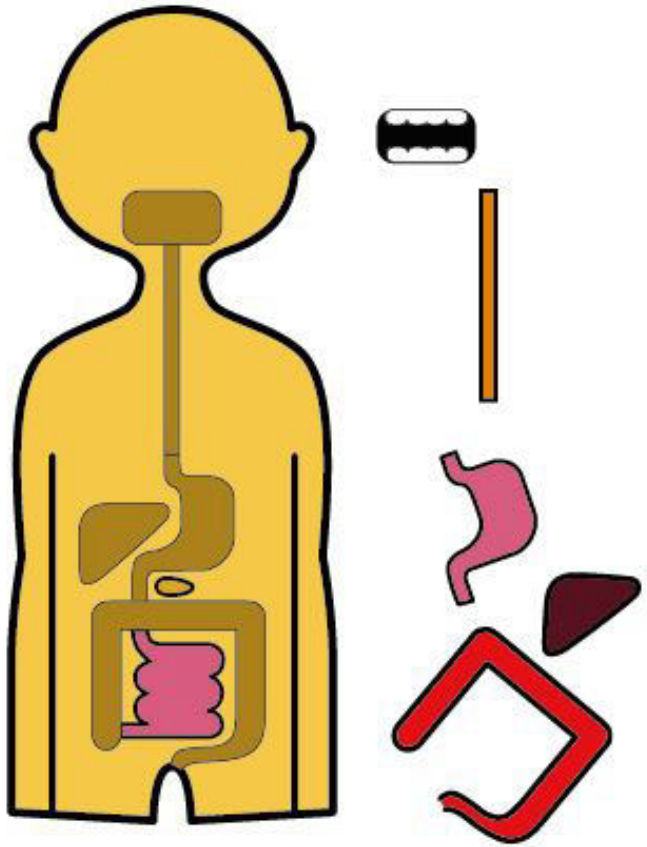
Game-2
- Continuous referencing was required
- Confusion in sequencing
- Too many Cards in hand
- Kids lost interest in the game

Insights
- The game play and the elements has to entirely changed.

Other Insights
Since the anatomy is represented in a complex forms in the books, it became difficult for children.

Inputs: Design a tool which teaches anatomy in a much simpler form to make it easier for kids to understand the basics.

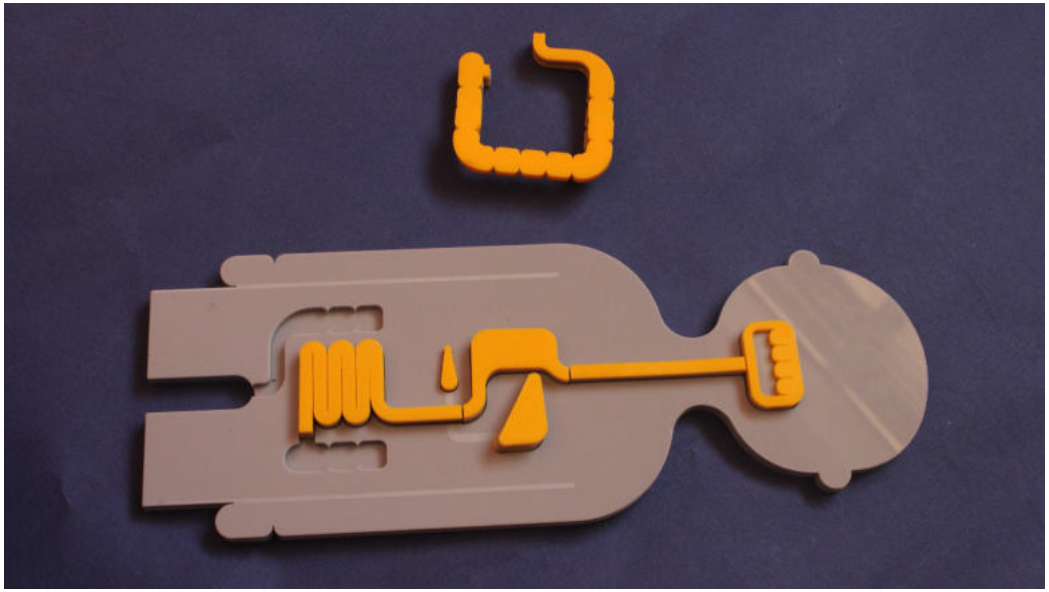


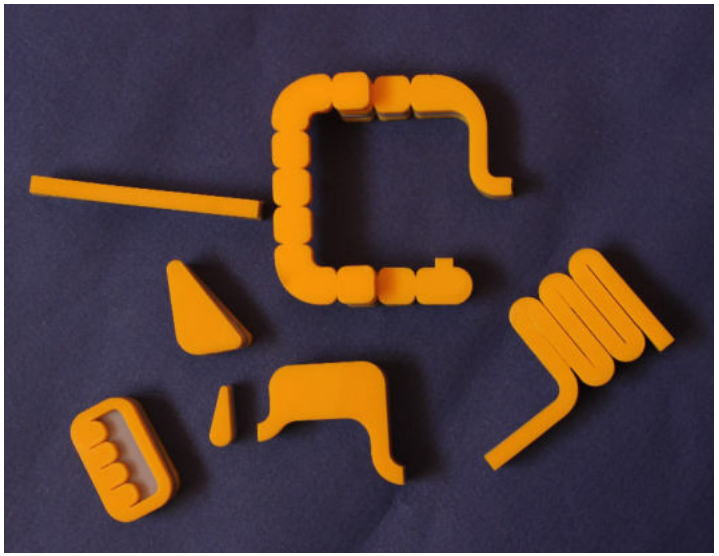


Even though the game had the board for visualization, there was a lack of information regarding the holistic structure of anatomy.

The initial idea was to complement the board game with a semi-realistic anatomical model to be used in the game.

The game needed elements to show anatomical structure so a tactile element to go with the board game was introduced, this carried only digestive system in the first iteration. Since the kids showed more interest and the teacher could also be involved I went ahead with teaching only through models.





INITIAL CONCEPT
-All the organs are made geometrical to have only the essence of the real organs.
-The simplified forms makes it easy for the child to understand.
-The teaching aid has two parts- Base, organs.
-The base consists of cavity. The organs fit into these cavities.

- The parts in the model are very small and handling would be difficult if a group of children are using it. Scaling it up to a size which would be easier for kids to use.
- Colours have to be introduced in the model.
- The size of the product would depend on the model of teaching method. Hence the teaching method has to be decided.
- Activities related or leading to use the product has to be designed.
- What are the ways other than games to be complemented with the product? Should it be a manual, a worksheet or an activity sheet. An activity based learning where the group of children are provided with charts (of an appropriate size that can be accessed by entire group). The activity may require the students to use the data provided in the worksheet to use the product.

ITERATION 1

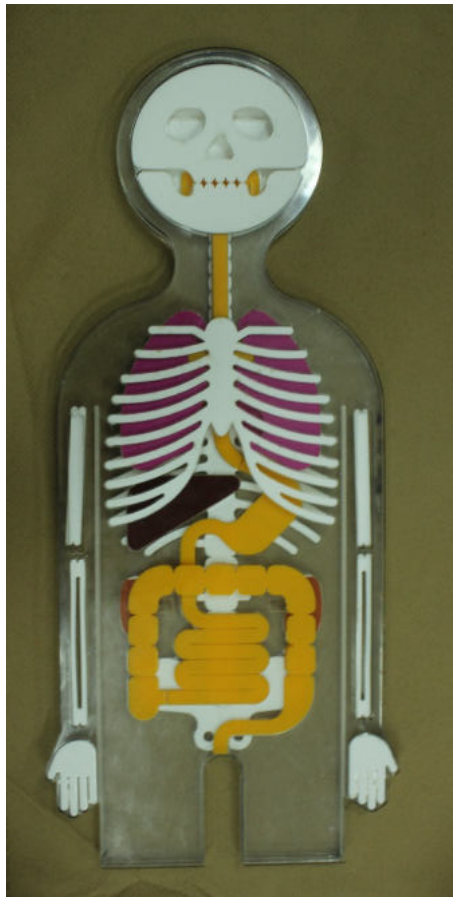
-Each system in separate base
-Opaque base
-The height of the base body: 22 cm
-Organs such as the pancreas was becoming was of size 8 mm which was very small to handle for the kids.

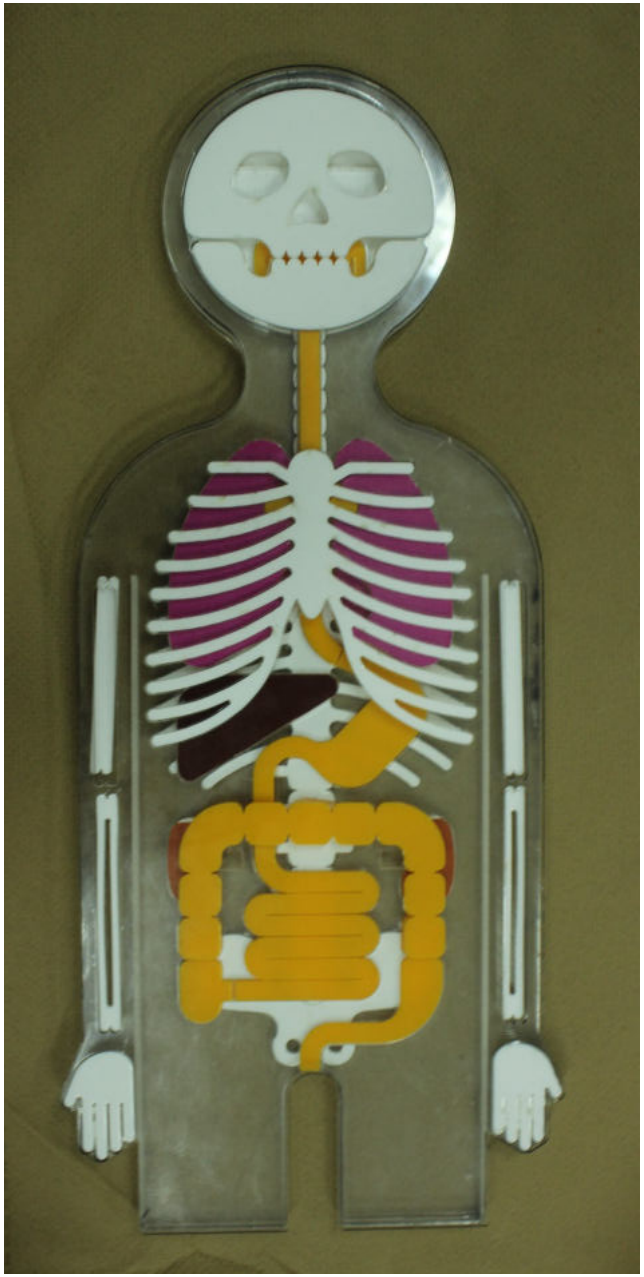
ITERATION 2

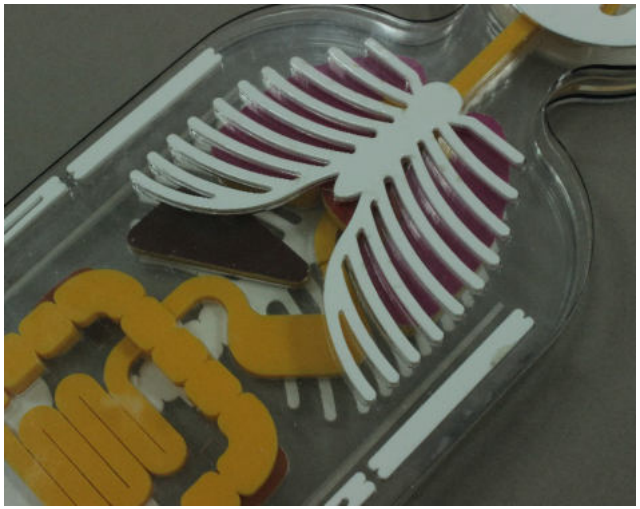
-All organs in one body
-The height of the base body : 22 cm
-Transparent base, see all organs

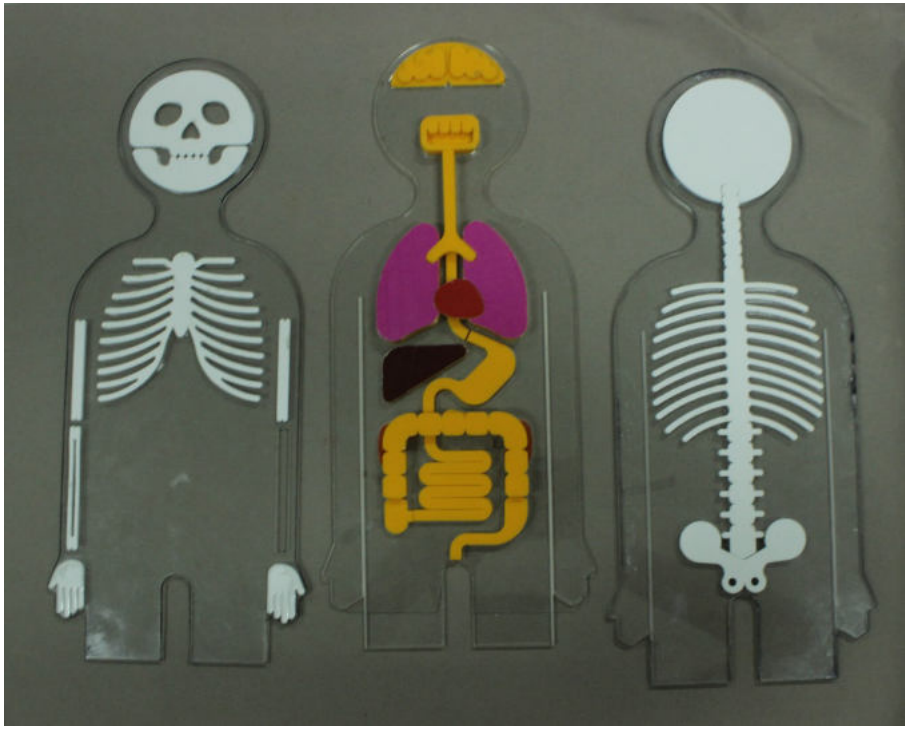
ITERATION 3

-All organs in one body
-The size of the base body : 31 cm
-Transparent base, see all organs
-Has 2 layers of abstracted skeletal system









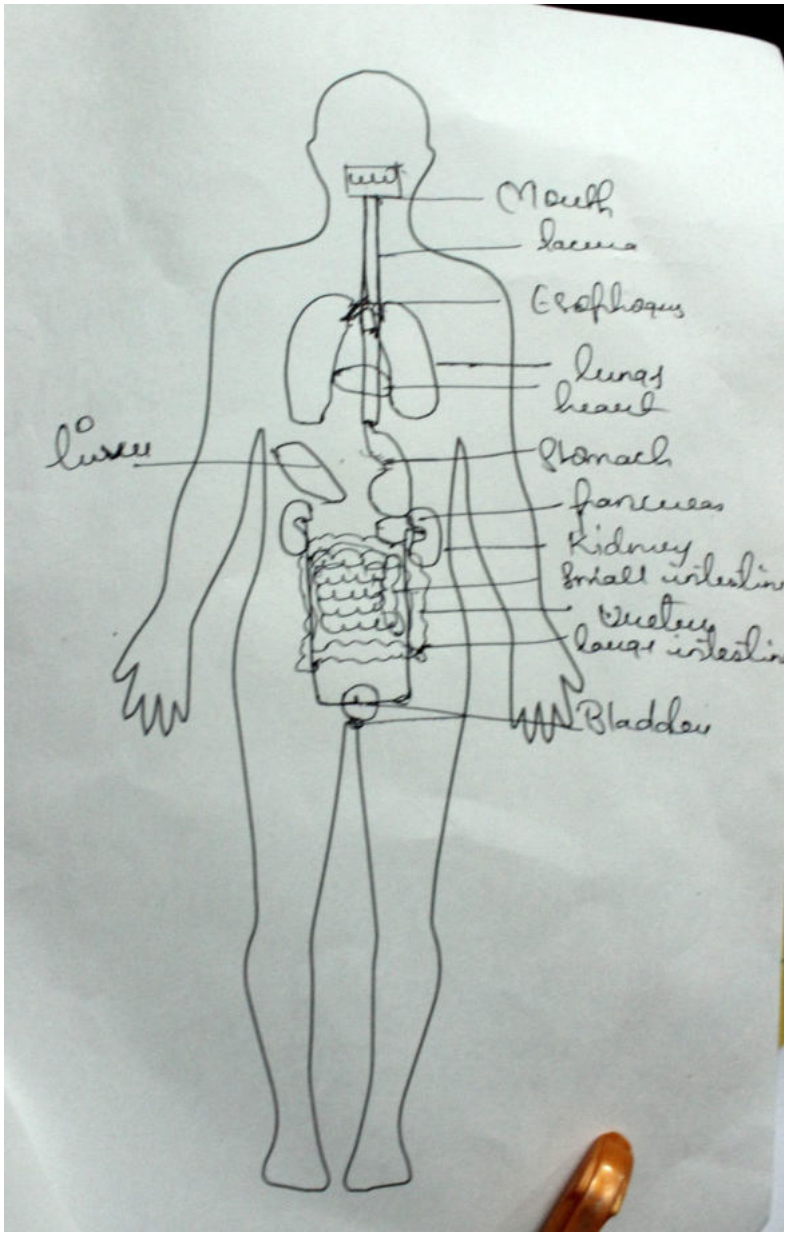
Asha Trust

Age: 9-10 years, Standard 4th and 5th
Number of students using the model: 6

Benefits
-Students were able to identify parts easily
-Assembling took around 4 minutes
-Kids drew more body organs
- Most organs were more appropriately located after the model was used to teach.

Shortcomings
-Once the assembly was done there was less repeat play

Other Insights
-Material has to be robust.
-Adding feedback to hold attention of the kid.
-Design of an appropriate method to merge the model in classroom settings.
-Product can be used as part of basic introduction to anatomy before kids start to learn anatomy in detail



Test Sheet

-Students were asked to draw what they learnt on a human outline

-More organs in appropriate places

-Able to show overlapping organs

Product with packaging, manual and reference sheets

InsideOut is the name given to the product.

A single kit of contains
- A base body
- The organs which would fit in the base body
- A manual how to use the assemble the parts
- Reference Sheets

A manual containing information how to use the InsideOut is given with the product. The contents of the manual are as follows-

A single kit contains
InsideOut is a teaching aid meant to help students understand the basics of human anatomy. It helps the students better remember the different parts of the human body by making them simpler to grasp, using only the most memorable, simplest of shapes and a simple interactive model. The multisensory nature of this aid helps in understanding and retention.

3 x Panels
14 x Organs
14 x Skeletal Structures
2 x Reference Sheets
1 x User Manual

There are different modules available for study in InsideOut. These modules can be taught individually or together.

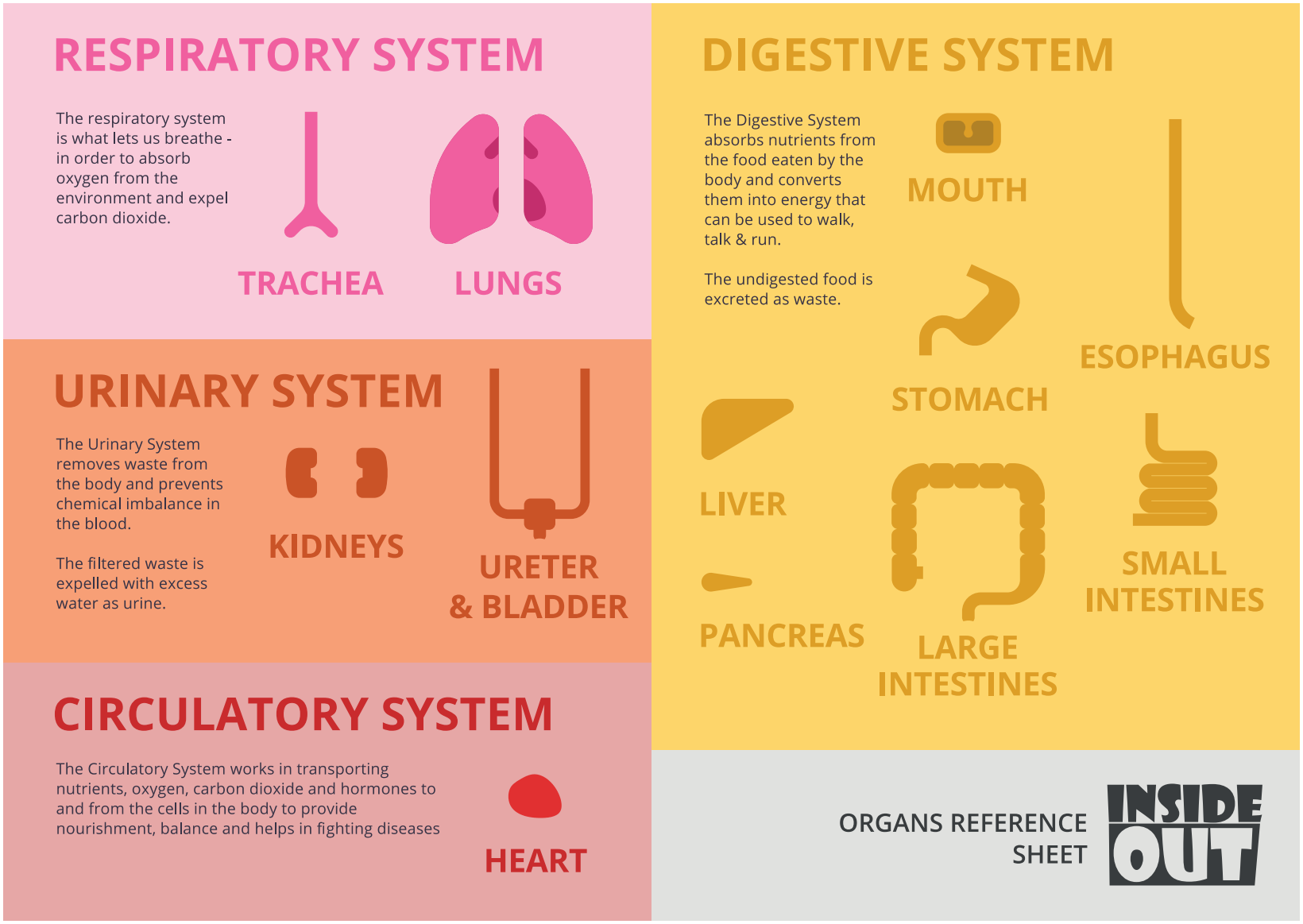
Basic Organs: The basic organs module consists of the heart, the Digestive system, the Urinary system and the Respiratory system. This module can be used as an aid while explaining the concepts of blood circulation, breathing, eating, digestion, absorption and egestion.
Skeletal Structure: The skeletal structure module contains the major bones present in the adult body. This module can be used as an aid while explaining the major functions of the skeleton, which are: support, movement, protection and production of blood cells.

As an Introductory Session
InsideOut is perfect for introducing anatomy to children of ages 10-12. There are two ways to use this teaching aid in an introductory lesson – facilitated by a teacher or used autonomously by children.
If a facilitator is present, the facilitator uses the teaching aid to engage the student. The facilitator starts by talking about the module(s) of choice, its function and its different parts. The facilitator then starts assembling the parts into the cast, one by one, naming each and engaging the children with their form and function. In such a scenario, 9-10 children can learn at once.
In case of autonomous activity by the children, the children should be given the panels and organs separately and told to complete the model by putting all the organs in place. They can refer to the manual for the names of different organs. At the end of this activity, a small quiz in which the children are asked to match the organs with their names and function will further reinforce their learning. In this kind of activity, the kit can be used by only 4-5 children at a time.

Note: For best results, the children must be allowed to practice with this aid a month before the lesson is formally taught in class. The reinforcement of the lesson allows them to retain the concepts learnt for a longer period of time.

As an Examination
InsideOut is useful as an examination of the child's grasp of basic anatomy. The examination can be held in multiple ways – one is to give the child some/all the parts and the beds and ask him/her to assemble and name everything. Another way is to give a single organ piece and ask him to identify, categorize and write about the function of the organ.

WITH THE SURGERY BOX
The SurgeryBox is an optional addon to the InsideOut Kit. It can also be made by the user with some simple, easily available parts.
Using the SurgeryBox
The intent of the SurgeryBox is to allow for a more innovative and engrossing experience with the InsideOut Kit.
The surgery box can be used in a classroom setting or in a laboratory setting. In a laboratory setting, groups of children can use it completely autonomously once given a proper assignment. In a classroom, children can take turns to use the kit.
Since all the parts of the product are confined to the box, it prevents the loss of smaller parts of the product.



Reference Sheet

The reference sheet can be used as a organizing chart- to match the organs, get information about it. The product has two reference sheets- organ reference sheet & skeletal system reference sheet

SKELETAL SYSTEM

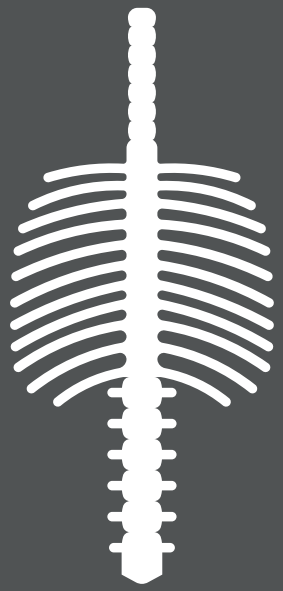
REFERENCE SHEET

INSIDE OUT

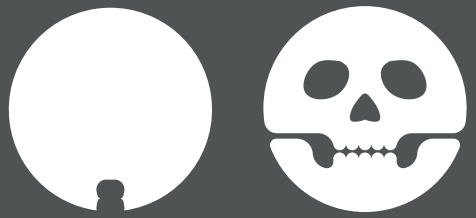
The Skeletal System is the internal framework of the body. The major functions of the skeleton are proving support, facilitating movement, providing protection and production of blood cells in the marrow.

An adult human has 206 bones in the body.

BACK BONE & REAR RIBCAGE



FRONT RIBCAGE



REAR FRONT

SKULL

PELVIC BONE

HUMERUS

RADIUS & ULNA

Reference sheet for skeletal system

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[2][3] http://psychology.about.com/od/developmentalpsychology/a/child-psychology.htm (as seen on 9/03/2016)
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