

## INTRICACIES IN IDENTIFICATION OF BIOLOGICAL MISCONCEPTIONS

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### Abstract

*Science is a systematic study of natural phenomenon. The natural phenomenon is perceived and understood by an individual based on his/her experience and cultural context.*

*The term misconception is complex in nature and has been conceptualize as alternative conceptions, preconceptions, alternative ideas, conceptual stumbling blocks, erroneous concepts, alternative framework in various contexts by researchers at different level of schooling and geographical locations. Identification of misconception is a challenging task due to various factors such as cultural context, individual differences, teaching-learning processes, students personal experience etc.*

*In the present context of multi and trans-disciplinary subjects, the identification of misconceptions has become essential and gain importance as they are contributing new knowledge and applications in Science and Technology. Hence, in the present paper researchers had made an attempt to analyze the intricacies in identification of misconceptions in biology. The paper heavily relies on secondary source of data.*

*In the present paper researcher has thoroughly reviewed and studied the identifications of misconceptions in the subject biology mixed approaches along with tools, techniques and strategies.*

**Keywords:** *Biological Misconceptions, Identification of Misconceptions, Intricacies*



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### Introductions

Science is the systematic study of nature. Science consists of physical and biological sciences. Biology is an important subject belongs to life sciences. It helps to develops the scientific temper, scientific attitude, scientific literacy, logical reasoning, awareness of environmental issues and respect about surrounding life among students. Biology provides in-

depth scientific understanding of how living and non-living organisms interact with each other. Biology gives insight on how diverse life forms are, moreover, Biology encompasses the sustainability of life, including the environment, ecosystem, food quality, causes of illness, the development of medicines.

The comprehension of the Biological concept to students in the classroom by scientific manner is the first responsibility of the biology teacher. While Biology concepts teaching-learning process students

### **Meaning of Misconception?**

Misconceptions correspond to the concepts that have peculiar interpretations and meanings in students' articulations that are not scientifically accurate. In the literature, misconceptions are also referred to as erroneous ideas (Fisher, 1985; Sanders, 1993), preconceptions (Hashweh, 1988; Gallegos, Jerezano & Flores, 1994), alternative conceptions (Arnaudin & Mintzes, 1985), naive beliefs (Caramazza, McCloskey & Green, 1981), alternative frameworks (Driver, 1981), multiple private versions of science (McClelland, 1984), spontaneous reasoning (Viennot, 1979), personal models of reality (Champagne, Gunstone & Klopfer, 1983), spontaneous knowledge (Pines & West, 1986), common sense concepts (Haloun & Hestenes, 1985), underlying sources of error (Fisher & Lipson, 1986) and children science (Gilbert, Osborne & Fensham, 1982).

The term "Misconception" has various definitions. Flower & Jaoude (1987) defined misconceptions as,

*"an accurate understanding of a concept, the misuse of concept the incorrect classification of concept examples, confusion between differing concept, improper hierarchical relationships or on- or under – under generalizing of concepts" (p.54)*

Misconceptions developed through the connection with social and physical world around them; students personal life, communication with diverse teachers & friends or through source of media. Previous studies also that textbooks are another prevalent source that contributes one of the important factor which prevent students meaningful learning.

### **Meaning of Intricacies**

For the present study intricacies refers to complexity in the identification of the misconceptions. The dictionary meaning of intricacies refers to the quality or state of being complex or perplex having many parts. Hence, in the present study intricacies with respect to identification of biological misconceptions the reviews were analyzed.

### Methodology

For the present study descriptive research content analysis method was adopted and 200 reviews has been analyzed and 20 reviews were found related to Biological misconceptions. The thorough review of the identified biological misconceptions on the basis of i) The research done in the year ii) Tools utilized for the research iii) Sample and location for the study.

**Table No.1 Identified Misconceptions**

Authors and Year	Tool/Techniques/ Strategies used	Variables+/ Level	Identified Misconceptions
Filocha Haslam & David F. Treagust (1987)	Two tier multiple choice test	Secondary students of year 8 to 12 (Perth, Australia)	<b>Photosynthesis-</b> photosynthesis can occur when there is no light energy at all. <b>Respiration-</b> respiration took place in the plant—in all cells of the plant
Din-yan (1998)	Yip 67 items Written test with justification	26 Biology teachers in Hong Kong	<b>Cellular metabolism-</b> 'The optimum temperature for enzyme activity is 37° because this is our body temperature' <b>The mechanism of photosynthesis:</b> 'Photosynthesis is made up of a light reaction and a dark reaction' <b>Blood flow at the capillaries:</b> 'In the mammalian circulatory system, the blood flow rate is lowest at the capillaries because the very narrow capillaries offer great resistance to blood flow.'
Abu-Hola, (2004)	I. Classroom observations & Open Discussion, Drawing	Teachers and Primary students in Jordan	<b>Endocrine and circulatory systems-</b> More gland secretion is a healthy symptom; . Ventricles and auricles contract at the same time <b>Excretion system-</b> Sweating protects body from dryness
Türkmen, Cardak, Dikmenli, (2005).	L., M. Multiple choice Biology Achievement Test & Concept maps	9 <sup>th</sup> grade 92 students in Province (Konya) centre Highschool, Turkey	Diversity of Living Organism and Their classification- genus and species almost the same meaning, as “type” or “kind” in Turkish.
Deshmukh, D., & Deshmukh.	N. -Open ended written test and	110 IX & X standard students, in Thane	<b>Life Processes-</b> heart converts impure blood into pure blood., heart is very vital organ,

V. M. (2007).	Interviews		region		because our feelings, emotions and life are stored in it' <b>Respiration-</b> 'Respiration means breathing'
Osman Cardak (2009)	Open questions, Drwaing & Interview		110 students in Slecuk University in Turkey		<b>Classification and Behavior of Birds-</b> a bat is a bird, or a penguin is a mammal or fish, a person touches the nest of a bird, birds will never come back to that nest, Birds migrate only to warmer regions in order to avoid freezing.
Deshmukh, N. D (2012)	Open ended questionnaire, Concept Based Objective Test, interview		216 urban and rural students from thane region		<b>Photosynthesis and Respiration-</b> Photosynthesis takes place during day time while respiration takes place at night
Ertugrul Sesli & Yilmaz Kara (2012)	Two-tier multiple choice diagnostic test		430-high school students (age-16-19 yrs)		<b>Cell Division-</b> The cells of the same species have the same genetic information <b>Reproduction-</b> Plants cannot reproduce sexually since they have no gender
Yangin, Sidekli, Gokbulut, Y.(2014).	S.; S.; Cross Design, Sectional Open-ended questionnaire		162 teachers in Recep Tayyip Erdogan University, Turkey		<b>Classification of Plants-</b> Pine is a plant without seeds, "Plants without seeds are plants with or without a big trunk, hard, spiny, living in various habitats, not having a colourful flower thus not having seeds", "Vegetables can be a seedless plant, not because their seeds. In addition, the foods we use in our everyday lives and cooking are also vegetable."
Benedict Israel Joseph (2014)	Tlala, Kibirige, Osodo Six stage Conceptual Change Model		78 Grade 10 Life Sciences learners from two neighbouring high schools in Nkangala Region of Mpumalanga Province, South Africa.		<b>Photosynthesis-</b> plants get their food from the environment rather than manufacturing it internally; soil supplies most of the raw materials for photosynthesis, soil was the plant's food which is the reason why people put food (fertilizer) in the soil for plants to eat.
Elif YÜCEL Muhlis (2015)	ÖZATA and ÖZKAN Word Association test		age between 12-14 years. Eighty-nine students at the City Centre of Kocaeli, in the North-west of Turkey.		<b>Ecological Concepts-</b> plants and animals together is the population, ecosystem is formed only by living organisms, "only garbage that is thrown away causes environmental pollution"
Nurbaety, Rustaman ve Sanjaya (2015).	D., N. Y. Drawing Interview with		8 grade students in Indonesia		<b>Plant Structure-</b> students stated that the stem has a function to produce branches and flowers <b>Photosynthesis-</b> photosynthesis only took place in daylight, because there was sunlight as light energy and it could not be replaced by other sources of energy

Chong Li Yong and Ch'ng Zhee Kee (2017).	Concept Cartoon	29 students in primary school in Penang, Malaysia	<b>Photosynthesis-</b> water, the sun, light energy and carbon dioxide are the food sources of the plants
Champagne Queloz A, Klymkowsky MW, Stern E, Hafen E, Kohler K (2017)	Biology Concept Instrument (BCI) -(24 Multiple choice questions)	First year undergraduate students (Gymnasium University, Switzerland)	<b>Evolution-</b> Naive ideas such as "needs as a rational for change" and "use and disuse" are often reported as important misconceptions that harm to deeply understand evolution
Yusmina Hala, U A Syahdan, Halifah Pagarra and S Saenab (2018)	Certainty of Response Index (CRI) method. CRI is a diagnostic test consisting of multiple-choice questions or true-false questions with a combination of confidence on the truth of the chosen answer	22 certified Biology teachers from 11 public high schools in Makassar City	<b>Cell concept-</b> The misconceptions were found in 6 Basic competences of the cell concepts.

### Interpretation and Discussions

- 1) Filocha Haslam & David F. Treagust (1987) developed two tier multiple choice test to identify misconceptions about photosynthesis and respiration in plants among secondary school (8 to 12 std ) students in Perth, Western Australia. The first tier of test consists of knowledge statements and second tier consists of reasons based on studies responses to interviews, open ended questions and /or previous researches. The Misconceptions identified about photosynthesis –‘photosynthesis can occur when there is no light energy at all.’ Misconception regarding respiration was-‘*respiration took place in plant-in all cells of the plant.*’
- 2) Din-yan Yip (1998) identified the Biological misconceptions among 26 Biology teachers who were participating in a course of initial teacher learning of the post graduate diploma in education. The 67 items written test with justification was administered on 26 Biology teachers. The identified Biological misconceptions was: Cellular metabolism- '*The optimum temperature for enzyme activity is 37° because this is our body temperature*', *The mechanism of Photosynthesis: 'Photosynthesis is made up of a light reaction and a dark reaction'* *Blood flow at the capillaries: 'In the mammalian circulatory system, the blood flow rate is lowest at the capillaries because the very narrow capillaries offer great resistance to blood flow.'*

- 3) Abu-Hola, I. (2004) conducted study to identify misconceptions in Biological science content. Classroom observations & Open Discussion, Drawing tools was administered by the biology Teachers to their Primary students in Jordan. The identified misconceptions was: *Endocrine and circulatory systems- More gland secretion is a healthy symptom; Ventricles and auricles contract at the same time. Excretion system- Sweating protects body from dryness.*
- 4) Türkmen, L., Cardak, O. & Dikmenli, M. (2005) developed multiple choice Biology achievement test and concept maps to identify misconceptions about Diversity of Living organism & their Classification. The 9<sup>th</sup> grade 92 students in Province (Konya) centre Highschool, Turkey used as sample for the study. Identified misconceptions about Diversity of Living organism & their Classification was: *Genus and species almost the same meaning, as "type" or "kind" in Turkish.*
- 5) Deshmukh, N. D., & Deshmukh. V. M. (2007) identified the 110 students ( 9<sup>th</sup> and 10<sup>th</sup> std ) misconceptions in Biology at thane region. Open ended written test and Interviews was administered to collect the data. The identified misconceptions was: *Life Processes- heart converts impure blood into pure blood., heart is very vital organ, because our feelings, emotions and life are stored in it'Respiration- 'Respiration means breathing'.*
- 6) Osman Cardak (2009) identified the misconceptions regarding Classification and Behavior of Birds. Researcher used Open questions, Drwaing & Interview techniques. The sample was 110 University students in Slecuk University in Turkey. The identified misconceptions regarding Classification and Behavior of Birds: *a bat is a bird, or a penguin is a mammal or fish, a person touches the nest of a bird, birds will never come back to that nest, Birds migrate only to warmer regions in order to avoid freezing.*
- 7) Deshmukh, N. D (2012) identified the misconceptions about the Photosynthesis and Respiration. The sample of the study was 216 urban and rural students from thane region. Open ended questionnaire, Concept Based Objective Test, interview was used as the tools for the data collection. The identified misconceptions about *Photosyntheis and Respiration was: Photosynthesis takes place during day time while respiration takes place at night*

- 8) Ertugrul Sesli & Yilmaz Kara (2012) identified the misconceptions about Plant Structure & Photosynthesis. The sample was 430-high school students (age-16-19 yrs). The Two-tier multiple choice diagnostic test was administered . The identified misconceptions was *Cell Division- The cells of the same species have the same genetic information*  
*Reproduction- Plants cannot reproduce sexually since they have no gender.*
- 9) Yangin, S.; Sidekli, S.; Gokbulut, Y.(2014) identified the misconceptions about Classification of Plants. Cross Sectional Design, Open-ended questionnaire was used as a tool. The data was collected from 162 Prospective teachers in Recep Tayyip Erdogan University, Rize, Turkey. The identified misconceptions was: **Classification of Plants-**  
*Pine is a plant without seeds, "Plants without seeds are plants with or without a big trunk, hard, spiny, living in various habitats, not having a colourful fl ower thus not having seeds", "Vegetables can be a seedless plant, not because their seeds. In addition, the foods we use in our everyday lives and cooking are also vegetable."*
- 10) Benedict Tlala, Israel Kibirige, Joseph Osodo (2014) identified the misconceptions about Photosynthesis. Six stage Conceptual Change Model was used for data collection. 78 Life Sciences learners of 10<sup>th</sup> Grade from two neighboring high schools in Nkangala Region of Mpumalanga Province, South Africa. The identified misconceptions about photosynthesis was *-plants get their food from the environment rather than manufacturing it internally; soil supplies most of the raw materials for photosynthesis, soil was the plant's food which is the reason why people put food (fertilizer) in the soil for plants to eat.*
- 11) Elif ÖZATA YÜCEL and Muhlis ÖZKAN (2015) conducted a study to identify misconception about ecological concepts. Word Association test was used to collect the data from age between 12-14 years. Eighty-nine students at the City Centre of Kocaeli, in the North-west of Turkey. The misconception about Ecological Concepts are:- *plants and animals together is the population, ecosystem is formed only by living organisms, "only garbage that is thrown away causes environmental pollution"*
- 12) Nurbaety, D., Rustaman, N. Y. ve Sanjaya, Y. (2015) identified Indonesian 8 grade students misconception about plant structure and photosynthesis. Drawing with Interview technique was adopted for data collection. The identified misconception was: Plant

Structure- students stated that *the stem has a function to produce branches and flowers*,  
Photosynthesis- *photosynthesis only took place in daylight, because there was sunlight as light energy and it could not be replaced by other sources of energy*

- 13) Champagne Queloz A, Klymkowsky MW, Stern E, Hafen E, Kohler K (2017) identified the misconception about Evolution Biology Concept Instrument (BCI) -(24 Multiple choice questions) instrument was administered for data collection. The identified misconceptions about Evolution was Naive ideas such as *"needs as a rational for change" and "use and disuse" are often reported as important misconceptions that harm to deeply understand evolution*
- 14) Chong Li Yong and Ch'ng Zhee Kee (2017) identified misconceptions about photosynthesis concept among 29 students in primary school in Penang, Malaysia. The concept cartoon tool was used to identify the misconceptions. The misconceptions related to photosynthesis was- '*water, the sun, light energy and carbon dioxide are the food sources of the plants*'
- 15) Yusmina Hala, U A Syahdan, Halifah Pagarra and S Saenab (2018) identified the misconceptions regarding cell concept. Certainty of Response Index (CRI) method. CRI is a diagnostic test consisting of multiple-choice questions or true-false questions with a combination of confidence on the truth of the chosen answer tool was administered on 22 certified Biology teachers from 11 public high schools in Makassar City. The identified misconceptions was **Cell concept-** *The misconceptions were found in 6 Basic competences of the cell concepts.*

## Conclusion

1) Most of the research finding state difficulties rather than misconception. It might be in the form of temporary. 2) The developed programmes to reduce the misconceptions does not take into consideration the other domain and correlation with other content. 3) While identifying biological misconceptions the tests made were purely specific subject based which itself limitations. 4) Identification of misconceptions of the subject Biology is stand alone way. 5) The vary purpose of the research might have not achieve while the students responses comes on different way. 6) After analyzing the reviews it was found that (Elif ÖZATA YÜCEL and Muhlis ÖZKAN ,2015; Chong Li Yong and Ch'ng Zhee Kee (2017) did not utilize



comprehensive multiple / combination test to identify misconceptions . Itself lead the limitation on the finding of the study. This taken more over to like achievement test. 7) The researches conducted in the area of identification of biological misconceptions are done by the researchers other than primary / secondary teachers. Teachers are the field workers and would be the right person to identify & develop remedial programme.

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