40 Inventive Principles and Biological Models

Ali Reza Mansoorian Email :mansoorian211@yahoo.com
Department of Creativity and Innovation , Faculty of ICT, Malek Ashtar University

Fatemeh Heidaryan Naini Email :a_heidaryan@yahoo.com
Research Center for Creatology , Innovation & TRIZ

The Father of TRIZ Science , Genrich Altshuller , by analysis of engineering and utility patents in the former USSR , discovered forty patterns of Inventive Solutions that are known as the 40 Inventive Principles . As such, the 40 Principles of TRIZ were constructed to tackle engineering problems. Much work has been done attempting to extend the use of the principles into non-engineering situations, such as agriculture, business, management, marketing, social relations, and biology. On the other hand, there are many parallels between engineering (technical) and nature. The way in which natural systems operate and evolve has much to teach us about the design and operation of engineering systems. The successful transfer of ideas between the two fields demands the application of abstraction and analogy that could inspire the biological model for improvement of Inventive Principles of TRIZ. However there has been less work in TRIZ integrated with biology. This paper introduced biological models of the 40 principles of TRIZ.

Biological Models of the 40 principles of TRIZ

	Principle	Models
1	Segmentation Divide into smaller parts	Segmentation in Bacteria , Ameba and other animals .
2	Extraction Taking Out	Absorbing necessary materials of land by root of plants , Absorbing necessary materials of blood by Intestine .
3	Local Quality Different parts of an object carry out different function. Change an object or system structure from uniform to non-uniform.	Especial Functions of any part of different plant and animal organs or tissues .
4	Asymmetry Change the shape of an object, system or event from symmetrical to asymmetrical form Increase the degree of asymmetry	Fundamental of Polarity and differentia in life were asymmetry that cause morphogenesis . Example : polarity in zygote .
5	Combination Consolidation , Merging	Combination of two sex cell in life and create zygote .
6	Universality Make an object or system	Diversity Functions in animals and plant : respiration, metabolism and …

	perform multiple functions Use an object to perform several function	
7	Nesting Place on object inside another Putting one thing inside another	Pregnancy Offspring in animals and plants that cause create on zygote inside animals and plant .
8	Anti-Weight Counterweight Compensate for weight of an object or system	Steel of stand up and walking in animals that off-setting weight of body . Interaction of bone and muscle .
9	Prior Counteraction Preliminary anti-action If it will be necessary to do an action with both harmful and useful effects , this action should be replaced with anti-actions to control harmful effects . Take action to prevent or reduce harmful effect .	Status of buffer in blood of humans and animals . Closing of stomata in plants versus dry stress . Regulation of hormones versus stress in plants and animals .
10	Preliminary Action Prior action . Perform , before it is needed . the required change of an object or event . Take action beforehand to ease an event .	Storage lipid and carbohydrate in animals and plants for future . Increase Saliva for best digestion . Extension of leaf in plants for absorb light .
11	Cushion in Advance Beforehand Cushioning Prepare for things which may fail or go wrong Prepare emergency means	Put Plasmodesmata in cell wall of plant endoderm for material transmission . Put health valves for prevent bake of blood flow .
12	Equipotentiality Avoid lifting or lowering an object In a potential filed , limit position changes	Proportionate root morphology with water of land and plant sort . Bird bone pitted for glide and easy fly .
13	Inversion The other way round	Glyceogenesis that Inversion with Glycolise . Catabolism and Anabolism
14	Spheroidality Replace linear with a curve or a sphere Instead of using rectilinear parts , surfaces , or form , use curvilinear ones	Goblets of Lipid Materials of Endoplasmic Reticulum and Golgy .
15	Dynamicity Create systems which are able to cope with change and intrusions from outside-separating parts, flexible connections etc. Design the characteristics of an object, external environment, or process to change to be optimal or to find an optimal operating condition.	Dynamicity in more organs of plants versus outside effect (phototropism) . Dynamicity in more organs of animals for motion . Syclosis .

16	Partial or Excessive Action Achieve more or less of the desired effect .	Recombination in Transcription and Translation of DAN . Adding HCL for Digestion .
17	Another Dimension Move an object or system in two or three dimensional space Go upward , sideway, around corners .	Another Dimension in leaf of plants(for increasing of resistance versus stresses) and animals (duration of risk)
18	Mechanical Vibration Cause an object or system to oscillate or vibrate . Increase frequency . Shaking – Vibrating .	Mechanical Vibration of Tentacles of Insects . Vibration and move Tongue in Amphibian . Vibration in different organs of animals for Equilibrium Retain .
19	Periodic Action Instead of continuous action, use periodic or pulsating actions .	Periodic Action of yearly growth in different seasons . Periodic Action of stomata in plants . Periodic Action of engender organs of humans and animals .
20	Continuity of Useful Action Carry out actions without a break Carry on work continuously	Crabs cycles in animals and plants . Photosynthesis and Respiration cycles . Sleep and Awaken in animals .
21	Skipping Rushing Through Conduct a process or certain stage at high speed . Do thing at high speed to reduce time for problems to occur .	Skipping in neuron systems of animals for transition of message . Skipping in secretion of hormones .
22	Convert Harm into Benefit Use harmful factors to achieve a positive effect.	Resuction of extra water by colon for necessary situations . Utilization of productive Antibody for further malady .
23	Feedback Introduce feedback to improve a process or action .	Positive and Negative Feedback with increasing and decreasing of productivity in metabolism cycles .
24	Intermediary Mediator Use an intermediary object to transfer or carry out an action .	Enzymes in life Reaction . Pigments in plants (chlorophyll C and B) for light absorbing .
25	Self Service /Self Organization Can your device do things for itself . Use waste resources, energy or substances .	Plants that too production and too utilization . Relief and Amend of tissues in plants and animals
26	Copying Use of a simple , cheap copy	Building diversity of RNA and Proteins with modeling of DNA .
27	Cheap Short – Living Objects Inexpensive short life Replace expensive object with a cheap one .	Utilization of Raw and mineral materials for organic material and energy by plants .
28	Replacement of a Mechanical System	Replacement of a Mechanical System with Cartilage by animals.

	Replace a mechanical system with a field	
29	Use of Pneumatic or Hydraulic Systems Use gas and liquid parts of an object or system instead of solid parts .	Common and water stomata . Water Absorbing for increasing of stability by vacuoles in plants . Preservation of zygote in water sac in Germinal Rotation .
30	Flexible Films or Thin Membranes Use flexible shells and thin films instead of three – dimensional structures .	Cell Membranes . Membrane of intercellular Organelles . Membranceous or thin membrane on eye .
31	Use of Porous Materials Make an object or system porous or add porous elements .	Cell Membrane filtered materials with channels. Sponge tissues in animals and plant .
32	Changing The Color Optical Properties Change .	Changing Color of plant leafs in winter season . Changing color of buff in different situations . Changing color of skin pigment .
33	Homogeneity Uniformity, Similarity, Equality .	Steady Explode or materials homogeneity in cells in duration of mitosis .
34	Rejecting and Regeneration Parts Discarding and Recovering .	Relief of different tissues after injuring . Peeling in different animals .
35	Parameter Changes Changing Properties . Transforming Physical or Chemical state .	Parameter Changes of fruit in plant after adult . Chemical and Physical Parameter Changes of food while Digestion .
36	Phase Transitions Use phenomena occurring duration phase transitions .	Phase Transitions in mitosis and meiosis (prophase , metaphase ,…) . Phase Transitions in cellular cytoplasm with cytoplasm movement .
37	Thermal Expansion Use thermal expansion of materials .	Thermal Expansion in Arum (especial plants) .
38	Use of Strong Oxidizers Replace common air with oxygen – enriched air .	Peroxizom , oxidation of glycolic acid . Oxidation Enzymes in respiration cycles . Alpha and Beta oxidation cycles of lipids .
39	Inert Environment Replace a normal environment with an inert one	Blood Complex .
40	Composite Materials Change from uniform to composite structures .	Organic Materials (lipids, carbohydrate , protein, …) . Blood composites .

References

1-S.M.G.Hashemi .(2003). Creatology and TRIZ . Journal of Khalaghiat Shenasi , Karafrini & TRIZ . N:1 . PP : 76 .

2- G.L. Ginar . (1989) . Plant Chemical Biology . translated by Reza Heidary . Published by Tehran University .

3- Atrii , Morteza .(2001) . Organogenesis and Morphogenesis . Published by Uromia University .
4 - B.Vaziri. (1988) . Dictionary of Biology . . Published by Tehran University .