

Holistic Approach of Science Education

Saifuddin Mollick
B.Sc. , B.Ed. (2019-2021)
Lokenath B.Ed. College

Abstract

Holistic education is a comprehensive approach to teaching where educators seek to address the emotional, social, ethical, and academic needs of students in an integrated learning format. Emphasis is placed on positive school environments and providing whole-child supports (services that support academic and nonacademic needs, also known as wraparound supports) to students. Students are taught to reflect on their actions and how they impact the global and local community, as well as how to learn from the community around them. Teachers often engage students in projects that apply critical-thinking skills toward solving real-world problems. In this paper, author will try to describe the holistic approach and illustrate the holistic approach in science education with example.

Keywords: Holistic Approach, Cognitive Domain, Affective Domain, Psychomotor Domain , Environment , Spiritual Domain

Introduction

Science explores and art expresses. Science intends to reveal the whole in an interrelated atomistic way. The drive of Science is to move from dot to globe, from elements to compounds, from disciplinary to interdisciplinary, from point to morphology. Occurrence of any phenomenon, however, big or small is holistic, such as, flying of birds, constellation and movements of the celestial bodies, evaporation of water and rainfall, viscosity and surface tension, electric discharge between clouds and thunder, chemical reactants, products and equation, osmosis and reverse osmosis, conservation of mass and momentum, and heart and brain entrainment. Science tends to have holistic understanding of the interrelation, correlation & cause and effect relation of perceptible variables. There is an inherent move from constructivism to connectionism and holism. We need to learn to appreciate the beauties of Science with universal positivism. NCERT Focus Group (2005) highlights that Science Education should enable the learner to know the facts and principles of science and its applications, to acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge, to develop a historical and developmental perspective of science and to enable the learner to view science as a social enterprise, to relate to the environment, local, as well as, global, and appreciate the issues at the interface of science, technology and society, to nurture the natural curiosity, aesthetic sense and creativity in science and technology, to imbibe the values of honesty, integrity, co-operation, concern for life and preservation of environment and to cultivate 'scientific temper'-objectivity, critical thinking and freedom from fear and prejudice. Thus, science education is to develop human beings for peaceful coexistence in the world. Teachers are the very important stakeholder of the society, because teachers can lead community and nation towards better and fruitful life. Teaching is a profession and teacher education is a process of professional preparation of teachers. Teachers are concerned, in an important way, with the total development of human beings – physical, intellectual, emotional, social, moral and spiritual. Teacher quality is a function of several factors: teachers' status, remuneration, conditions of work and their academic and professional education. The teacher education system through its initial and continuing professional development programmes is expected to ensure an adequate supply of professionally competent teachers to run the nation's schools. Initial teacher education especially, has a major part to play in the making of a teacher. It marks the initiation of the novice entrant to the calling and as such has tremendous potential to imbue the would-be teacher with the aspirations, knowledge-base, repertoire of pedagogic capacities and humane attitudes. (NCFTE, 2009).

Objectives

- To Understand the Holistic Approach
- To Understand how to teach through Holistic Approach
- To Design Science Lessons for Physical , Cognitive , Affective , Psychomotor, Environmental and Spiritual development
- To Demonstrate the Holistic development

Methodology

As the study is merely descriptive in nature the investigator has made an honest attempt to study the various relevant books/Journals/various website for the information regarding the Holistic Approach and its implementation in Science Education. The investigator has tried his utmost to make the study as objective as possible by employing different previous studies and information available on internet.

Holistic Education

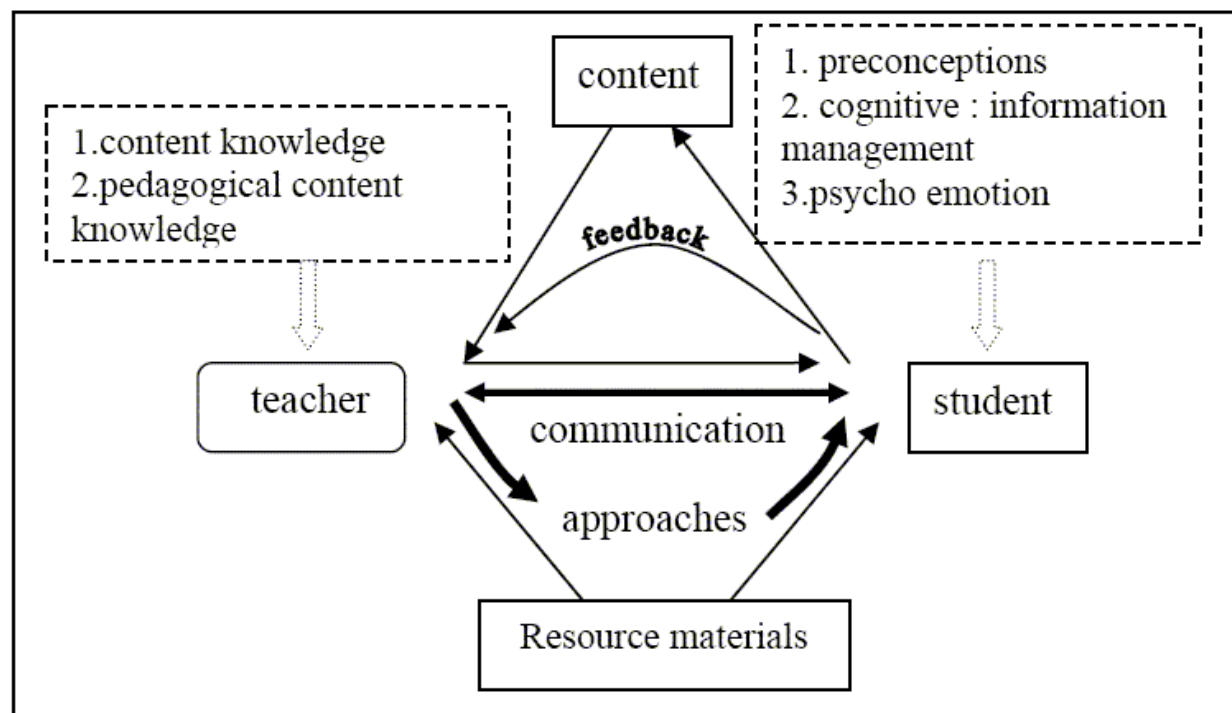
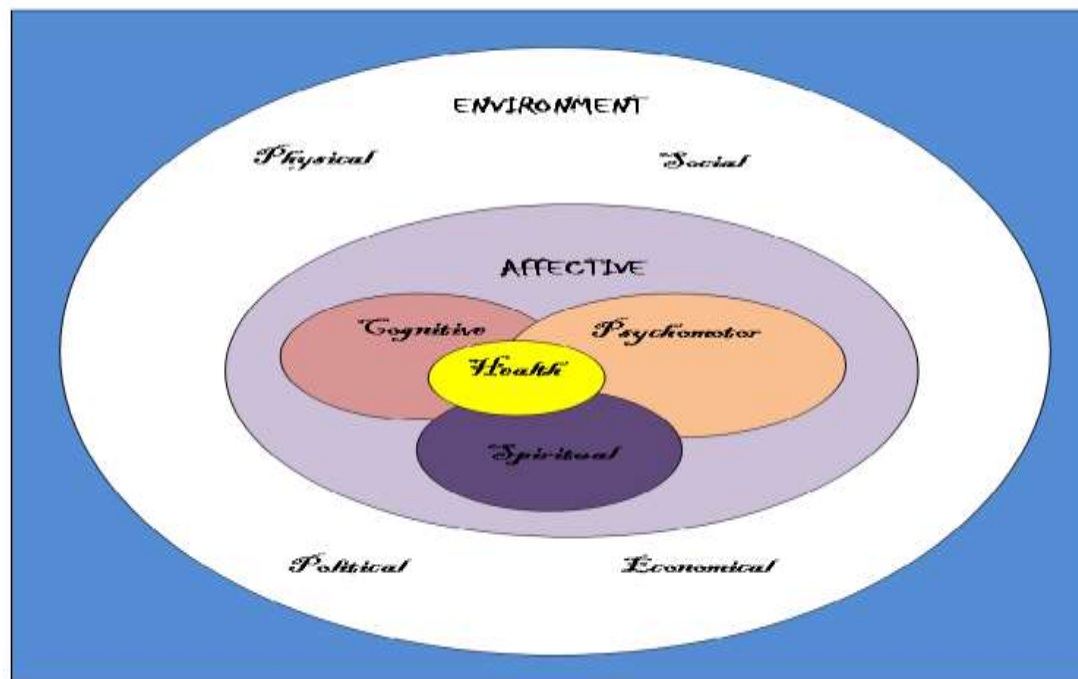
Huie (2010) outlined the components of Holistic education, such as, active learning, deep understanding, critical and creative thinking, along with an emphasis on social relationships and realizing the fullness of human existence. Holistic education is a philosophy of education and concerned with the development of every person's intellectual, emotional, social, physical, and spiritual potentials. Report of Kothari commission (1964-66) has recommended cultivating social, moral and spiritual values as one of the important aims of Education. Further, Miller (1999) has been of the view that "Holistic Education is based on the premise that each person finds identity, meaning and purpose in life through connections to the community, to the natural world, and to spiritual values, such as, compassion and peace." The holistic education places significance on relationships and primary human values within the learning environment (Martin, 2003). Martin & Forbes (2004) divided holistic education into two categories: the idea of ultimacy and Basil Bernstein's notion of Sagacious Competence.

Holistic Approach

Concept of holistic approach is that the totality of something is much greater than the sum of its component parts and their functioning i.e. the whole cannot be understood by the isolated analysis of its parts, their nature, structure and function rather the whole is integrated functioning of all the parts with interrelation & interdependence. The holistic approach is approach, such as, Naturalistic, Constructivist & Connectionist.

Holistic approach is way of teaching a subject as a whole by considering all aspects of the curriculum tending towards holistic. It is interdisciplinary disciplinary approach dealing in integration of content within & between subjects. The content caters to cognitive, affective, psychomotor, and spiritual domains in resonance with the environment. The holistic approach focuses on the integrated development of all the domains, that is, all round development. The holistic approach enables students to explore their own potential and that of surroundings in an integrated way. Maheshwari (2010) has defined holistic approach as an essential element to educating students which one seeks to open the mind, awaken the heart and nurture the spirit. Key concepts of such an approach include fostering a passion for learning and nourishing the sense of wonder. Holistic Approach is one where the education is going beyond narrow focus on the intellect, transcending space, time, matter and mind.

Holistic approach can be presented through Venn diagram:



The model for holistic approach

Holistic Approach of Science Education

Holistic approach deals with all the domains, such as, cognitive, affective, psychomotor, health and environment, and spiritual. Science is a discipline where students learn many laws which are related to the universe. In the study of Science students are doing practical and by that they can experience success and failure. The aim of holistic education is developing student as a whole. While exploring & gaining knowledge through the holistic approach, the curriculum is such that it takes care of development of all the domains. Through the Science subject, development of affective domain is done because in curriculum there are so many topics related to self, relationship, health and environment. The students are able to learn and feel the environment. All the domains, such as, Health-Intelligence-Emotional-Spiritual- Environmental-Metaphysical can be developed through Science, both, Natural & Social, holistically.

Development of Humane and Professional Teachers through Holistic Science Education

Professional and Humane qualities are required in teachers, such as, Research& Knowledge, Interest, Value & Attitude, Truthfulness, Compassion & Forbearance, Skill-Scale& Speed, Communication, Innovation-Creation-Construction & Connection, Dedication& Identification, Determination& Action, Empathy& Adjustment, Curiosity-Quest & Immersion, Engagement & Passion, Generosity & Authority, Yoga & Control, Motivation & Inspiration, Sensitivity & Search, Deviation & Resilience, Freedom & Control, Courage & Patience, Leadership, Administration, Organization & Management, Openness & Positivity, be-becoming-being & debecoming, Having & Being, Production& Evolution, Above all a teacher ought to be essentially researcher, innovator, creator, connector, communicator, approachable, open, impartial & judicious intellectual. The Text of a Teacher ought to have its own testimony. Science is our extension -Radio is extension of Voice, Television is extension of Visual, Computer is extension of Brain, Motor Bike is extension of our Feet, whereas, Cloths are extension of our Skin. Science plays tremendous role in human life. Man has been able to transcend time and space with the help of Science. Science facilitates life and living. Science tends to know the universe. Science has the attributes of regency, omnipresence and immediacy. Holistic science education deals with all the aspects the universe. Ultimate aim of Science Education is development of universal beings.

Holistic Development of Teachers -An illustration on Tea Preparation

Introduction

Here is a lesson on Tea preparation employing Holistic Approach of Science Education.

Inputs

For preparation of tea there is a need to gather all the apparatus and ingredients required for the tea preparation, such as, Pan, Milk, Water, Gas stove/Kerosene stove/ Electric coil/ Induction gas, Lighter, Match box, Pair of tongs/ Cloths used for handling hot pan, Tea leaves container/Tea bags container, Sugar container/Sugar Free Tablets Container, Basil, Elaichi (Cardamom), Ginger, Black Pepper, Sieve, Tea pot, Cup and Saucer/ Tea Mug. Edible materials used in preparation of tea are, such as, Water, Dry Tea Leaves, Ginger, Cardamom, Black Pepper, Basil, Pudina, Green Tea Leaves, Sugar.

Process

After collecting all the ingredients and apparatus for preparation of tea, there is need to exercise choice for pan. After that drinking water is collected. Then the gas is burnt with the help of lighter/match box. There is need to regulate the desired volume of the flame. After boiling water, it's time to add dry tea leaves, basil, grated ginger, black pepper, green tea leaves, Pudina and cardamom. After extraction of these things there is need to add sugar and milk. Boil for some time and pour it in tea pot, serve it in cups and enjoy Tea. This is the simple recipe for Tea.

Emerging Questions

1. What ought to be the characteristics of the Pan use for tea preparation?
2. What is the chemical composition of all the ingredients used in preparation of tea?
3. Why water for extraction of ingredients?
4. What is the chemical composition of the various materials?
5. What are the contents of the prepared tea?

6. What is TEA as a whole & what for?

Properties of materials and ingredients

a. Properties of Metals

1. Metals, in their pure state, have a shining surface. This property is called metallic lustre.
2. Metals are generally hard. The hardness varies from metal to metal. They are solids at room temperature, except mercury which is a liquid.
3. Some metals can be beaten into thin sheets. This property is called malleability. Gold and silver are the most malleable metals
4. The ability of metals to be drawn into thin wires is called ductility. Gold is the most ductile metal.
5. Because of their malleability and ductility metals can be given different shapes according to our needs.
6. Metals are good conductors of heat and have high melting points. The best conductors of heat are silver and copper. Lead and mercury are comparatively poor conductors of heat.
7. Metals can form positive ions by losing electrons to non-metals.
8. Metals combine with oxygen to form basic oxides. Aluminum oxide and zinc oxide show the properties of both basic as well as acidic oxides. These oxides are known as amphoteric oxides.
9. The pan should be optimum in size. Handle of Material of Pan should be made from non-conducting, this is insulating material. Most of the pan handles are made from asbestos.
10. Pan metal should be such which cannot easily peel, crack, vaporize, dissolve or harbor bacteria. It should be a good conductor of heat in order to cook food uniformly, and it should be easy to clean thoroughly. Alloy can be used for best result because it has good quality of more than one metal.

b. Water

Water is the most abundant compound on Earth's surface, covering about 70 percent of the planet. In nature, water exists in liquid, solid, and gaseous states.

Density: 1,000.00 kg/m³

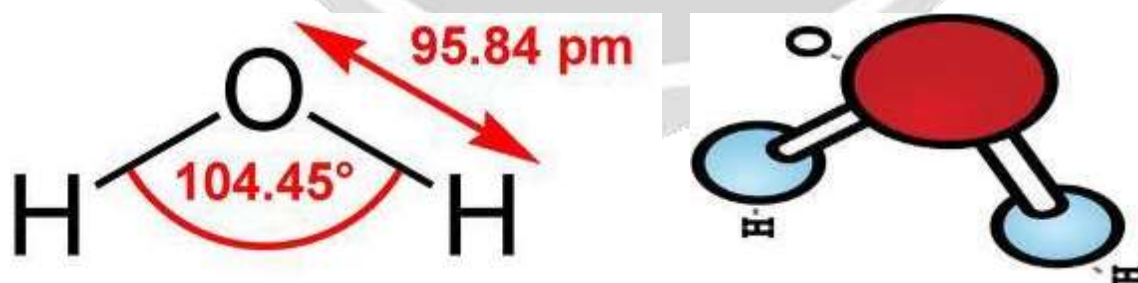
Molar mass: 18.01528 g/mol

Boiling point: 99.98 °C

Formula: H₂O

Melting point: 0.0 °C

IUPAC NAME: Dihydrogen oxide



Water is a tasteless, odorless liquid. At ambient temperature and pressure, it appears colorless in small quantities, although it has its own intrinsic very light blue hue. Water has pH 7.

c. Milk

The constituents of milk are water, lipids, carbohydrates, proteins, vitamins and minerals.

Water:

This constitutes about 85-87% of milk. This is the main medium for the suspension of all other components.

Lipids:

Milk is an emulsion and the lipids are found in a globular form. The main lipids present in milk are triglycerides, phospholipids and cholesterol. The triglycerides are formed of a number of fatty acids, such as, palmitic acid, stearic acid, lauric acid, and linolic acid. Lecithin, Cholin and many cerebrosides are other forms of fats present in milk. The percentage of fats in milk varies in different breeds; it may vary from 3.5-5%.

The fatty substances in milk can be separated in a solid form by applying centrifugal force after it is allowed to get curdled. Butter, the concentrated fat of milk is an important food ingredient in human diet. Ghee is another product obtained by melting the butter.

Carbohydrates:

The most important carbohydrate present in milk is lactose. It is commonly called milk sugar. Lactose is a disaccharide formed of two monomeres of monosaccharides-glucose and galactose.

Protein:

Among the proteins, casine commonly called the milk protein is the most important constituent. In milk, casine combines with calcium forming calcium caseinate. For growing children casine is a very essential protein. Other proteins of milk include lactoalbumins and lactoglobulins.

Vitamins and minerals:

Milk contains a number of essential mineral elements such as sodium, potassium, calcium, magnesium, iron, copper, iodine etc. Among the vitamins, milk has B complex and vitamin C and A. Even vitamin D and E are present in milk.

How milk is wholesome diet

Milk contains calcium, vitamin A, vitamin B12, iodine, riboflavin, potassium, magnesium, zinc, phosphorus, carbohydrate and high quality protein. These components make Milk a wholesome diet.

Properties of Milk (Colloidal Solution)

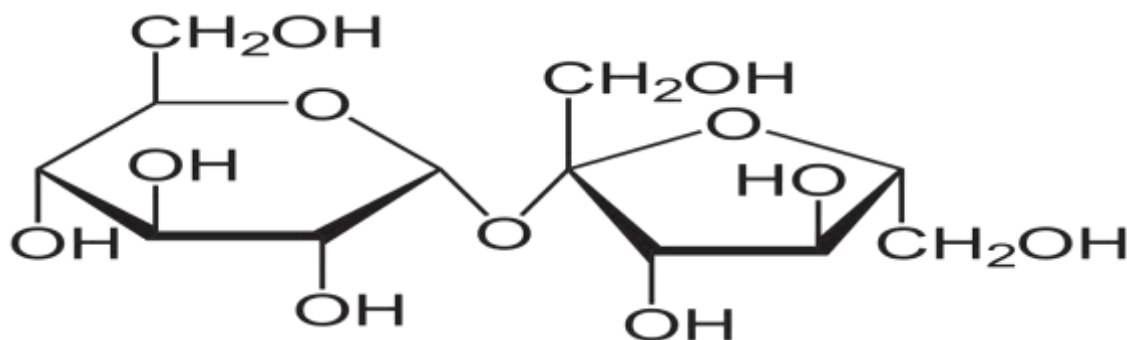
1. Milk is a colloidal solution. A colloid is a heterogeneous mixture.
2. The particles of a colloid are uniformly spread throughout the solution. Due to the relatively smaller size of particles the mixture appears to be homogeneous.
3. But actually, a colloidal solution is a heterogeneous mixture. Because of the small size of colloidal particles, we cannot see them with naked eyes. But, these particles can easily scatter a beam of visible light. This scattering of a beam of light is called the Tyndall effect.
4. They do not settle down when left undisturbed, that is, a colloid is quite stable.

d. Sugar

Sugar is also known as sucrose. Natural source of sucrose are beetroot and sugarcane. Sucrose is a disaccharide constituent of glucose and fructose. During the process of digestion by sucrose enzyme sucrose split into monosaccharide namely, glucose and fructose. Sugar (sucrose) found in two form i.e. powder and crystalline.

Molecular Formula of sucrose: $C_{12}H_{22}O_{11}$

Structural Formula:



Sugar Free Powder/ Tablet

Sugar Free is a substitute of sugar for diet. Sugar free is used as artificial sweetening agents which are stevia, aspartame, sucralose, neotame, acesulfame potassium, and saccharin. Sugar Free found in different forms i.e. tablet, powder and liquid. Sugar Free is very much useful for diabetic patient and calorie conscious people.

e. Tea leaves

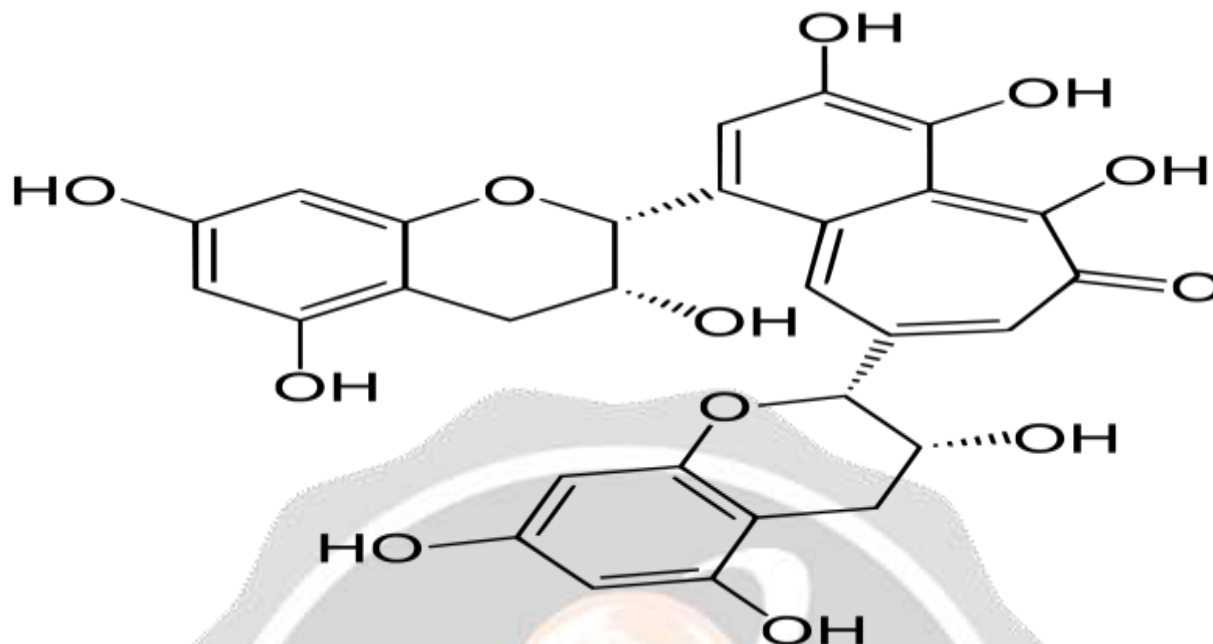
Compounds presents in tea leaves are polyphenols, amino acids, enzymes, pigments, carbohydrates, methylxanthines, minerals and many volatile flavor and aromatic compounds which give aroma, flavor, and taste to tea.

1. Polyphenols

Polyphenols are largely responsible for astringency. There are an estimated 30,000 polyphenolic compounds in tea, flavonoids are arguably the most important group of polyphenols in tea and are the source of the many health claims surrounding tea, and specifically tea antioxidants. A strong cup of tea contains around 180-240 mg of polyphenol compounds.

2. Flavanols

Flavanols are also referred to as tannins, and during oxidation are converted to theaflavins and thearubigins—the compounds responsible for the dark color and robust flavors notably present in black tea. The major flavanols in tea are: catechin (C), epicatechin (EC), epicatechingallate (ECG), galocatechin (GC), epigallocatechin (EGC), and epigallocatechingallate (EGCG). EGCG is the most active of these catechins and is often the subject of studies regarding tea antioxidants. Tea flavanols are sometimes collectively referred to as catechins. Besides flavanols, tea flavonoids also include flavonols, flavones, isoflavones, and anthocyanins; all of which contribute to the color of a tea's infusion and its taste.



Amino Acids

Tea leaves contain many amino acids, the most abundant of which is theanine. Theanine, more specifically L-Theanine is responsible for promoting alpha brain wave activity which promotes relaxation. L-Theanine in concert with caffeine can induce a state of “mindfulness” in the tea drinker.

4. Enzymes

Polyphenol oxidase and peroxidase are the most important enzymes in tea leaves. They are responsible for the enzymatic browning of tea leaves that takes place when the cell walls in the leaves are broken and the polyphenols are exposed to oxygen – otherwise known as oxidation.

5. Methylxanthines

Methylxanthines in tea include the stimulant caffeine and two similar compounds: theobromine and theophylline. Methylxanthines also contribute to a bitter taste.

Effect of Milk on Polyphenols present in Tea

The compounds in Tea derived from catechins can have antioxidant effects on the body, these could have beneficial effects on cardiovascular health. Casein proteins in milk could bind to polyphenols and as a result prevent their antioxidant effects.

f. Medicinal uses of different herbs used in preparation of tea

1. Name: Ginger

Name: Ginger

Scientific Name: *Zingiber officinale*

It is used in preparation of tea to prevent morning sickness, motion sickness, and nausea that accompanies gastroenteritis.

2. Name: CardamomScientific Name: *Elettaria cardamomum*

It is used in preparation of tea to prevent infections in teeth and gums, to prevent and treat throat troubles, congestion of the lungs as well as Flavoring agent.

3. Name: BasilScientific Name: *Ocimum tenuiflorum*

It is used in preparation of tea as Healing Power, Fever & Common Cold, Coughs, Sore Throat, Respiratory Disorder, Mouth Infections, and Headaches.

4. Name: Black PepperScientific Name: *Piper nigrum*

It is used in preparation of tea to improve digestion, stimulate appetite, and treat gastrointestinal problems, including diarrhea, dyspepsia and flatulence. It is also used to treat colds, coughs and sore throats.

5. Name: PudinaScientific Name: *Mentha arvensis*

It is used in preparation of tea for treatment of vomiting and nausea. It is also useful for stomach disorders and as antiseptic.

Holistic Development**Cognitive Domain****Material Science****Lever**

Types of Lever	Fulcrum	Work	Force	Example
First	Middle	One side	Other side	Scissor, Pairs of tong
Second	One side	Middle	Other side	Screw driver,
Third	One side	Other side	Middle	Forceps

Lighter:

According to Newton's first law in absence of external force body should maintain its motion with constant velocity. But instead of velocity remaining constant it reduces gradually and after traveling some distance body comes to halt. This force which opposes motion of the body is called as force of friction. When a body moves on a surface, keeping contact with the surface, force exerted by the surface on moving body which opposes motion of the body is called frictional force. A lighter works on the principle of friction.

Structure of Tea Mug:

Upper portion of tea mug is broader than lower portion. Broader portion helps to make tea cold faster because more of surface area is in contact with environment and lower narrow portion keeps the tea hot due to small surface area in contact with environment.

Structure of double layer Tea Mug:

Outer layer of mug is not in contact with hot tea so its temperature is normal as environmental temperature, inner layer is not directly in contact with environment so it keeps the tea hot.

Stove: Combustion converts fluid energy into heat which helps to prepare food.

Shape & Size of Pan: Has utility for utilizing thermal energy and capacity for holding material used for tea preparation. Metal & structure of the Pan matter a lot.

Reaction time also depends upon the surface area of sugar crystals.

Psychomotor Domain

- ▶ Handling of different materials and apparatus used tea preparation.
- ▶ Handling of Gas stove, lighter, and match sticks.
- ▶ Pouring tea from pan to pot.
- ▶ Cleanliness of platform before, during and after preparation of tea.
- ▶ Handling of hot pan with cloth or pan having Insulated handle, wooden handle.

Health and Environment

- ▶ Utility of tea for human beings.
- ▶ Utility of used tea leaves for plants.
- ▶ Milk is a wholesome meal.
- ▶ Over extraction of tea is harmful for health.

Affective Domain

- ▶ Tea preparation as a whole requires the holistic faculty of a person and results into the holistic development of persons.
- ▶ A sip of tea relieves the persons of fatigue & tension, howsoever, momentary.
- ▶ Tea symbolizes togetherness of the unique characteristics of various ingredients.
- ▶ Tea symbolizes interrelation & cooperation of various agents, namely, tea gardener & workers, tea factory labourers, fuel sources & resources, and various Tea ingredients.

Spiritual Domain

Prepared tea is an integrated whole of many a ingredients, contributing their substance, flavour and essence with full immersion, where ingredients, their substance, essence, flavour, and fragrance all together become one.

Conclusion

Science as discipline can significantly contribute towards the development of universal beings. Though atomistic, the ultimate aim of science education is to have a comprehensive knowledge base of the entire universe so as to facilitate healthy, happy, full and meaningful life in resonance with all. We need to explore the genesis and constitution of every phenomenon scientifically. Teaching of Science rather than fragmented ought to be holistic for the casting of balanced personalities.

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