



# TURNING POINT

NEWSLETTER BY TATA CENTER FOR TECHNOLOGY AND DESIGN, IIT BOMBAY

Issue 5  
Feb-April  
8th Feb 2016

## Q&A with Prof. Noronha

Prof. Noronha talks about the motivation and challenges of his projects and has advice for budding researchers

## Cool Roof Coatings

Prof. Khanna and team work on development of affordable and dark colour cool roof coatings

## Transforming Ideas into Products

Product Realisation Lab on opening its door to larger community

## TATA CENTRE FOR TECHNOLOGY AND DESIGN

The Centre aims to develop solutions to challenges faced by resource-constrained communities within India and across the world using an end to end innovation approach.

[www.tatacentre.iitb.ac.in](http://www.tatacentre.iitb.ac.in)



## A Day with My Prospective Consumer

Soham Harshe, Tata Fellow; Suhail Shaikh, Tata Centre for Technology and Design

### Exposure visit to SEARCH, Gadchiroli and stay at village

Calling the individual from the resource constrained community a “consumer” may sound bit unacceptable for some. But my prospective consumer has taught me a different perspective in looking at their needs and created a belief of co-creation. Which also means to unlearn the notion of I AM THE PROVIDER and accept that I’m prospective too. Unless I understand the needs of the community and individuals from their perspective and enable my perspectives to merge with theirs, it’s very difficult for my solutions to succeed. At Society for Education, Action and Research in Community Health (SEARCH), Gadchiroli while interacting with Dr. Abhay Bang and his team we learnt that it

requires a high level of persistence and empathy to solve the issues of people living in subsistence.

Five days spent at SEARCH made me understand that the solutions for many unaddressed issues and new product development comes through empathy research and co-creation. Leonard (1998), defines empathic design as “the creation of product or service concepts based on a deep (empathetic) understanding of unarticulated user needs”. It is “a set of techniques, a process of developing deep empathy for another’s point of view and using that perspective to stimulate novel design concepts” (Leonard and Swap, 2005). Empathic design differs from

Unless I understand the needs of the community and individuals from their perspective and enable my perspectives to merge with theirs, it's very difficult for my solutions to succeed.

The question at times which will come to one's mind is that how much time is enough to be spent within the community to understand all of their requirement.

contextual inquiry precisely because it does not rely on inquiry; in the situations in which empathic design is most useful, inquiry is useless or ineffective (Leonard, 1998). The more deeply a researcher can get into the mind-set of a prospective or actual user, the more valuable is the knowledge thus generated (Leonard, 2007).

With each day there are numerous experiences and knowledge shared e.g. in one of the field experiences Dr. Abhay Bang shared a life-changing incident in his life. An infant in almost critical condition was carried from a distant village by her mother and grand-mother to Dr. Abhay Bang's home, as he was the only doctor available. The infant died while Dr. Bang was examining her, he felt helpless as he couldn't save the infant's life. He mapped 17 reasons (from lack of healthcare access to lack of road) which caused the death of that infant and finding solution to any one cause could have saved the life. The experience led to determination of saving lives of new births but it couldn't have come without understanding the daily lives of the community. "It's important to identify the daily frustrations of the consumer experiences and the types of innovation that could result in a

marketable and acceptable product. For consumers living in poverty, it helps to understand the reasons – and there is always a reason - for behaviours that may not at first make sense to an outsider." (Pickard, 2016) For example, in one of real-life stories Dr. Abhay Bang shared that the tribal community encouraged less food consumption for pregnant women, as delivery of a lesser weighing, thinner infant would be easier in a resource constrained environment. But unfortunately it causes low birth weight and lower ratios of survival. For an outsider it is difficult to understand that why would a community practice encourage eating less; but with enough time and investigation the reasons could be identified and solutions to change the behaviour could be created.

The question at times which will come to one's mind is that how much time is enough to be spent within the community to understand all of their requirement. The knowledge gained and



Tata Fellows interacting with Dr. Abhay Bang

generated through market research, empathic design and product development etc. should not vanish after the project is finished. Indeed, it is essential to retain vital knowledge to share and transfer (Cusumano and Nobeoka, 1998; Nobeoka and Cusumano, 1997). It's a continuous process and should evolve as the communities and their practices do. A day in my life with my prospective consumer at Gadchiroli was the initiation of acquiring knowledge and applying to it create solutions for their needs.

Article is based on the insights shared by Dr. Abhay Bang, Dr. Rani Bang, Dr. Yogesh Kalkonde, Mahesh Deshmukh, Sunil Chavan, Nikhil, Kedar and the villagers who hosted the Tata Fellows.

#### References:

- Leonard, D. (1998) *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*, Harvard Business School Press, Boston.
- Leonard, D. and Swap, W.C. (2005) *When Sparks Fly: Harnessing the Power of Group Creativity*, Harvard Business School Press, Boston.
- Leonard, D. (2007) 'Market research in product development', in Ichijo, K. and Nonaka, I. (Eds.): *Knowledge Creation and Management: New Challenges for Managers*, Oxford University Press, New York.

Pickard, L. (2014) *Product Development from the Bottom (of the Pyramid) Up*, <https://www.nopaymba.com/>

Cusumano, M.A. and Nobeoka, K. (1998) *Thinking Beyond Lean: How Multi-Project Management is Transforming Product Development at Toyota and Other Companies*, The Free Press, New York.

Nobeoka, K. and Cusumano, M.A. (1997) 'Multiproject strategy and sales growth: the benefits of rapid design transfer in new product development', *Strategic Management Journal*, Vol. 18, No. 3.



## Q&A With Prof. Noronha

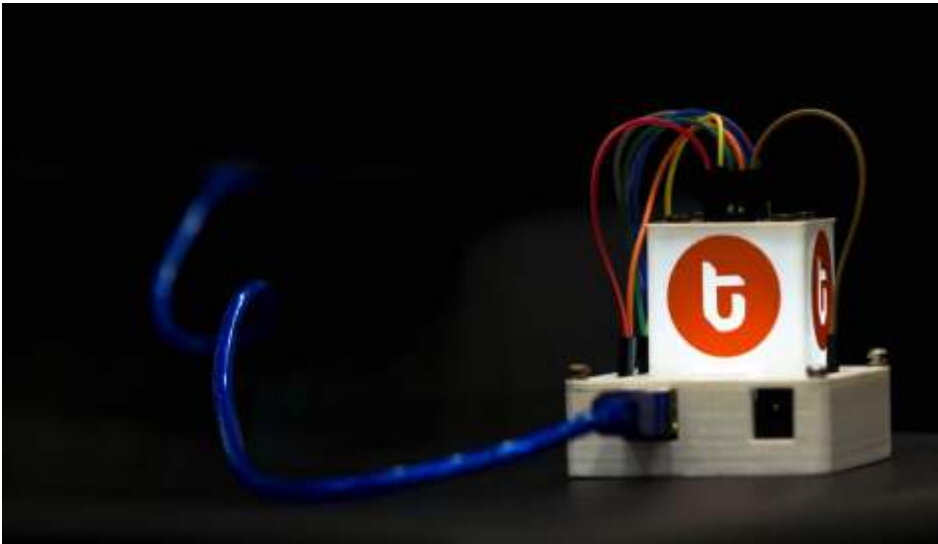
Prof. Santosh Noronha, Chemical Engineering Dept.; Interviewed by Akshay Subramaniam, Tata Fellow

### On Cervical Cancer and Healthcare Projects

**Q:** What was the motivation behind your choice of projects?

**A:** Through our collaborations in the Healthcare Research Consortium (HRC), many science institutions in the vicinity of IIT Bombay have approached us with biomarker leads for various diseases and conditions, which could be developed into diagnostic products. The National Institute for Research in Reproductive Health (NIRRH),

new paradigms for preventive oncology. Over the past year we have intensely debated strategies for shifting cancer screening efforts from a tertiary-care centre like TMH to the country's interior. During this process we came up with a few ideas for developing screening-level diagnostics that could be developed and deployed in resource-poor areas at low cost.



Early Prototype of a Point-of-Care Device for Detection of Biochemical Markers And Diagnosis of Osteoporosis

has identified a set of biomarkers for the detection of Osteoporosis. Translation of these biological insights into a diagnostic product capable of detecting these molecules was thus the logical next step. We are focussed on developing platform microfluidics technologies for disease diagnosis. Our collaborators are thus expected to identify and propose candidate molecules for various diseases and conditions, for which our platform technology will be adapted.

The cervical cancer project arose from a request from the Tata Memorial Hospital (TMH) to ideate

**Q:** How are your solutions an improvement over conventional solutions?

**A:** Osteoporosis is conventionally diagnosed via Bone Density Measurements (BMD) using specialised apparatus using X-rays. This limits access to the major cities. We propose a facile, minimally-invasive diagnostic, which indicates the relative rates of bone formation and resorption by measuring the levels of relevant biomarkers. A device that can be deployed in the field by minimally-trained personnel can greatly enhance the scale and reach of testing. We also expect this to substantially reduce the cost, as



Prof. Santosh Noronha

our solution precludes the need for sophisticated infrastructure or highly-trained personnel. As such, osteoporosis is a chronic disease largely ignored in rural areas, so any penetration in this context would be highly beneficial.

Cervical cancer detection is also restricted to major hospitals, with only occasional screening camps in rural areas which are themselves held by highly-trained oncologists. There is a need to transfer the screening activity to grassroots workers in primary healthcare centres, especially as cervical cancer is easily curable if detected early, and many lives are lost due to lack of access to easy screening.

**Q:** What is the major scientific/technological hurdle you have faced in the course of these projects?

**A:** For the osteoporosis project, the major challenge has been the conversion of a fairly long and sophisticated reaction protocol to a microfluidic format that can be operated with minimal training, while maintaining assay sensitivity and specificity. In cervical cancer, we have encountered the biggest bottlenecks in rapidly deploying our gadgets in rural areas, as there are very few trained personnel capable of executing the diagnosis. So the focus has shifted from product-level innovation to developing a skills training and development effort for community health workers.

**Q:** What is the current status of projects and what are your future aims?

**A:** In the osteoporosis project, we have identified a set of biomarkers and have developed basic device prototypes. We are now trying to understand how to reproducibly manufacture these prototypes at large scale, to be in a position to execute a clinical trial. For the cervical cancer, we have developed

devices for visual inspection and smear-based testing, and are now focussed on training a cadre of paramedics capable of deploying these products, and their connectivity with oncology experts in regional centres like TMH.

**Q:** Any advice for budding researchers in your field?

**A:** Many healthcare projects are essentially about high-quality estimations of various healthcare

conditions in a low-cost, robust and user-friendly manner. But it is more important to develop an ecosystem around the products so they are effectively deployed by many people. Students and researchers should be willing to leave their comfort zone and engage in in-depth interactions with various stakeholders and understand the various aspects of successfully executing their innovations.



## Lemonade In News

Article sourced from Times of India, Nagpur, 14 Dec 2015

### Instant lemonade maker wins national award

If life has given you lemons, they say, then you make lemonade. It'll help though if you could make it faster and more hygienically. Bang on! Pratik Gadkar and Mirza Asim had invented a machine that produces lemon juice in a hygienic way, and fast. It can even turn the juice into lemonade too.

The project bagged an award at India Innovation Initiative - i3 National Fair 2015, which is jointly organised by Department of Science and Technology, Government of India, All India Council for Technical Education (AICTE) and Confederation of Indian Industry.

Out of more than 740 entries pan-India, invention titled 'Design and Fabrication of Lemon Juice Making Machine' won the IVCA award for being the Top Innovator. Believed to be a first of its kind, the machine can produce almost 100 litres of lemon drink in 10 minutes. The machine was made by students Pratik Gadkar, Mirza Asim Baig and Govind Sahasrabudhe.

Pratik Gadkar says that "The idea was to automate the process of

making lemon juice which is much in demand in our country. The machine not just provides a faster mechanism but also a much healthier product as the juice is filtered four times. It also has a refrigerating tank in which a pump mixes water, lemon juice and sugar syrup in proper proportion to make fresh lemonade instantly. After we got the award, many investors are approaching us to fund the project.

We want to commercialize it at places like hospitals, sports complexes, college canteens and corporate offices so that people can get to drink hygienic lemonade. The best apart about the machine is that it requires zero human contact and is thus a healthier option than the traditional way of making a lemon drink"

Pratik Gadkar and Mirza Asim are staff of Tata Centre for Technology and Design.



Mirza Asim and Pratik Gadkar receive the award from Dr. Harsh Vardhan, Ministry of Science and Technology and Ministry of Earth Sciences and Y.S Chowdary, Minister of State, Science and Technology & Earth Sciences

## Keep It Cool!

Parth Joshi, Sayan Samanta; Tata Fellows

### Development of Advanced Dark Colour Cool Roof Coatings



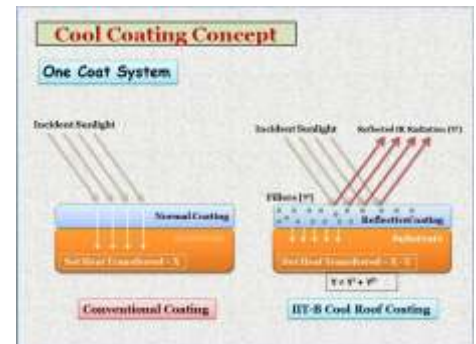
Many would be aware about the blue-painted house of the “sun city” Jodhpur, also blue-city for many tourists, where the day temperature is average of 33.6°C and the record high temperature is 54°C. While on a tour there, the tourist guide told me that the houses are painted white and blue to protect it from the sun's heat. Travel photos from the Mediterranean and Middle East often show a landscape of homes with white roofs and walls. These are in fact cool roofs, and have been a common architectural element for thousands of years.

Global surface temperature has increased at the rate of approximately 0.2°C per decade in the past 30 years, similar to the warming rate predicted in the 1980s in initial global climate model simulations with transient greenhouse gas changes. From a scenario in which metal roofing conjured images of corrugated GI sheets put over outhouses and sheds, Indian construction has embraced the new-age metal roof in a big way. The market size for coloured metal has grown from 45,000 tonnes per annum to about

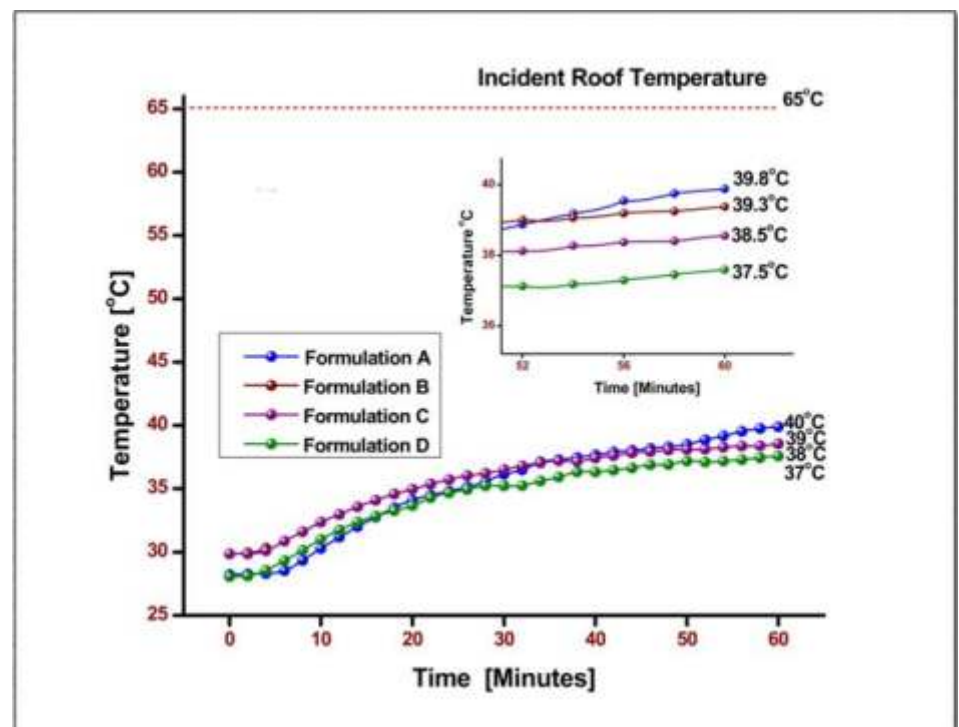
200,000 tonnes per annum in a short span of a few years, growth was estimated at 15-20% in year 2006 (MGS Architecture, 2016). The uncoloured metal sheets are majorly used by the lower and middle segment of the society for housing purpose and the upper income group will use it for auxiliary structures e.g. garages, store houses, etc. The cost for cooling in industrial setups rises due to the heat

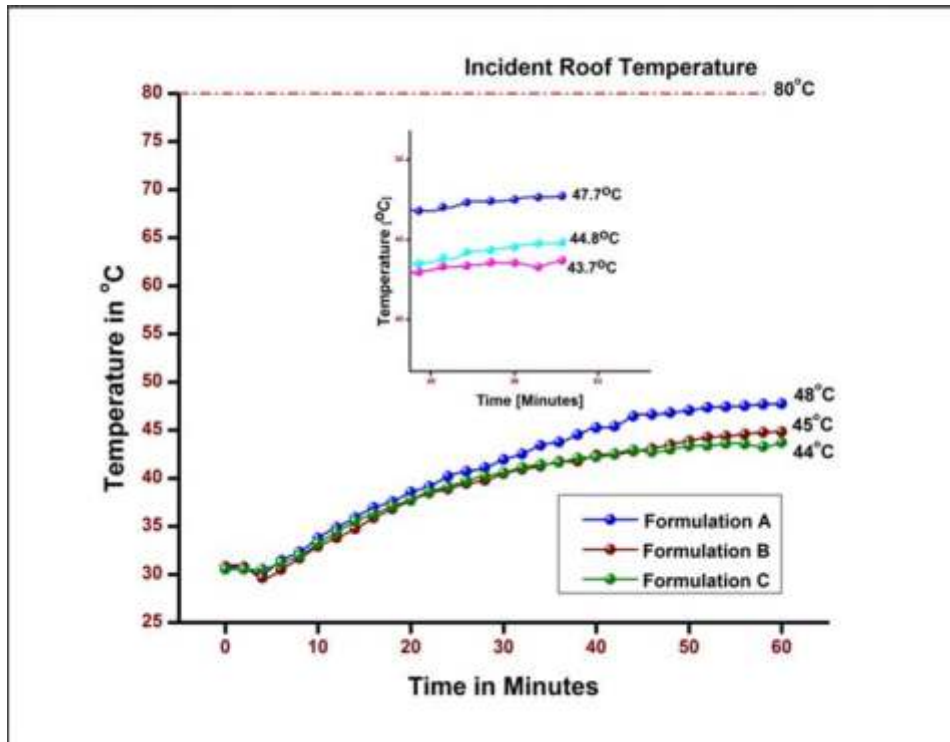
generated under metal roofs and living in such homes becomes difficult not only for Indians in middle and low income group but in other developing nations as well.

Tata Centre for Technology and Design with Prof. A. S. Khanna and his team (Department of Metallurgical Engineering & Materials Science) have developed affordable “Dark Coloured Cool-Roof Coating” which can provide a difference of 10°C between the exterior and internal room temperature and it comes in a wide variety of colours!



Research team working on the solution has successfully synthesised a ready to use thin adherent water based paint with standard hardness for exterior concrete surfaces (walls and roofs)





with high IR and near IR reflectivity of ~65% (depending on the colour) as compared to existing reflectivity of conventional coatings < 10%. In addition, they have incorporated hollow microspheres and Metasilicate as a composite to the paint. These particles form a thin thermal barrier which insulates the substrate from a significant part of the heat that otherwise would be absorbed by the coating. The

schematic of the formulation is mentioned in the *Cool Coating Concept* diagram on the previous page.

Preliminary studies have been conducted for two separate roof temperature of 80°C and 65°C. Results show a steady state interior temperatures less than 47°C and 40°C which vary slightly based on the minor variations in paint formulation (refer to *Incident Roof*

*Temperature diagrams*).

This innovation can solve the issues of air conditioning and ventilation of enclosed spaces during summers. This coating system can also reduce the energy demand, which can further reduce the stress on electricity supply needs and demand for coal and petroleum import. In the larger perspective it can also reduce greenhouse emissions (lower load on air-conditioners) and shall improve ambient air quality by reducing smog (by decreasing urban air temperature). At the same time, this solution will maintain the aesthetic panorama of urban space instead of all-white moribund looking societies, all this can be achieved at affordable price. Current estimates suggest an electricity savings of approximately 450 crores of rupees per year in a city with 10 lakh air-conditioners users for a 2BHK house of 1000 square feet area and 08 hours AC usage.

The inputs for this article were provided by Mr. Narayanan Rajagopalan (PhD scholar under supervision of Prof. Khanna) Mr. Vikram Singh (Associate Tata Fellow student working on the project).



## Transforming Ideas into Products

Dhiraj Nimje, Ramprasad V.; Tata Fellows

### Activities Undertaken in Product Realisation Lab

It would be nice to follow a checklist and innovate successfully, but that's not possible. Travelling into new territory means never being able to map your route fully beforehand. Innovators use design thinking to move through three general phase: During "inspiration," they experience a "problem or opportunity" that sets them in motion; during "ideation," they generate and test ideas; and during

"implementation," they move their innovation "from the project room to the market." Product Realisation Lab (PRL) of Tata Centre for Technology and Design is the apt place for design thinking and believes in do-it-yourself attitude. Established in 2015, PRL is envisioned for the needs of technical and design incubation for product development.

PRL is equipped with CNC routers, 3D printers, laser cutters, assorted saws, extra-large milling machines, full-range welding apparatus, sand blasters, furnaces, surface coating facilities, PCB printers, surface mounting instruments, multifarious oscilloscopes, rework stations, function generators, differential preamplifiers and high-end measuring and analysing devices and the list just keeps increasing over the time. "In effect, the resource theory maintains that if adequate resources are brought together in one place, student learning and development

will occur. Many college administrators believe that the acquisition of resources is their most important duty.” The resources will be underutilised if only the users from the Centre use it everyday. In fact the users, who are technicians, researchers, staffs, professors will see a lower enthusiasm every time they come to the PRL and some regular users might itself start behaving like machines which has to turn on at beginning of the day and off at the end. There will be slow restriction swamping the openness of mind and imagination of the design thinking. To avoid this, the doors of the PRL are opened to not only the IITB community but also for the aspiring learners from other engineering colleges and even for newbies from schools of rural area. Starting with Kalpana Design Competition in mid-2015 for engineering students outside IITB, school students from Introduction to Basic Technologies by Vigyan Ashram, first year bachelor students of design under Industrial Design Centre, there has been numerous caucuses for thinking and creation by involvement. It is a learning experience for PRL to see budding thinkers interacting and getting involved with the equipment and people, it provides new insights into



how users take inspiration, ideate and implement.

Insight into how people actually use things is central to design thinking. This insight comes not from crunching numbers, but rather from observing what people actually do, noting what they don't do, and understanding what they don't or can't explain about what they do. Design thinking borrows ethnographic observational techniques from anthropology and reapplies them to generating practical solutions. This requires empathy, because feeling alongside others allows you to move past seeing them as subjects or

Travelling into new territory means never being able to map your route fully beforehand.

Innovators use design thinking to move through three general phase: During “inspiration,” they experience a “problem or opportunity” that sets them in motion; during “ideation,” they generate and test ideas; and during “implementation,” they move their innovation “from the project room to the market.”

consumers and really experience things as they do. This is exactly what PRL focuses on and implies to itself when working with ideators of various backgrounds. The PRL team quips that its learning never stops due to its continually-experimenting character and user-friendly environment. Thus, the PRL with its strong technical and design team, coupled with its wide range of equipment, is no way short of realising its own dream of launching products from sketch to stage.

#### References:

Brown, T. (2009) *Change by Design*, New York, Harper Business

Astin, A. W. (1984) *Student Involvement: A Development Theory for Higher Education*, Los Angeles, University of California



# CHEMPLAY

Tata Centre for Technology and Design

## Designing a card game to introduce chemistry subject in schools

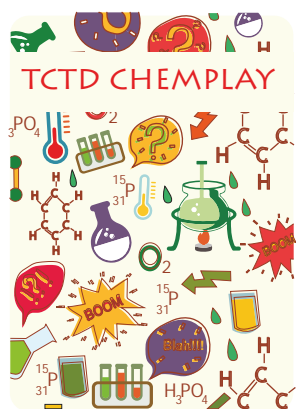
Chemistry is one of the fundamental subjects introduced in Secondary and Higher Secondary School curriculum. The traditional way of teaching chemistry involves theoretical and visual tools. The experimental kits available focus more on the observations or the effects which at times fail to address the fundamentals. Moreover, unfortunately the course content in standard texts is not well connected. High school students have termed chemistry as one of the dry subjects which requires lot of cramming and memorizing. A play-way approach works best not only to address the fundamentals but to make the subject more interesting. Use of innovative, cost effective tools like board and card games can make the subject more interesting and easy to understand. TCTD, IIT Bombay under the domain of 'Education' is worked on a compendium of board

and card games to make the teaching-learning process of chemistry meaningful, well connected and fascinating. The objective is not to replace the traditional teaching pedagogy but to complement it. The present focus is on standards VII and VIII where chemistry is introduced. A part of this compendium is a card game CHEMPLAY which addresses two important aspects of chemistry viz; introduction to first twenty elements and formation of simple compounds.

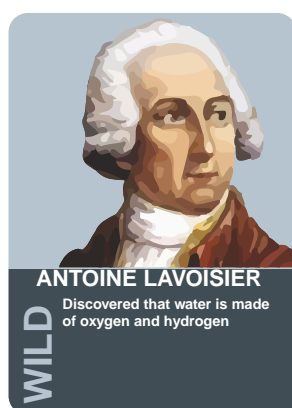
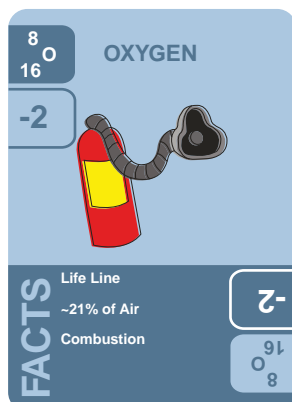
CHEMPLAY comprises of 56 cards with 10 Wild cards. The card layout includes an image highlighting the application, chemical symbol, atomic number, atomic mass and valency of the element (Figure 1). Additionally it includes three salient features pertaining to physical and chemical

property and common application. The Wild cards include famous scientists who have contributed to the field of chemistry (Figure 2). The graphics wizard at TCTD has given an attractive outlook to the front side of the card. It not only lures the players but is also relevant to the theme (Figure 3).

The card games were tried in few schools. the feedback obtained from the students and the teachers was positive. TCTD plans to try it out in few other schools before freezing the design. In addition to its own staff, TCTD recognizes the contribution of Dr. Nitin Bhate, Mrs. Pradnya Gokhale and Mrs. Shalini Kumar for their contribution towards the development and design.



Design: Mrunal P.



Newsletter Team: Akshay Subramaniam, Dhiraj Nimje, Jibi Jacob, Parth Joshi, Ramprasad V., Sayan Samanta, Shreenet Rathi, Soham Harshe

Photo Credit

Page 1, 2: Vivek Patil

Page 4: Pratik Gadkar

Other Pictures by Romit Patil

We invite feedback and comments on newsletter. You can also ask us to include an article. Please write to us: [tctd.iitb@gmail.com](mailto:tctd.iitb@gmail.com)