

Cognic Zoom

This is a proposal for a project to produce materials to be used in learning and teaching in a broad range of areas centred around problems of scale (e.g. large numbers, small numbers, powers of ten) understanding the universe, and exploring the material world at different levels of scale. It is based on the difficulties we observe of students - and people in general, including ourselves - understanding problems of scale: we have no idea how large the earth is, how far away the moon is, or what tiny things even the largest planets are in comparison to the distances between the planets. We find it very hard to understand how long ago dinosaurs existed compared to how long humans have existed and how long one person lives. We can't understand how much 2 lakh crore rupees is in comparison to the price of a litre of milk.

Rather than just focussing on the learning objective of understanding mathematical scale, we will use scale as an organising guide for many learning objectives that happen to be somehow related to problems of scale.

The over-all learning objective will also be to promote a scientific temper or outlook so that learners will be motivated to collectively use a scientific method throughout their everyday lives to ask questions, make observations, and search for answers, in order to purposively and constructively make the world better, more just, and more equitable.

That all the branches of the natural sciences are all part of a single story - the history of the universe, would be one of the important learnings of the engagement of learners with Cognic Zoom.

The scientific basis for the essential unity of all humans at a fundamental level is another important learning .

A scientifically informed concern for the protection of the environment and a deeper understanding of the threat to the survival and well being of humans and life in the present and future due to the current economic systems is yet another important understanding that will emerge from the engagement.

The brand name "Cognic Zoom" has already been officially registered as a trademark and website. The main effort will be to develop, test-out, produce and distribute a body of teaching/learning materials and methods.

The project will be initially funded by seed contributions from participating organizations. The future requirements will be built systematically on the principles of self reliance, by producing and distributing materials developed by the project.

Cognic Zoom Team

The core team could consist of two coordinators and several others, including some teachers. Some members will be volunteers or people who are already working on related projects. The core team will facilitate the creation of a network of people to spread the ideas, carry on the work and test out ideas.

Workshops

We will conduct a series of workshops in order to develop ideas and materials for Cognic Zoom. The core team will conduct the workshops, some sessions of which will be hands-on sessions to develop teaching/learning materials and activities and try them out with small groups of children and teachers.

Children's Club: We plan to conduct a (weekly?) science clubs (at schools ?) in which many of the Cognic Zoom ideas can be developed and tested out with children of a range of ages, especially middle-school children (or children from Classes IV to IX).

Materials to be produced

We will prepare material and methods that can be used to illustrate the process of zooming from the scale of things that we experience in our ordinary, everyday lives up to very large scales and down to very small scales. This will include things that students can actually see: from Brownian motion (atoms at work) and an oil film on water at the smallest scales to Andromeda (something outside our galaxy) at the largest. We will produce toys, games, and other teaching learning materials and methods.

Cognic Zoom books will be published in both soft and hard copies. We will also produce posters, short films, material on websites and possibly apps and/or software, and manuals and guides which are part of kits. We will also provide lists and links to related material that is already available.

Cognic Zoom space book: In this book, each page shows representations that are a power of ten larger than the previous page. We will visualise zooming up from our own hand to the solar system and beyond, and zooming down to molecules and atoms. This is similar to the book from USA, "Powers of Ten" by Philip Morrison and Phylis Morrison

and the Office of Charles and Ray Eames (1982) Scientific American Library. The difference would be that the illustrations would be drawings, rather than photographs, and it would be done in the Indian context, showing, for example, an Indian child, a family in a village house, a village or community, paddy fields, a tehsil, a district, a state, the country, the earth, etc. The social relations at each level can also be explored.

Cognic Zoom space workbook: This will be a workbook to accompany a square copy in which each page is a grid (graph paper) for the learners' use - the users follow guidelines and ideas to make their own Cognic Zoom books. (Alternatively, the workbook could include the graph paper pages.) Learners would write notes and draw sketches of objects or representations of various aspects of physical reality at different scales - for example, pictures which are powers of ten larger or smaller than each other. They can list and draw things which are of similar scales, e.g. things which are about 1 cm in size, or things which weigh about 1 kg, things which weigh about 100 g, things which weigh about 10 g.

Cognic Zoom time: This book would show the progression of time, from very long ago (maybe even the Big Bang) to the present.

Cognic Zoom wavelength: This book would present activities that can be done to explore wavelength at different scales, including the visible spectrum, radio waves, soundwaves, etc.

Cognic Zoom money: Another 'dimension' will be money, which can be investigated in terms of various forms of wealth: housing, clothing, necessities and luxuries, or the cost of food. Thus there could be one or more books to present scale in terms of money. One book could focus only on food, showing on each page how much food could be bought for given amounts in powers of 10. For example, a page for Rs 5 could show 10 toffees and 1 egg, a page for Rs 50 could show 10 eggs and 1 litre of milk, and a page for Rs 500 could show 10 litres of milk and 1 litre of whisky, etc. This could be in the form of a workbook which learners would write and draw for themselves. They would have to do some sorts of research in order to find the costs of different things. One objective would be to get some understanding of the meaning of very large amounts of money, like 100 lakh crore. Another objective would be to think about economic disparity and the source of wealth.

Existing Kits

Material that is already being produced by Navnirmitti and can be used to investigate problems of scale are: the nano solar system, astrokit, daytime astronomy kit, gyano telescope, magic mirror, ball and mirror

solar projector, sundial, geosynchron, etc. A make it yourself microscope will be included.

New Kits and Products

Cognic Zoom Kit: This kit will contain materials and equipment which learners can use to work on their Cognic Zoom Workbooks and other activities, such as finding examples of things of different scales. Materials and tools could include rulers and scales of various types, lenses, a telescope, a microscope, etc.

Microscopes: Simple, low-cost microscopes will be designed and produced. Ideas for children to make their own microscopes can be explored and booklets with the ideas produced. Activities and experiments with the microscopes will be developed.

Atomic model building kits: The 3D JODO technology will be modified so that the connectors are rigid and colour coded to correspond to different atoms. There could be one kit for building models of simple organic molecules, another for making a DNA model, another for common crystal structures, etc. New structural elements will be added including playdough, foam, wire, etc.

Sphere Zooming Kit: This kit will consist of several sizes of spheres - e.g. with diameters 1 mm, 1 cm, 10cm, and 1 metre, with weights 1 kg, 100 g, 10 g, 1 g, and with volumes 1 litre, 100 ml, 10 ml, 1 ml. Activities with the spheres will be developed and discussed in an accompanying booklet.

Cube Zooming Kit: This kit will consist of several sizes of cubes - 1 mm, 1 cm, 10 cm, 1 metre. Activities with the cubes will be developed and discussed in an accompanying booklet.

History of India in a Box: This is envisioned as a box of rocks from different eras, the oldest rocks from Cuddapah to the youngest, in the Himalayas, including sedimentary rock uplifted in the Himalayas, fossils such as coal, volcanic rocks from the Deccan Trap eruptions which played a role in the extinction of dinosaurs 65 million years ago, etc. It could be designed as a basic starting set for learners use to create their own more extensive rock collections. Ideas for activities and experiments as well as basic information on how we determine the age of rocks can be included in the accompanying manual.

Pedagogy and Framework

Activities will be developed with the collaboration of teachers and tested with students and people of various ages. We will try to include activities which are both open-beginninged and open-ended. This will be done by devising ways to encourage students to collaboratively ask their own investigatable questions and plan and carry out investigations to answer their questions. This could be done by giving students some materials and tools or bringing them to certain environments which will encourage them to become confused and become aware of contradictions which will lead them to ask questions.

Through Cosmic Zooming, we will try to avoid the impression of the nature of science as being just a list of 'facts'. This means that we will have to include some sense of the questioning and searching for answers, the methods and processes of exploring, the uncertainties and tentativeness. For example, for sizes too large or too small to see with our eyes, we will use devices such as lenses, telescopes, and microscopes, and methods that are used to estimate sizes. The nature of measurement and the reasons for measurement and how and why various scales have been invented will be areas of concern. That sizes are approximate or 'average' can also be investigated, along with the concept of variation. Investigates of scale can be very cross-curricular, including mathematics, various natural sciences (including physics, chemistry and biology), various social sciences (including economics, history, and sociology), languages (including oral and written literature and songs, music, visual arts, etc. Also, we need to mention social connections whenever relevant. In books, there can be the main text, in a large font, and more detailed text in smaller fonts in boxes or footnotes, for more experienced readers. Websites material can be hyperlinked and cross-referenced.

~25 People

some initial names suggested :

Jodogyan - Usha Menon

Sabyasachi Chatterjee AIPSN and Ajit Padmanabhan (his student)

Aamod Karkhanis, Navnirmiti

Nandkumar Jadhav, Navnirmiti Eduquality

Geeta Mahashabde , Priyanvada Barbhai - Navnirmiti Learning Foundation

Eklavya - Anjali, Arvind, Sushil

Anwar Jafri

Dinesh Lahoti and Khushboo – Edugenie, Assam

Chandita M.

Seema M.

TVV - Delhi

Nagesh Waikar - Hingoli

HBCSE students

Ashok Rupner IUCAA

Niruj R.

New Date decided after discussing with few participants is 5th and 6th April 2017.

Venue : W.W. Sawyer Memorial , Pune.