



COMMONWEALTH of LEARNING

Commonwealth Educational  
Media Centre for Asia

# Skill Development in Science through Open and Distance Learning



**NETAJI SUBHAS OPEN UNIVERSITY  
SCHOOL OF SCIENCES**

*7<sup>th</sup> October, 2015*

Ramesh Sharma



# Distance Education

- **Method of teaching learning at distance**
- **Transactional Strategies**
- **Self-directed learning systems**

# Distance ... Technology ...



<https://internationalstudyabroad.wordpress.com/2013/02/16/10-most-popular-distance-learning-universities-in-india/>



<http://www.tonybates.ca/2012/02/10/is-open-and-distance-learning-the-solution-for-developing-countries/>

# The condition of science in India: A serious issue

- Truly, the majority of science students are those whose second choice was science. The majority of science stream students at the higher secondary level which is the basic level on which a major decision effecting the whole career is taken, do so to get a chance to go to the various engineering and medical courses. The reason for this is the better job prospects. Here I would like to add a fact that as far my knowledge goes, very few of the academicians who are in science send their progenies to the science fields. The reason is very simple. They do not like their children to face the same problems which they faced in their life. The same reason is applicable to the fact that most of the science graduates lose a year or so on the average in trying their hands at different professional courses. This is the period when much of the scientific temperament and enthusiasm most needed to excel in science gets suppressed. This trend can be verified by the views of the majority of higher secondary boards' toppers throughout the country. In majority of cases, they dream of only civil services and other professional courses. Importantly, the theoretical science courses in the JEEs get lower priority and even those who opt for them prefer to go abroad. The situation warrants something effective and drastic to be done to raise the rating of science as a career.

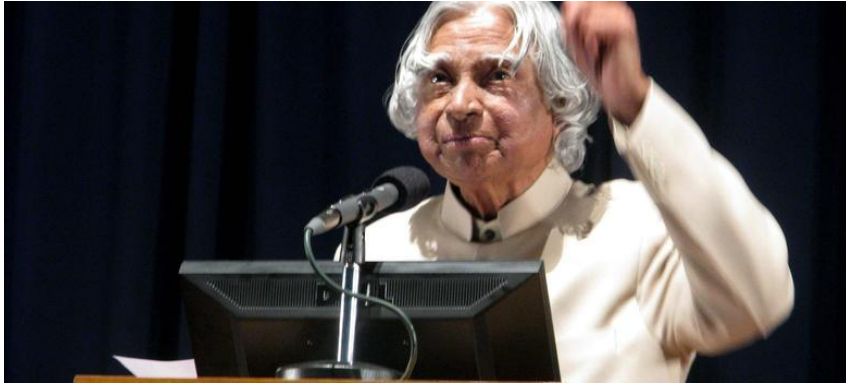
VACHASPATI PANDEY

Physical Research Laboratory, Navrangpura, Ahmedabad 380 009

<http://www.iisc.ernet.in/currsci/oct25/articles3.htm>



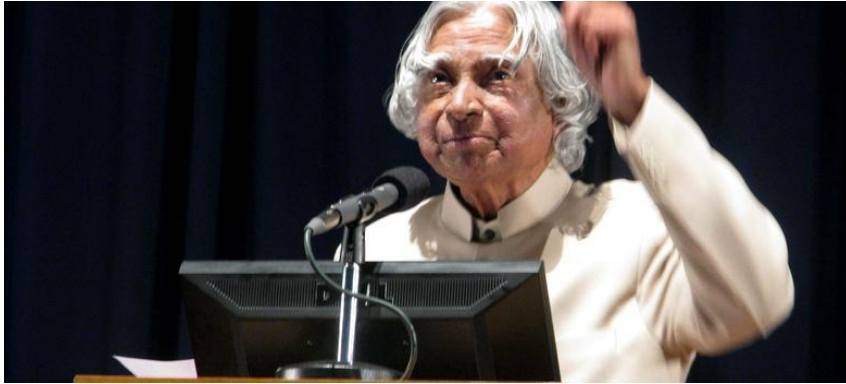
# Transforming India



## Distinctive Profile of a Developed India

<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>

# Transforming India



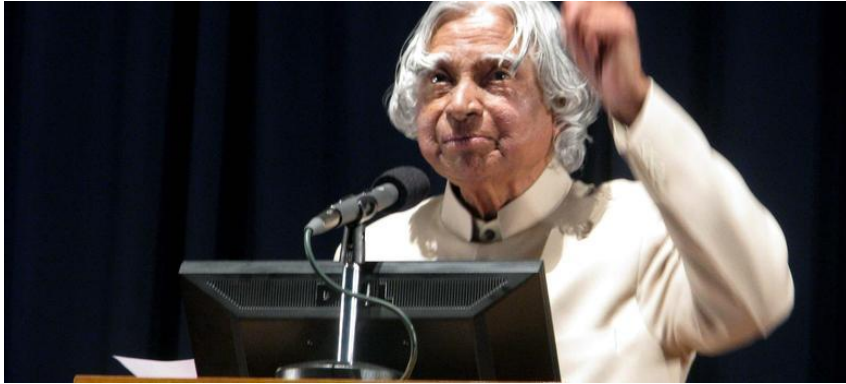
**Distinctive Profile of a Developed India**

**A nation where the rural-urban divide has been reduced to a thin line.**



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# Transforming India



**Distinctive Profile of a Developed India**

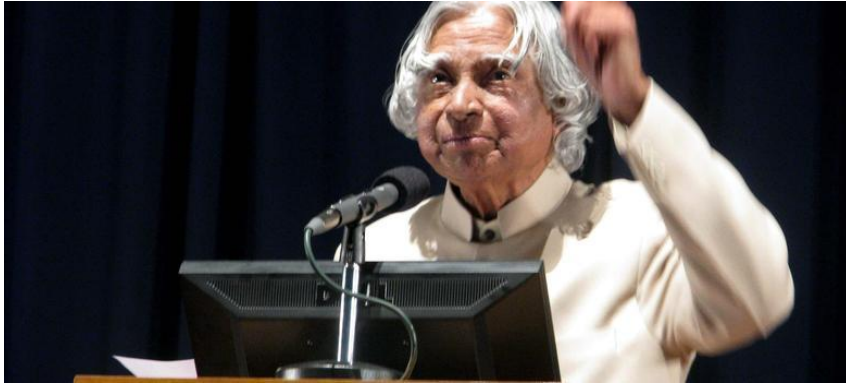
**A nation where there is an equitable distribution of, and adequate access to, energy and quality water.**



<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>



# Transforming India



**Distinctive Profile of a Developed India**

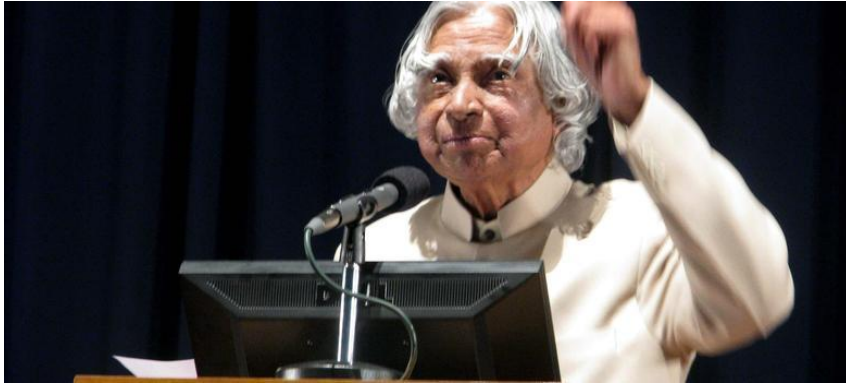
**A nation where agriculture,  
industry and the service  
sector work together in  
symphony.**



<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>



# Transforming India



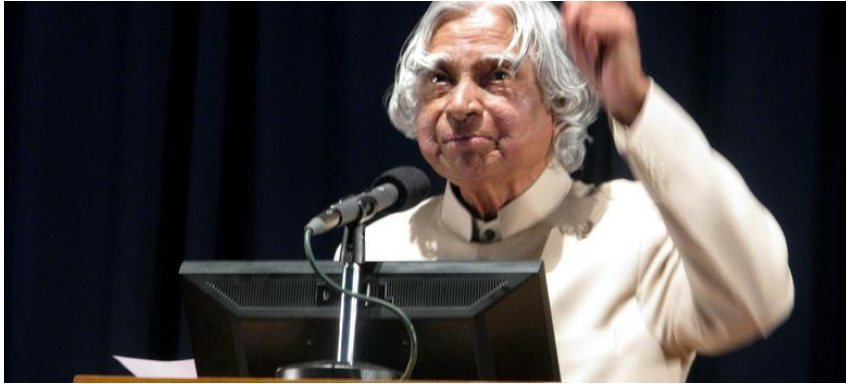
## Distinctive Profile of a Developed India

**A nation where education with a good value system is not denied to any meritorious candidates because of societal or economic discrimination.**



<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>

# Transforming India



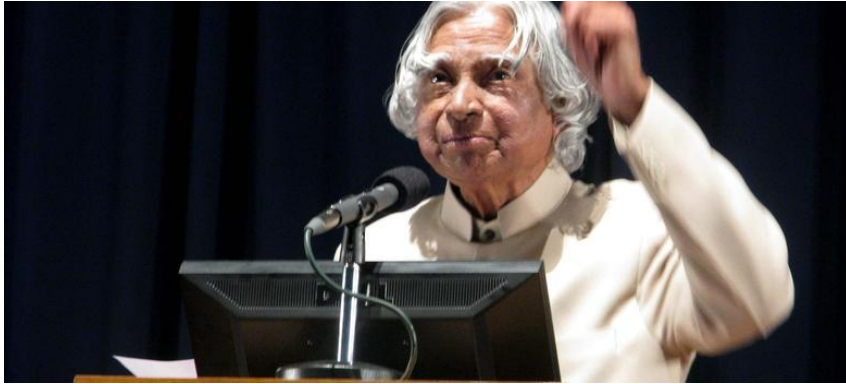
**Distinctive Profile of a Developed India**

**A nation which is the best destination for the most talented scholars, scientists, and investors from around the world.**



<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>

# Transforming India



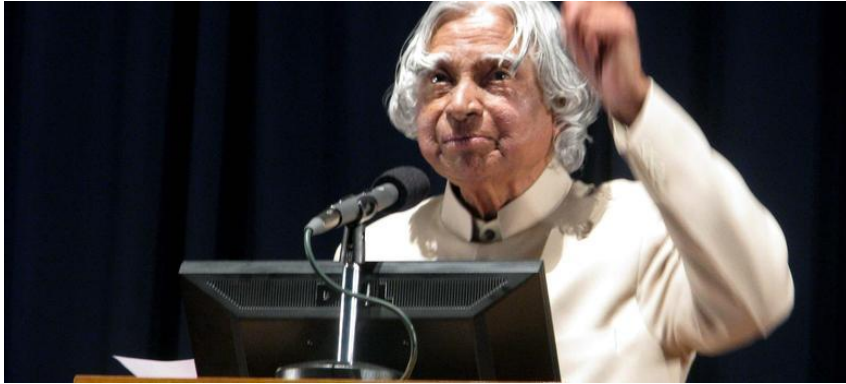
**Distinctive Profile of a Developed India**

**A nation where the best of  
healthcare is available to all.**



<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>

# Transforming India



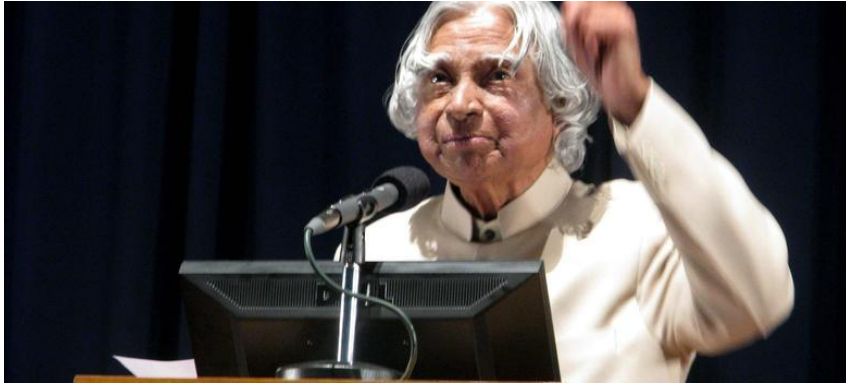
**Distinctive Profile of a Developed India**

**A nation where governance is responsive, transparent and corruption-free.**



<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>

# Transforming India



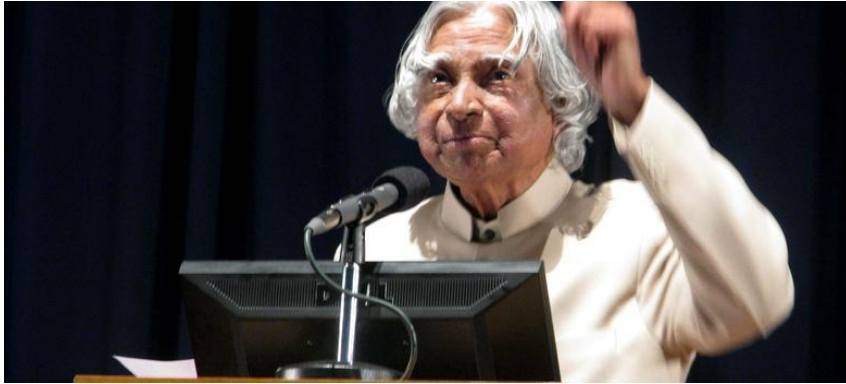
## Distinctive Profile of a Developed India

**A nation where poverty has been totally eradicated, illiteracy removed, crime against women and children is absent, and no one in the society feels alienated.**



<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>

# Transforming India

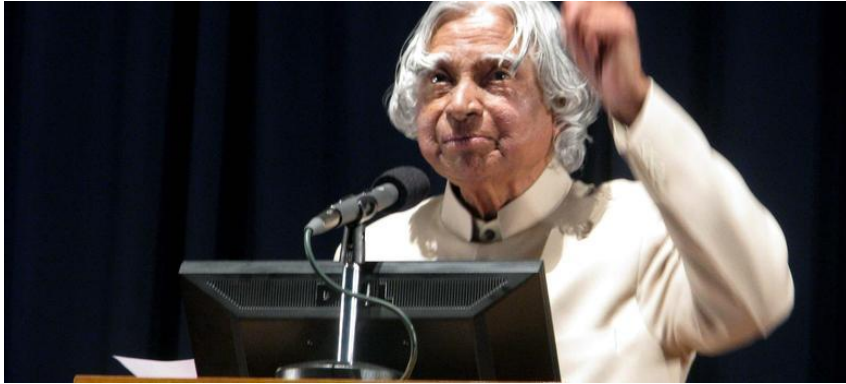


**Distinctive Profile of a Developed India**

**A nation that is prosperous, healthy, secure, devoid of terrorism, peaceful and happy, and continues on a sustainable growth path.**

<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>

# Transforming India



**Distinctive Profile of a Developed India**

**A nation that is one of the best places to live in and is proud of its leadership.**



<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>



# Integrated Action for a Developed India



**we have to transform India in five areas where India has core competence**

<http://scroll.in/article/744333/apj-abdul-kalam-we-have-to-transform-india-in-five-areas-where-india-has-core-competence>

# Five areas where India has core competence

- 1. Agriculture and food processing
- 2. Education and healthcare
- 3. Information and communication technology
- 4. Infrastructure development, which includes reliable and quality electric power, surface transport and infrastructure for all parts of the country including rural and urban areas under PURA
- 5. Self-reliance in critical technologies.



Image Source:  
<http://dooarstours.com/new/index.php/dooars-hotels-and-resorts/70-all-india-hotel-booking>

# Former President A.P.J. Abdul Kalam

- “In decades, India will need 300 to 500 million employable skilled youth and there is a need to completely change the university education syllabus and secondary school education syllabus. **Two certificates should be given to students.** In schools, one **skill certificate** and one education certificate and in college, degree and diploma on the expertise acquired. In schools from classes 9 to 12, 25 per cent of the time has to be allotted for skill development programme,”



Speaking on the occasion of third Malti Gyan Peeth Puraskar 2015 in New Delhi

# Skill sectors and manpower needed

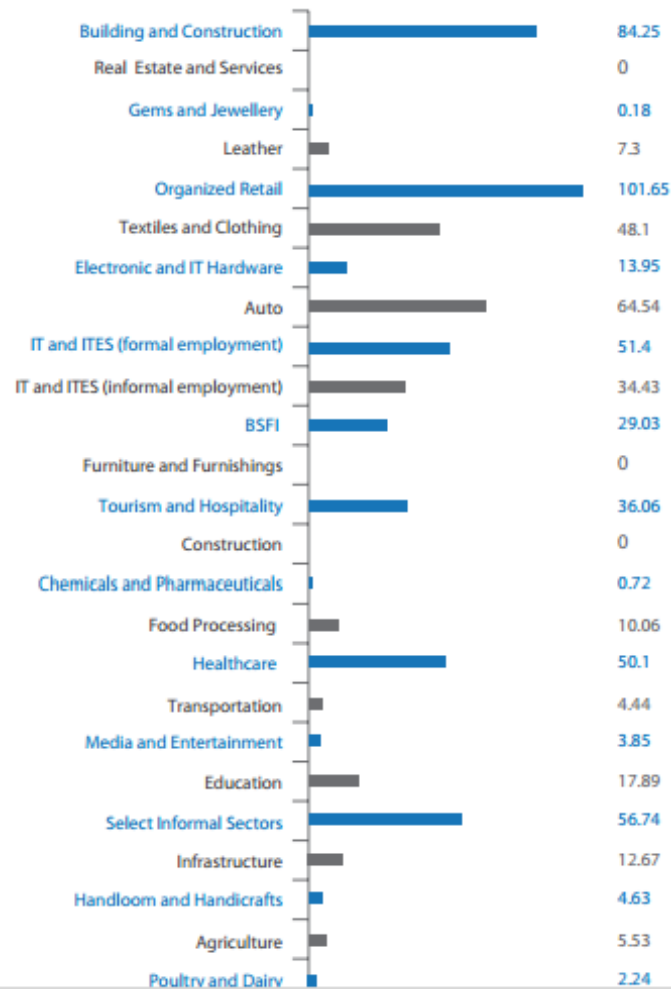
## The Need to Skill - Local & Global Skilled Manpower Shortage

**Local Need:** The 20 high-growth sectors are estimated to face a skilled manpower shortage of 347 million people over the next 10 years just to sustain industry growth.

Industry	Incremental requirement (in million)	Industry	Incremental requirement (in million)
Building and Construction Industry	33.0	Tourism and Hospitality services	3.6
Infrastructure Sector	103.02	Construction Material and Building Hardware	1.4
Real Estate Services	14.0	Chemicals and Pharmaceuticals	1.9
Gems and Jewellery	4.6	Food Processing	9.3
Leather and Leather Goods	4.6	Healthcare	12.7
Organised Retail	17.3	Transportation and Logistics	17.7
Textiles and Clothing	26.2	Media and Entertainment	3.0
Electronics and IT Hardware	3.3	Education and Skill Development Services	5.8
Auto and Auto Components	35.0	Select informal employment sectors (domestic help, beauticians, security guards etc)	37.6
IT and ITES	5.3	<b>Total Incremental</b>	<b>347</b>
BFSI	4.2		
Furniture and Furnishings	3.4		

**Global Need:** There is also a global shortage of manpower projected and there would be an opportunity for people from India to work overseas.







# Mobile skill development laboratory

- **Make Education System More Skill-Oriented, Says Former President APJ Abdul Kalam**



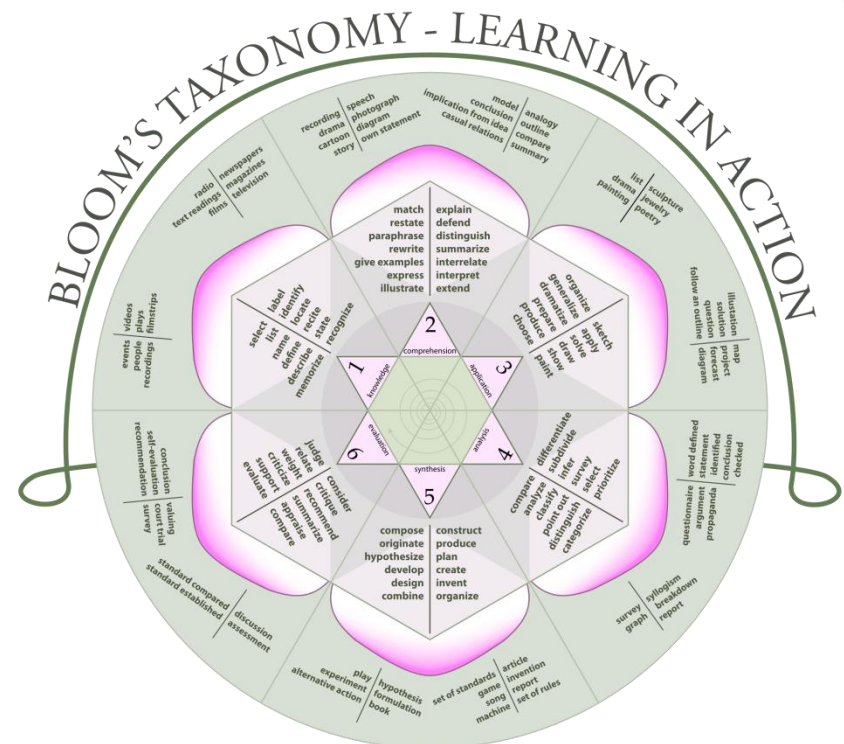
"We have approximately 9,000 schools in Delhi but all of them don't have the same resources. Therefore, I suggest that mobile skill development laboratories should be introduced for the benefit of the students.

"The mobile vans will be ICT enabled and will have the mechanical and chemical engineering set up. There will be a pre-defined schedule for the van and it will cover two schools in a day," he said.

<http://www.ndtv.com/india-news/make-education-system-more-skill-oriented-says-former-president-apj-abdul-kalam-777659>

# Instructional Design Models and Methods

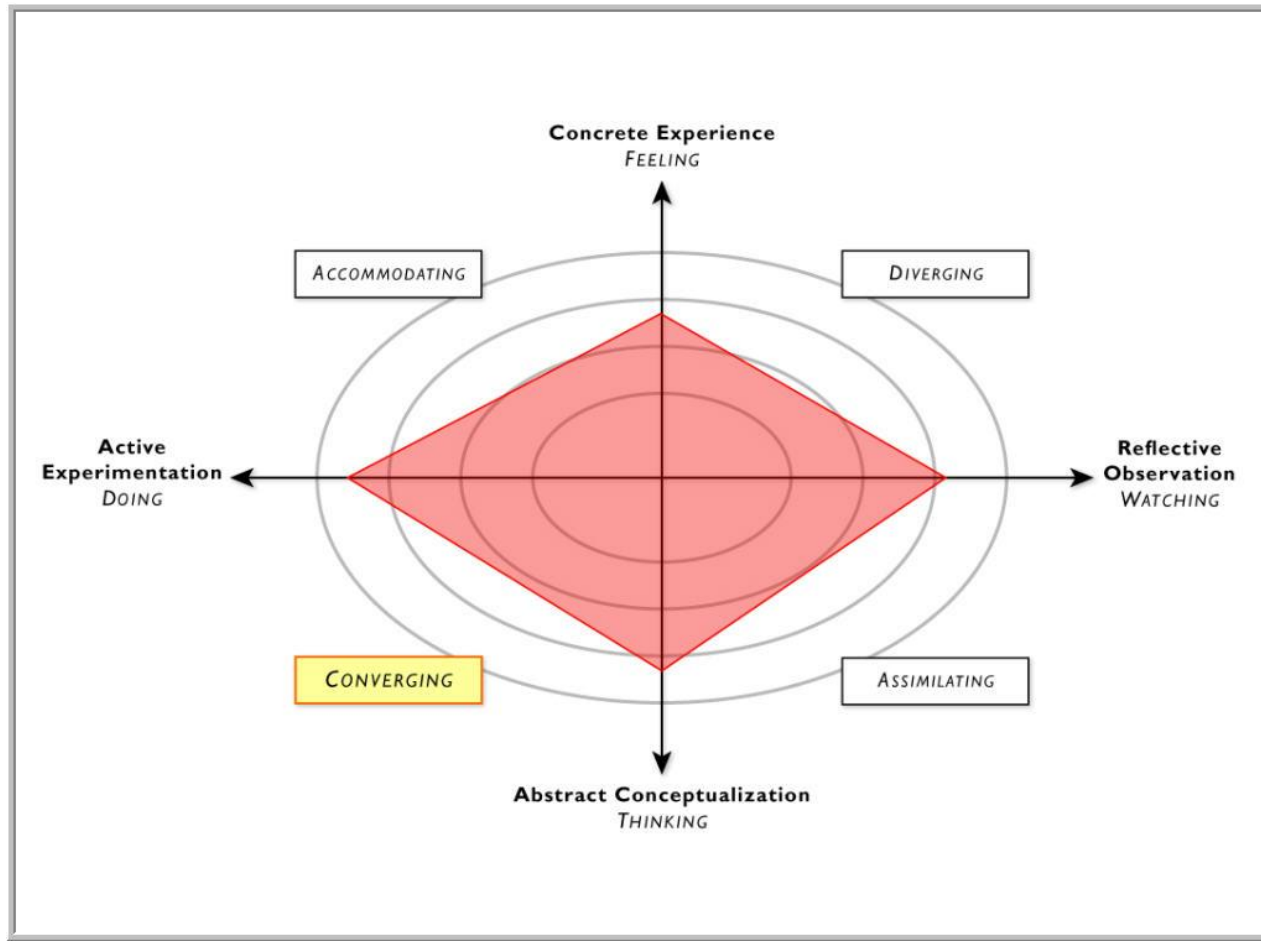
- Merrill's First Principles of Instruction
- ADDIE Model
- Dick and Carey Model
- Kemp's Instructional Design Model
- Gagné's Nine Events of Instruction
- Bloom's Learning Taxonomy
- Kirkpatrick's 4 Levels of Training Evaluation
- Cathy Moore's Action Mapping



[https://en.wikipedia.org/wiki/Bloom%27s\\_taxonomy](https://en.wikipedia.org/wiki/Bloom%27s_taxonomy)



# Learning Styles



[https://commons.wikimedia.org/wiki/File:Learning\\_Styles.jpg](https://commons.wikimedia.org/wiki/File:Learning_Styles.jpg)

# The Barometer Story



[http://swift.cmbi.ru.nl/teach/B2/LINK/NOOT\\_87.html](http://swift.cmbi.ru.nl/teach/B2/LINK/NOOT_87.html)

# Ernest Rutherford



## Ernest Rutherford

Physicist

Ernest Rutherford, 1st Baron Rutherford of Nelson, OM, FRS was a New Zealand-born British physicist who became known as the father of nuclear physics. Encyclopædia Britannica considers him to be the greatest experimentalist since Michael Faraday. [Wikipedia](#)

**Born:** August 30, 1871, [Brightwater, New Zealand](#)

**Died:** October 19, 1937, [Cambridge, United Kingdom](#)

**Notable students:** [Niels Henrik David Bohr](#), [James Chadwick](#), [more](#)

**Awards:** [Nobel Prize in Chemistry](#), [Copley Medal](#), [more](#)

**Doctoral students:** [Nazir Ahmed](#), [Norman Alexander](#), [more](#)

# Niels Henrik David Bohr



## Niels Henrik David Bohr

Physicist

Niels Henrik David Bohr was a Danish physicist who made foundational contributions to understanding atomic structure and quantum theory, for which he received the Nobel Prize in Physics in 1922. [Wikipedia](#)

**Born:** October 7, 1885, Copenhagen, Denmark

**Died:** November 18, 1962, Copenhagen, Denmark

**Influenced by:** Ernest Rutherford, Joseph John Thomson, Søren Kierkegaard, Christian Christiansen, Harald Høffding

**Awards:** Nobel Prize in Physics, Max Planck Medal, more

# Science Skills





# Nine Real NASA Technologies in 'The Martian'

The screenshot shows the NASA website interface. At the top is the NASA logo and a navigation menu with links for Topics, Missions, Galleries, NASA TV, Follow NASA, Downloads, About, and NASA Audiences. A search bar is located on the right. Below the navigation is a 'Journey to Mars' banner featuring a large image of a Mars rover and an astronaut. To the left of the main article is a 'Latest' sidebar with four news items, each with a small thumbnail image and a timestamp. The main article title is 'Nine Real NASA Technologies in 'The Martian'' with a date of 'Aug. 19, 2015'. Below the title are social media sharing icons for Facebook, Twitter, Google+, Pinterest, and a plus sign. The beginning of the article text is visible, starting with 'Mars has held a central place in human imagination and culture for millennia.'

**Latest**

- NASA Completes Successful Heat Shield Testing for Future... *3 hours ago*
- Top 10 Ways ISS Is Helping Get Us To Mars *21 days ago*
- Forest-Mapping Instrument for Space Station Passes Major... *21 days ago*
- NASA is Laser-focused on Deep Space Communication *a month ago*
- NASA Fluid Shifts Study Advances Journey to Mars *3 months ago*

**Related**

**Journey to Mars**

Aug. 19, 2015

## Nine Real NASA Technologies in 'The Martian'

Mars has held a central place in human imagination and culture for millennia. Ancients marveled at its red color and the brightness that waxed and waned in cycles over the years. Early observations through telescopes led some to speculate that the planet was covered with canals that its inhabitants used for

[f](#) [t](#) [G+](#) [p](#) [+](#)

<http://www.nasa.gov/feature/nine-real-nasa-technologies-in-the-martian>

# Habitat

The screenshot shows a web browser window displaying a NASA article. The browser's address bar shows the URL [www.nasa.gov/feature/nine-real-nasa-technologies-in-the-martian](http://www.nasa.gov/feature/nine-real-nasa-technologies-in-the-martian). The page header includes the NASA logo and navigation links: Topics, Missions, Galleries, NASA TV, Follow NASA, Downloads, About, and NASA Audiences. A search bar is located on the right side of the header.

The main content area features a large heading "Habitat" and a sub-heading "In the future, NASA is already developing many of the technologies that appear in the film." Below this, the text reads: "On the surface of Mars, Watney spends a significant amount of time in the habitation module -- the Hab -- his home away from home. Future astronauts who land on Mars will need such a home to avoid spending their Martian sols lying on the dust in a spacesuit." A link is provided: "At NASA Johnson Space Center, crews train for long-duration deep space missions in the [Human Exploration Research Analog \(HERA\)](#)."

The article includes two images: a 3D rendering of a Martian landscape with a bright light source and a person in a dark uniform working inside a complex, metallic habitat structure.

The left sidebar contains a "Latest" section with several article teasers:

- NASA Completes Successful Heat Shield Testing for Future... *3 hours ago*
- Top 10 Ways ISS is Helping Get Us To Mars *21 days ago*
- Forest-Mapping Instrument for Space Station Passes Major... *21 days ago*
- NASA is Laser-focused on Deep Space Communication *a month ago*
- NASA Fluid Shifts Study Advances Journey to Mars *3 months ago*
- NASA Robotic Servicing Demonstrations *Continues Suborbital...*

The Windows taskbar at the bottom shows the system clock at 23:54 on 06-10-2015 and various application icons.



# Plant Farm

The screenshot shows the NASA website interface. At the top left is the NASA logo. A navigation bar contains the following links: Topics, Missions, Galleries, NASA TV, Follow NASA, Downloads, About, and NASA Audiences. A search bar is located on the right side of the navigation bar. Below the navigation bar, there are two columns: 'Latest' and 'Related'. The 'Latest' column contains a list of news items with small thumbnail images. The 'Related' column contains a list of news items with small thumbnail images. The main content area features the article 'Plant Farm'. The article title is 'Plant Farm'. The article text reads: 'Today, astronauts on the International Space Station have an abundance of food delivered to them by cargo resupply vehicles, including some from commercial industries. On Mars, humans would not be able to rely on resupply missions from Earth – even with express delivery they would take at least nine months. For humans to survive on Mars, they will need a continuous source of food. They will need to grow crops.' Below the text are two images: the left image shows a man in a blue shirt crouching in a large, white, dome-shaped structure filled with green plants; the right image shows a person wearing blue gloves handling a tray of red leafy plants in a laboratory or space station setting.

**Latest**

- NASA Completes Successful Heat Shield Testing for Future... *3 hours ago*
- Top 10 Ways ISS Is Helping Get Us To Mars *21 days ago*
- Forest-Mapping Instrument for Space Station Passes Major... *21 days ago*
- NASA is Laser-focused on Deep Space Communication *a month ago*
- NASA Fluid Shifts Study Advances Journey to Mars *3 months ago*
- NASA Robotic Servicing Demonstrations Continue Onboard the...

**Related**


## Plant Farm


Today, astronauts on the International Space Station have an abundance of food delivered to them by cargo resupply vehicles, including some from [commercial industries](#). On Mars, humans would not be able to rely on resupply missions from Earth – even with express delivery they would take at least nine months. For humans to survive on Mars, they will need a continuous source of food. They will need to grow crops.


# Water Recovery


The screenshot shows the NASA website's navigation bar with links for Topics, Missions, Galleries, NASA TV, Follow NASA, Downloads, About, and NASA Audiences. A search bar is located on the right. The main content area features a 'Latest' sidebar with five articles and a main article titled 'Water Recovery'. The sidebar articles include: 'NASA Completes Successful Heat Shield Testing for Future...' (3 hours ago), 'Top 10 Ways ISS is Helping Get Us To Mars' (21 days ago), 'Forest-Mapping Instrument for Space Station Passes Major...' (21 days ago), 'NASA is Laser-focused on Deep Space Communication' (a month ago), and 'NASA Fluid Shifts Study Advances Journey to Mars' (3 months ago). The main article, 'Water Recovery', discusses the challenges of water supply on Mars and the capabilities of the Water Recovery System (WRS) on the International Space Station. It includes a quote about the #SpaceVine project and a link to a related article.


**Latest**      **Related**


 NASA Completes Successful Heat Shield Testing for Future...  
3 hours ago

 Top 10 Ways ISS is Helping Get Us To Mars  
21 days ago

 Forest-Mapping Instrument for Space Station Passes Major...  
21 days ago

 NASA is Laser-focused on Deep Space Communication  
a month ago

 NASA Fluid Shifts Study Advances Journey to Mars  
3 months ago

 NASA Robotic Servicing Demonstrations

**Water Recovery**

There are no lakes, river or oceans on the surface of Mars, and sending water from Earth would take more than nine months. Astronauts on Mars must be able to create their own water supply. The Ares 3 crew does not waste a drop on Mars with their water reclaimer, and Watney needs to use his ingenuity to come up with some peculiar ways to stay hydrated and ensure his survival on the Red Planet.

On the International Space Station, no drop of sweat, tears, or even urine goes to waste. The Environmental Control and Life Support System recovers and recycles water from everywhere: urine, hand washing, oral hygiene, and other sources. Through the Water Recovery System (WRS), water is reclaimed and filtered, ready for consumption. One astronaut simply put it, "Yesterday's coffee turns into tomorrow's coffee."

Liquid presents some [tricky problems](#) in space. The WRS and related systems have to account for the fact that liquids behave very differently in a microgravity environment. The part of the WRS that processes urine must use a centrifuge for distillation, since gases and liquids do not separate like they do on Earth.

NASA is continuing to develop new technologies for water recovery. Research is being conducted to advance the disposable multifiltration beds (the filters that remove inorganic and non-volatile organic contaminants) to be a more permanent component to the system. Brine water recovery would reclaim every drop of the water from the "bottoms product" leftover from urine distillation. For future human-exploration missions, crews would be less dependent on any resupply of spare parts or extra water from Earth.

*#SpaceVine - Turns out a sphere of floating water makes the ultimate fisheye lens <https://t.co/uobc1ue8RB>*

# Mars Spacesuit

The screenshot shows a NASA website page with a dark navigation bar at the top containing the NASA logo and links for Topics, Missions, Galleries, NASA TV, Follow NASA, Downloads, About, and NASA Audiences. A search bar is on the right. The main content area features a sub-header: "NASA is working to recover even more oxygen from byproducts in the atmosphere to prepare for the journey to Mars." Below this is the article title "Mars Spacesuit" and a short introductory paragraph: "The Martian surface is not very welcoming for humans. The atmosphere is cold and there is barely any breathable air. An astronaut exploring the surface must wear a spacesuit to survive outside of a habitat while collecting samples and maintaining systems." The main image is a composite: on the left, a close-up of a man's face in profile, looking thoughtful with his hand to his chin; on the right, a full-body image of a person in a grey and blue spacesuit standing on a rocky surface under a blue sky. A sidebar on the left lists "Latest" and "Related" articles with small thumbnail images and titles.

**Latest**

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- Top 10 Ways ISS Is Helping Get Us To Mars *21 days ago*
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- NASA is Laser-focused on Deep Space Communication *a month ago*
- NASA Fluid Shifts Study Advances Journey to Mars *3 months ago*
- NASA Robotic Servicing Demonstrations

**Related**

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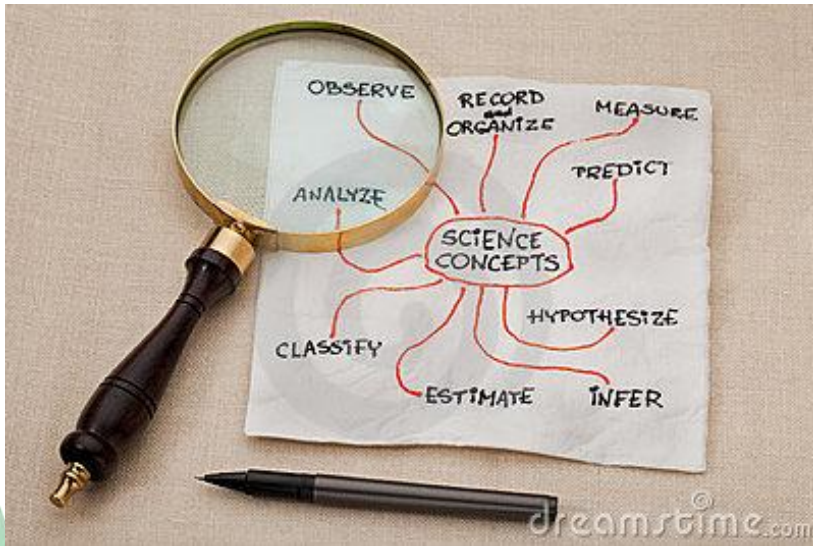
## Mars Spacesuit

The Martian surface is not very welcoming for humans. The atmosphere is cold and there is barely any breathable air. An astronaut exploring the surface must wear a spacesuit to survive outside of a habitat while collecting samples and maintaining systems.

**C·O·L**



# Science concepts



- 3 major elements
  - Attitudes
  - Processes and Methods
  - Products

[http://sherwintieonscienceportfolio.blogspot.in/2013\\_03\\_01\\_archive.html](http://sherwintieonscienceportfolio.blogspot.in/2013_03_01_archive.html)

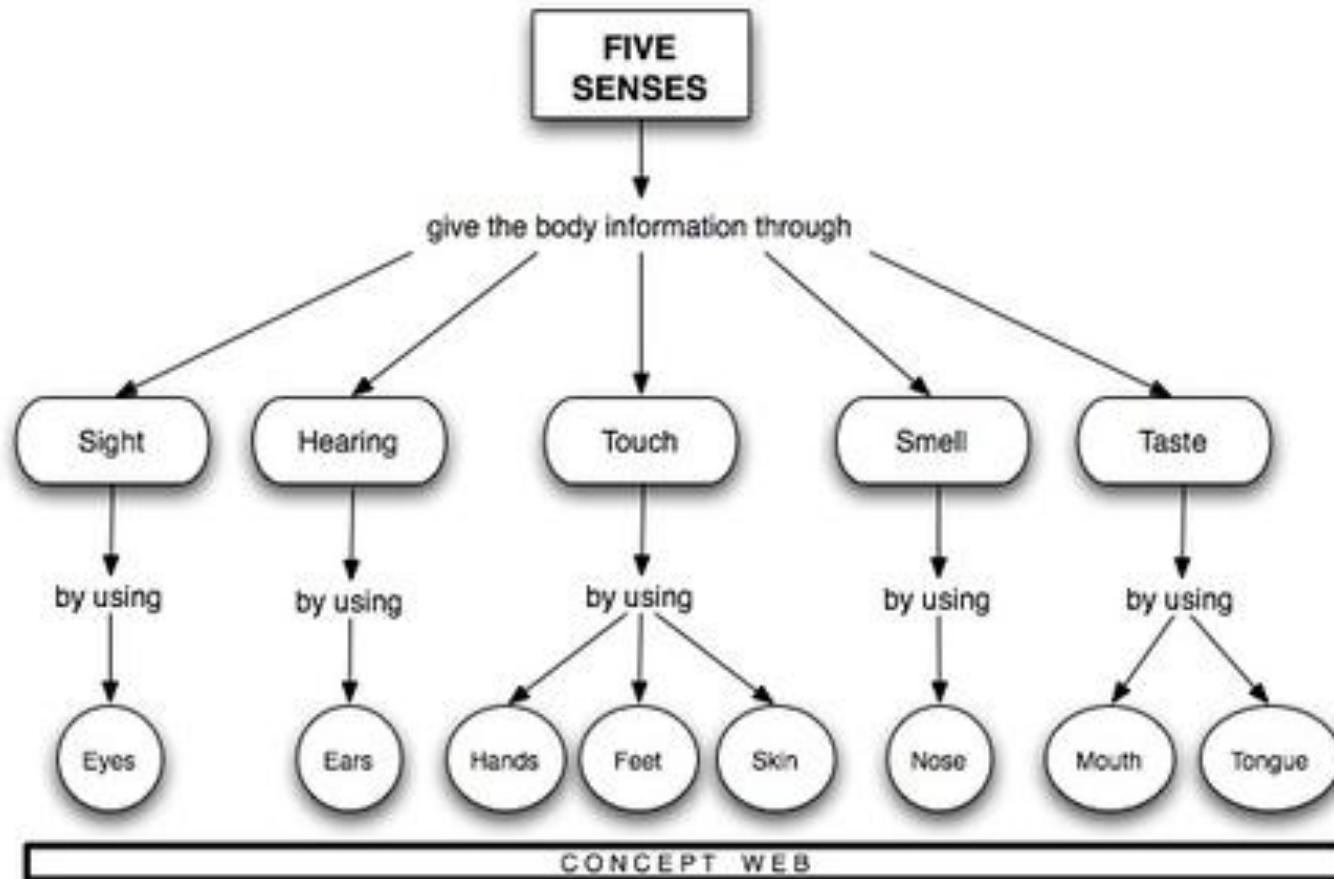
# Attitude

- willingness to modify their own views in the face of new evidence.
- respect for ideas of others.
- disposition not to jump to conclusions.
- scepticism for generalisations not based on verifiable (repeatable) observations.
- objectivity by seeking data and information to validate observations or explanations.
- interest and enjoyment in studying the marvels of nature.



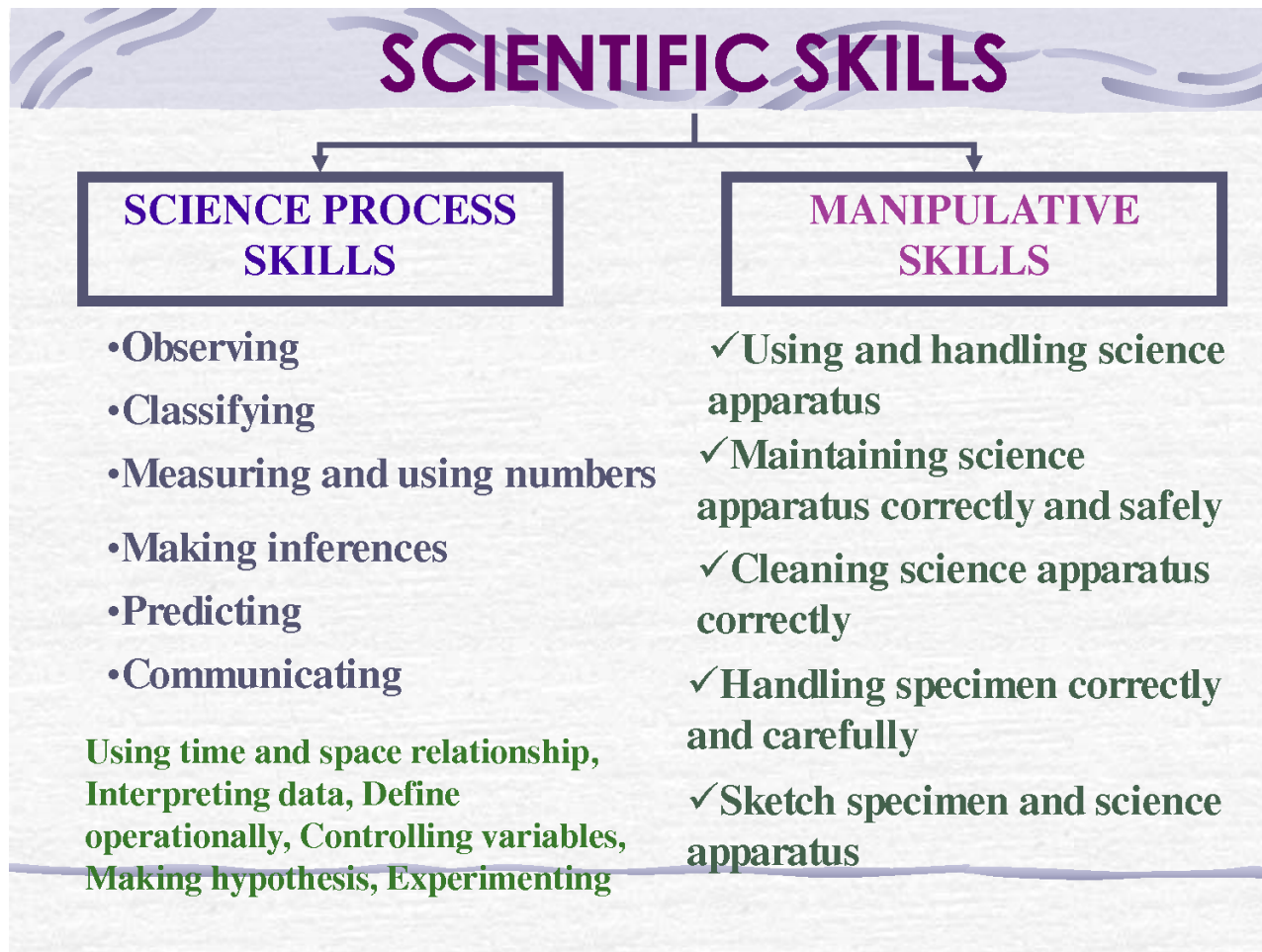
[http://sherwintieonscienceportfolio.blogspot.in/2013\\_03\\_01\\_archive.html](http://sherwintieonscienceportfolio.blogspot.in/2013_03_01_archive.html)

# Observing skills - process



<http://elsaghirscience.weebly.com/observing.html>

# Scientific Skills



[http://sherwintieonscienceportfolio.blogspot.in/2013\\_03\\_01\\_archive.html](http://sherwintieonscienceportfolio.blogspot.in/2013_03_01_archive.html)



# Products of Science



<https://www.e-education.psu.edu/geosc10/node/1708>

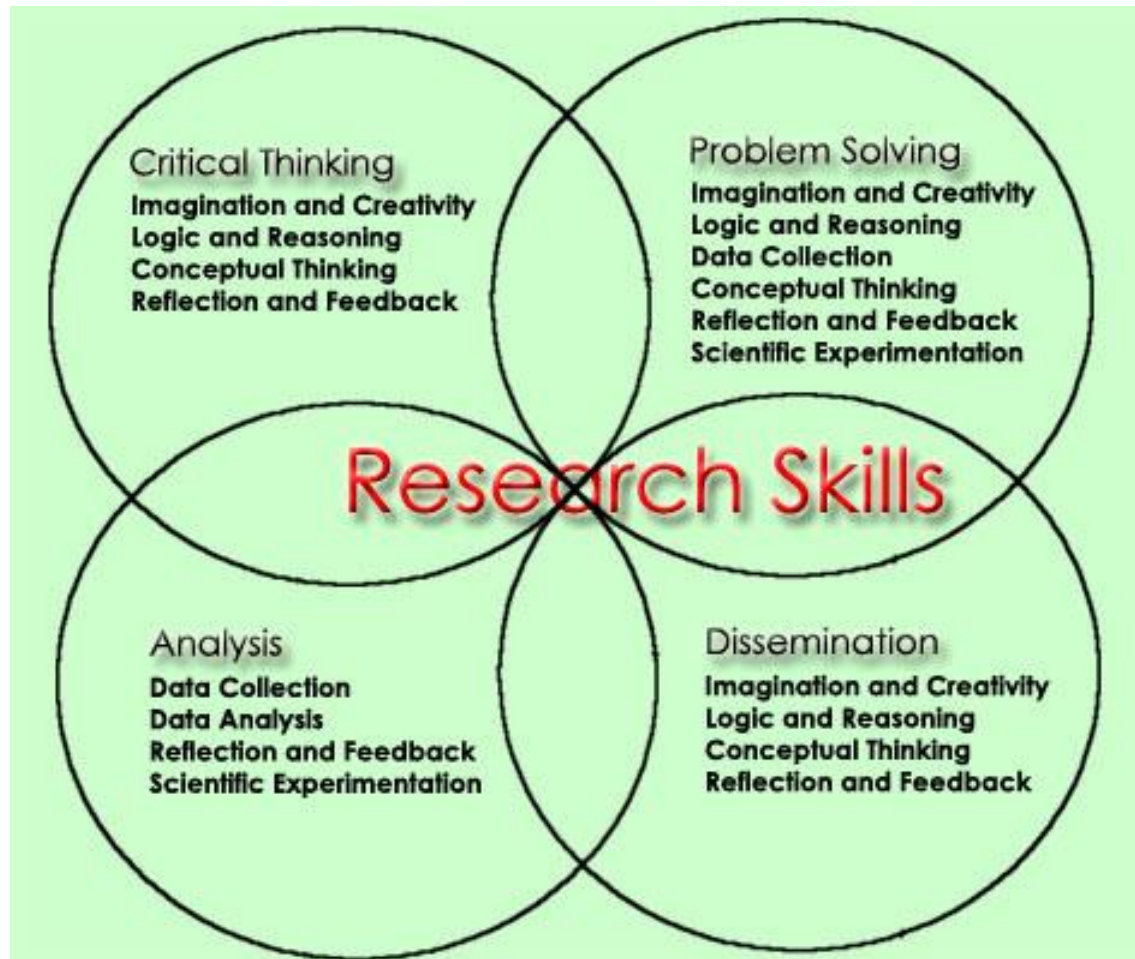


<http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20120412000044&cid=1204>



<http://beforeitsnews.com/science-and-technology/2013/01/blu-products-vivo-4-65-affordable-dual-sim-android-smartphone-2527314.html>

# Research Skills



<http://science.uniserve.edu.au/projects/skills/jantrial/research.htm>

# Future Work Skills 2020

## Future Work Skills 2020

While all six drivers are important in shaping the landscape in which each skill emerges, the color-coding and placement here indicate which drivers have particular relevance to the development of each of the skills.

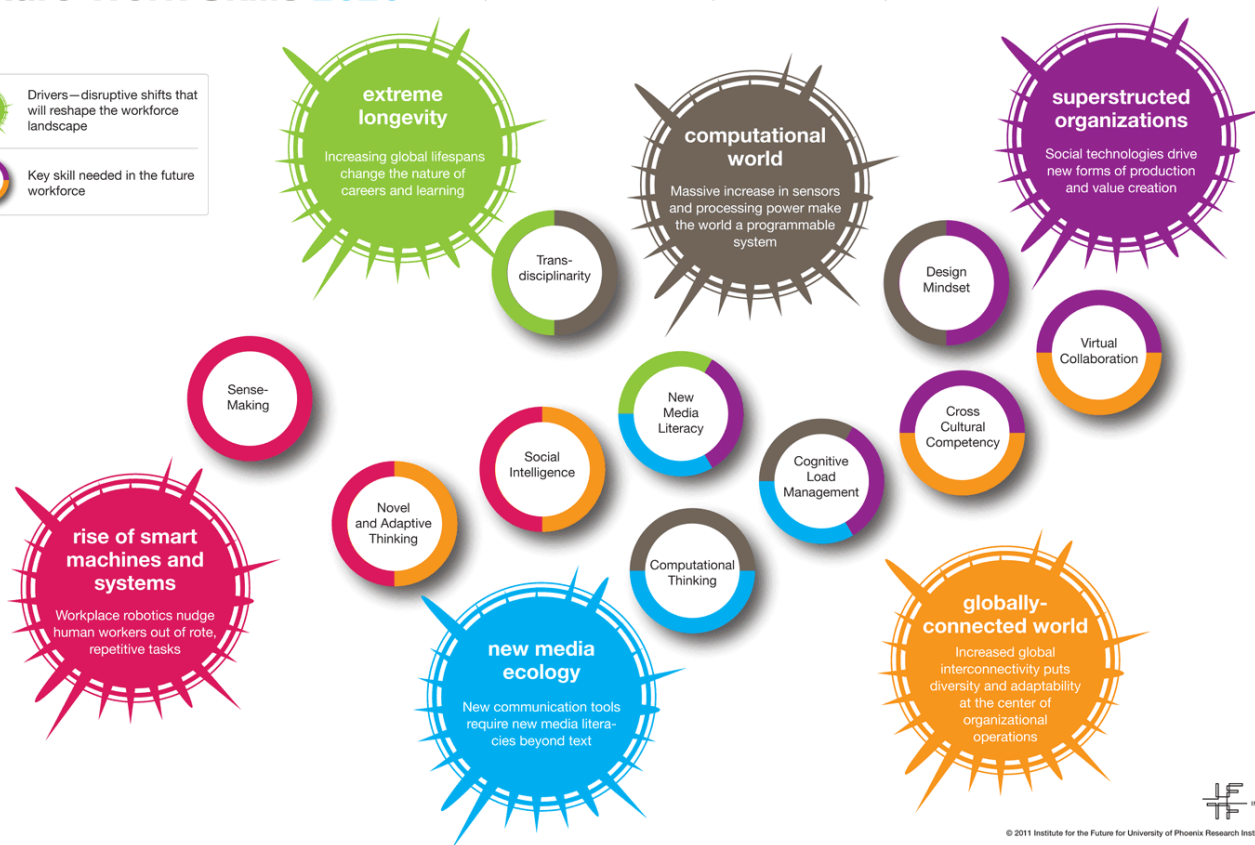
### KEY



Drivers—disruptive shifts that will reshape the workforce landscape



Key skill needed in the future workforce



# Sense Making



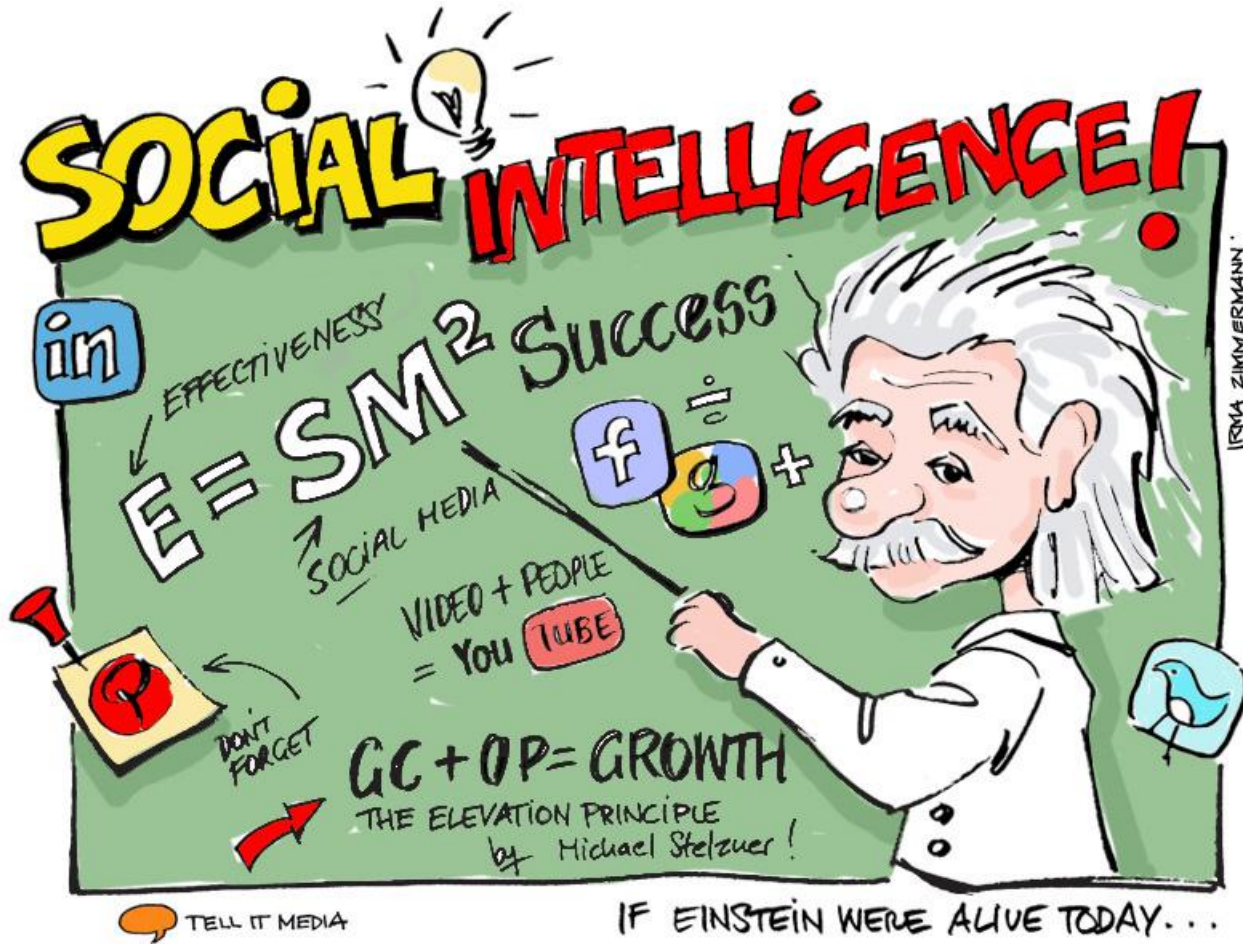
<http://stanford.edu/~cpiech/cs221/apps/deepBlue.html>



<http://socialmediab2b.com/2011/02/greatest-b2b-campaign-ever-ibm-watson-jeopardy/>



# Social Intelligence



<http://mysocialintelligence.com/blog/social-media-in-business-a-graphic-designer-case-study/>

# Novel and adaptive thinking



<https://www.tempocreative.com/adaptive-content-means-a-new-way-of-thinking-about-your-user-interactions/>



# Cross cultural competence

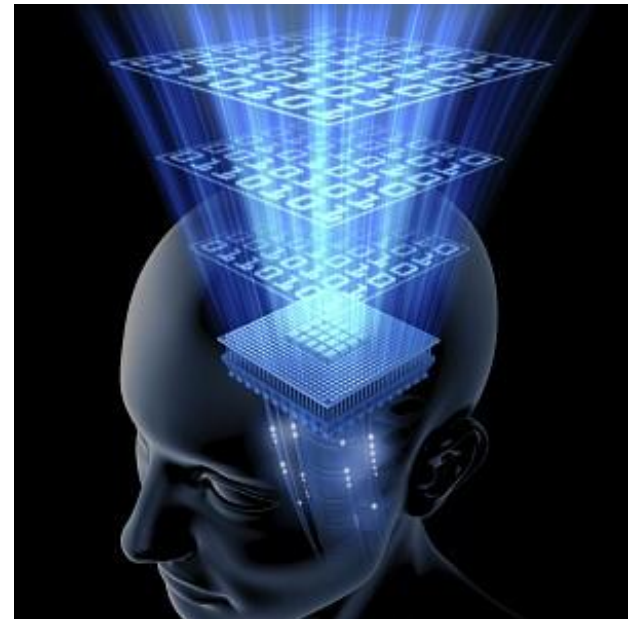


[http://www.newahec.org/Cultural\\_Competency.html](http://www.newahec.org/Cultural_Competency.html)

# Computational Thinking



Barefoot would like to acknowledge the work of Julia Briggs and the eLIM team at Somerset County Council for their contribution to this poster.



<http://barefootcas.org.uk/barefoot-primary-computing-resources/concepts/computational-thinking/>

<https://computationalthinkingk12.wordpress.com/2014/05/07/introducing-computational-thinking-into-your-school/>

# New Media Literacy



<http://www.newmediarights.org/node/13936>

# Transdisciplinarity



<http://www.discovery.edu.hk/curriculum/primary-years-programme/transdisciplinary-teaching-learning/>



# Design Mindset



<http://www.foxmovies.com/movies/the-martian>

# Cognitive Load Management



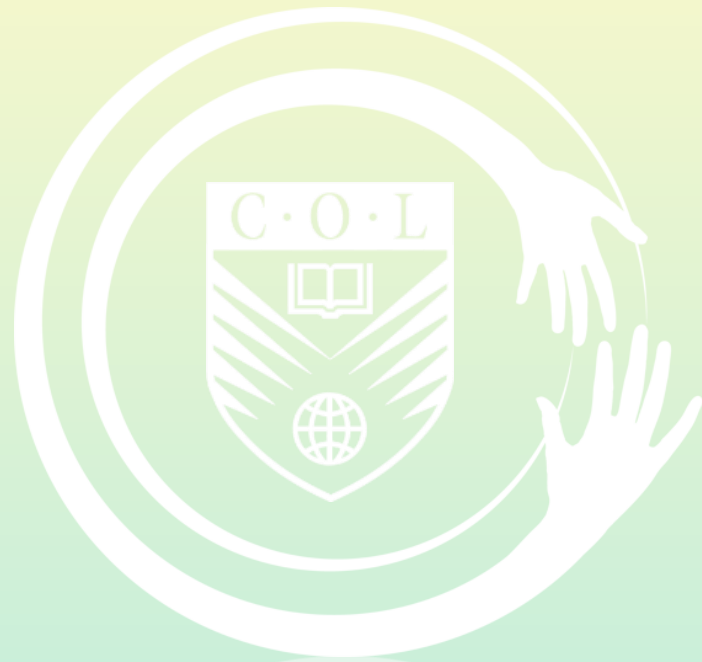
<http://www.open.ac.uk/libraryservices/beingdigital/objects/63/index.htm>



# Virtual Collaboration



<http://betanews.com/2015/09/30/social-intranet-allows-anytime-anywhere-workplace-collaboration/>



**THANK YOU**

