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Philosophy

- Philosophy comprises of
 - Logic (reasoning)
 - Epistemology (nature and scope of knowledge)
 - Metaphysics (study of reality)
 - Aesthetics (sensory-emotional values)
 - Morals and ethics (the best way to live)

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Philosophy

- Philosophy as a method
 - Questioning
 - Critical evaluation
 - Systematic approach
 - Rational argument

3

CREATE

- **C**onsider
- **R**ead (literature)
- **E**lucidate hypotheses
- **A**nalyze and interpret data
- **T**hink of the next **E**xperiment strategy

A. J. Gottesman and S. G. Hoskins, CBE Life Sci Educ vol. 12, 59-72, 2013

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How to create

Modified Bloom's Taxonomy

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Period of Science, technology and industrialisation

- Industrial revolution started around 1860
 - Emergence of science, development of efficient technology
 - Initiated hostile relationship with environment
 - Birth of technological man
 - Indiscriminate exploitation of natural resources led to present ecological problems

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Major technological inventions

Famous inventors honoured by UK



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Major technological inventions

Famous inventors of 18th - 19th Century

Person	Invention	Date
James Watt	First reliable Steam Engine	1775
Eli Whitney	Cotton Gin, Interchangeable parts for muskets	1793, 1798
Robert Fulton	Regular Steamboat service on the Hudson River	1807
Samuel F. B. Morse	Telegraph	1836
Elias Howe	Sewing Machine	1844
Isaac Singer	Improves and markets Howe's Sewing Machine	1851
Alexander Graham Bell	Telephone	1876
Thomas Edison	Phonograph, Incandescent Light Bulb	1877, 1879
Nikola Tesla	Induction Electric Motor	1888
Rudolf Diesel	Diesel Engine	1892
Orville and Wilbur Wright	First Airplane	1903
Henry Ford	Model T Ford, Assembly Line	1908, 1913

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Creators

• A. Graham Bell



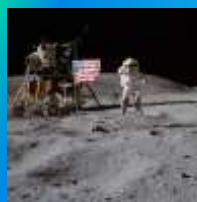
• Wright brothers



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Milestones

• Landing on moon



• Polio vaccine



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Creator

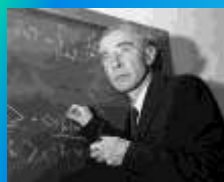
- When asked who owned the patent to polio vaccine, Salk said, "***There is no patent. Could you patent the sun?***"
- How Much Money Did Jonas Salk Potentially Forfeit By Not Patenting The Polio Vaccine?" (\$6 B)



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Creators

• Robert Oppenheimer
– "Father of Atomic bomb"



• Alfred Nobel
• Inventor of Dynamite



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Self realization



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The merchant of death is dead

- When Nobel's brother died, a French magazine wrongly reported that as Alfred Nobel's death. "*Le marchand de la mort est mort*," or "**the merchant of death is dead**." The obituary went on to describe Nobel as a man "who became rich by finding ways to kill more people faster than ever before."

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Self realisation

- Nobel Prize



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Antonie van Leeuwenhoek

- The Discovery of the Leeuwenhoek Lens



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Antonie van Leeuwenhoek

- “...my work, which I’ve done for a long time, was not pursued in order to gain the praise I now enjoy, but chiefly from a **craving after knowledge**, which I notice resides in me more than in most other men. And therewithal, whenever I found out anything remarkable, I have thought **it my duty to put down my discovery on paper**, so that all ingenious people might be **informed** thereof.”

(Father of microbiology)

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Creative

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Candle problem



A candle, a book of matches, and a box of thumbtacks. Using these items, the goal was to position the candle in a way that, while lit, no wax would touch the ground.

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Candle problem



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What is special about your brain?

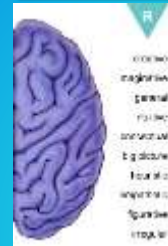
- On the left side, there is nothing right



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What is special about your brain?

- On the right side, there is nothing left



22

What is special about your brain?

- On the left side, there is nothing right
- On the right side, there is nothing left



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Read the colour of the text

RED
ORANGE
BLUE
PURPLE
GREEN

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Ambidextrous



25

How to find a needle in a haystack?



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Creative questions

- Society needs creative scientists for continued innovation.
- Can creativity be taught?
- If so, does the process for teaching scientific creativity differ from artistic creativity?

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Preparation

Incubation

Illumination

Verification

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Preparation

- The preparation comprises of
 - investigation in all directions
 - construction of the new ideas
 - research and planning
- The preparation occurs in fully conscious stage (right frame of mind and attention)

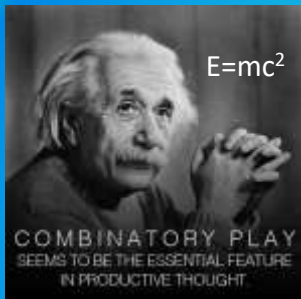
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Incubation

- Combinatory play
 - Two or more ideas combined effectively
 - Result is creative thinking
- By bringing together what we know and what we don't know through analogy, metaphorical thinking strikes the spark that ignites discovery.

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Combinatory play



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Incubation

- “Negative Fact” – During incubation, no conscious deliberation of a problem
- “Positive Fact” – Series of unconscious, involuntary mental events

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Illumination

- “Sudden Illumination” (Henri Poincaré) – Flash of insight that cannot be controlled by conscious self.
- Creating connections between the seemingly unconnected are the true secret of genius.



Poincaré



Steve Jobs

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True secret of genius

- Connecting the dots
- Steve Jobs drops out of regular college, joins Calligraphy (Reeds College)
- 10 years down the lane he creates Mac using serif and sans serif type faces. (Rest is History)

You can't connect the dots looking forward; you can only connect them looking backward.

-Steve Jobs

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Verification

- Conscious and deliberate effort
- Testing the validity of the idea
- Reducing the idea to an exact form

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5 ways to spark creativity

- When you are focused on a goal, a seemingly mindless task might help spur creative thoughts.



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5 ways to spark creativity

- Red means danger. It makes us anxious, and anxiety causes you to focus.
- Blue connotes peace and tranquility. It tells us we can relax and let the imagination roam free.



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Market (Red Vs Blue)

RED oceans

Known market space
Many competitors
Fight for market share

Cutthroat competition
turns the ocean bloody

BLUE oceans

Unknown market space
Few competitors
Create market share

New market makes
competition irrelevant

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5 ways to spark creativity

- Live abroad : Adapting to a new culture may spur some sort of psychological transformation that enhances creativity



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5 ways to spark creativity

- Relax: Anxiety focuses a person, but good cheer and contentment liberate creativity.



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5 ways to spark creativity

- Sleep helps generate new ideas in several ways. During sleep, the brain consolidates memories, the act of consolidation.



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Sleep inspires insight

- Insight denotes a **mental restructuring** that leads to a sudden gain of explicit knowledge.
- Sleep, by restructuring new memory representations, facilitates extraction of explicit knowledge and insightful behaviour.

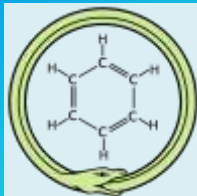


Nature 427, 352-355 (22 January 2004) | doi:10.1038/nature02223

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Sleepy discoveries

- Like a snake biting its tail, the circular chain of carbon atoms danced through the dreaming mind of August Kekulé.

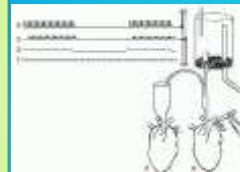


Nature 408, 523 (30 November 2000) | doi:10.1038/35046170

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Sleepy discoveries

- Nobel prize winner Loewi (1936, Physiology) reported that he woke up with the essential idea for an experimental confirmation of his theory of chemical neurotransmission.



Nature 408, 523 (30 November 2000) | doi:10.1038/35046170

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Sleepy discoveries

- Loewi proved that the nerves **do not influence the heart directly** but liberate from their terminals specific **chemical substances (acetyl choline)** which, in their turn, cause the well-known modifications of the function of the heart characteristic of the stimulation of its nerve.

Nature 408, 523 (30 November 2000) | doi:10.1038/35046170

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Sleepy discoveries

- Mendeleyev, reported that his understanding of the critical rule underlying it emerged out of a dream following unsuccessful puzzling with the symbols of the elements. (chemical properties and atomic weights)



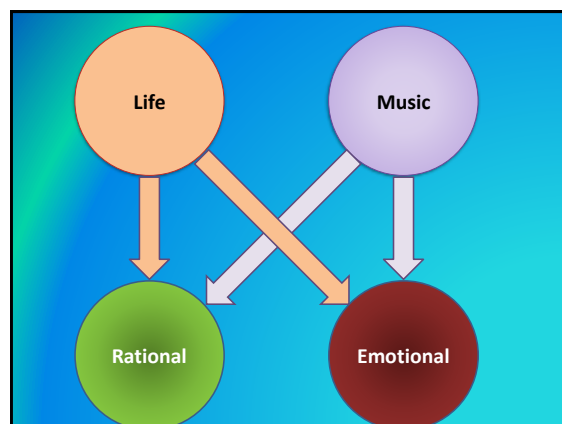
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To be a successful researcher

- Boost up your knowledge
- Do not jump in to conclusion
- Have imagination
- Identify patterns

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Improvisation

- The brain deactivates the area involved in self-censoring, while cranking up the region linked with self-expression.
- Essentially, a musician shuts down his inhibitions and lets his inner voice shine through.



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Music

- Guitar strings, drum heads, even the human voice box, they all generate sound at defined, periodic frequencies.
- When you hear all those sounds intertwined in music, it is truly an emotional experience.



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Seven Blunders of the World

1. Wealth without work.
2. Pleasure without conscience.
3. **Knowledge** without **character**.
4. Commerce without morality.
5. **Science** without **humanity**.
6. Worship without sacrifice.
7. Politics without principle.

M. K. Gandhi

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Sharpen your tools



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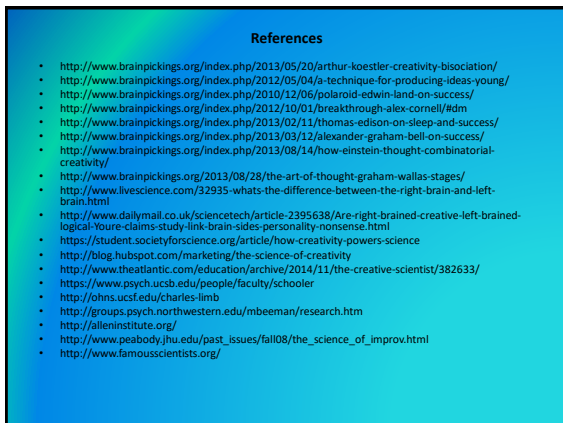
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