



## **IDENTIFICATION OF THE CURRICULUM EXPECTATIONS OF PHYSICAL SCIENCE CURRICULUM OF WEST BENGAL BOARD OF SECONDARY EDUCATION**

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### **Abstract**

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*Curriculum is an important factor in school education as it provides a frame and a guideline for the various stakeholders. Curriculum expectation is a crucial aspect of curriculum as it defines knowledge and skills, which are expected to be learnt by learners. After review of literature it was found that no study has been done India on curriculum expectation. Therefore the researchers had tried to identify the educational goals, overall and specific curriculum expectations of physical science of WBBSE by using content analysis technique. It was found that the goals of physical science could be classified under three major themes which further defining three overall expectations for each unit. The specific expectations were again the reflection of the respective overall curriculum expectation. The identified goals of science, overall and specific curriculum expectations were discussed in details in this article.*

**Keywords:** *physical science curriculum, curriculum expectation, overall expectation, specific expectation, goals of physical science*



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### **Introduction:**

According to Kola (2013), "Science education deals with sharing of science content and process with individuals who are not considered traditionally to be member of the scientific community; the individuals could be students, farmers, market women or a whole community." So the responsibility of the state is, to make its future citizens aware about the scientific endeavour as they are living in an era of colossal evolution of science and technology. At present, every single step of life cannot be imagined without the function of science and its application. Hence, it is perceptible that the state should provide science education at different levels. In order to provide a systematic educational process, the necessity of a curriculum document cannot be ignored. A curriculum provides a solid frame to the process of education. It decides the role of different stakeholders, and focuses upon

what to teach and what not to teach at a specific level. It reflects the needs of the society and the nation. In order to make the educational process more systematic and meaningful, a curriculum should have well-defined curriculum expectations. In one sentence, curriculum expectation can be defined as what the students are expected to learn from the curriculum. Hence, what the students are expected to learn from physical science curriculum could be termed as curriculum expectation of physical science. Curriculum expectations are of two types. The first type is the 'Overall expectation'. Overall expectations are the expectations in general from a unit. Overall expectations describe the knowledge and skill in general terms that the students are expected to demonstrate. The second type is the 'Specific expectation'. It is more specific in its objectives. The specific expectations describe the expected knowledge and skills in greater detail (The Ontario Curriculum Grades 9 and 10, Science, 2008.).

After a review of related literature, it was found that only two empirical studies had been done on curriculum expectations (Yang, Soprano & McAllister, 2012), (Dreyfus. A, and Jungwirth, 1988). Both the studies examined what a student is expected to learn (i.e. curriculum expectation) with regard to specifically one concept(e.g. concept of cell) or area (e.g. knowledge related Sun and Moon) but not the science curriculum as a whole. None of the studies were conducted in India. It was also found that no specific document was available on the curriculum expectation of physical science of West Bengal Board of Secondary Education (WBBSE). Furthermore, in order to analyse and examine the present status of the physical science education at the secondary level in West Bengal with the reference to the curriculum expectation, the first task is to find out the overall and specific curriculum expectations. Therefore, a need was felt to identify the curriculum expectations of the physical science curriculum at the secondary level of West Bengal Board of Secondary Education.

### **Statement of the Study**

The present study is stated as, "identification of the curriculum expectations of physical science curriculum of West Bengal board of secondary education."

### **Operational Definition:**

**Curriculum Expectation:** Those knowledge and skills, related to physical science, which are expected to be learnt by learners at the secondary level.

**Science Education:** In this study, Science Education is related to physical science (comprising of physics and chemistry) at the secondary level.

## **Objectives of the Study**

The major objective of the study was to identify the curriculum expectations for physical science at the secondary level.

## **Research Questions**

1. What are the goals of physical science education at the secondary level?
2. What are the overall curriculum expectations for physical science education at the secondary level?
3. What are the specific curriculum expectations for physical science education at the secondary level?

## **Delimitations of the Study**

1. The study was delimited to the physical science curriculum of secondary level of the West Bengal Board of Secondary Education.
2. Three units of physical science of grade nine were taken for identifying the overall and specific curriculum expectations.

## **Methodology**

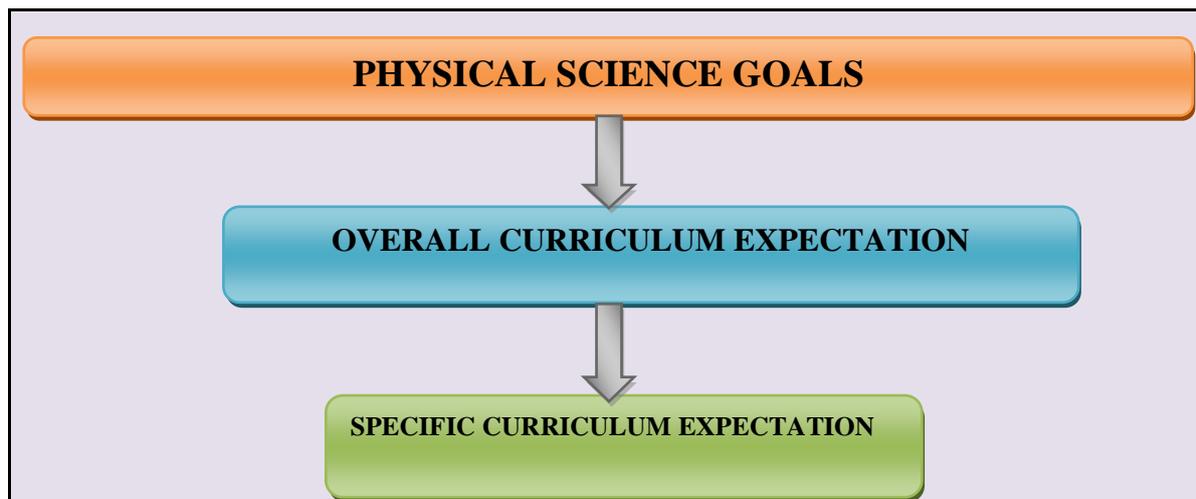
For the present study, a standard physical science textbook (Element of Physical Science written by Dasgupta, Majumdar and Mukherjee, 2017) of grade nine of West Bengal board of secondary education was selected for analyzing the content to find out the overall and specific curriculum expectations and the measures had been taken in the textbook to achieve those expectations.

There were seven separate units in the textbook following the syllabus laid down by West Bengal Board of Secondary Education. Out of this seven units the content of all three units were analyzed separately. The units were: (i) Energy in Action: Work, Power and Energy, (ii) Heat, and (iii) Sounds

## **Findings:**

### **Identifications of the Goals of Physical Science at Secondary Level**

The overall curriculum expectations could be derived from the goals of physical science education of secondary level. Hence before the identification of overall expectations and thereby specific expectations the primary task was to find out the goals. The goals of physical education should be in the context of present Indian education system and the needs of the Indian society and individuals. Thus the goals were identified by analysing the content of the position paper of NCERT on Teaching of Science (2006) and National Curriculum Framework 2005 of NCERT.



**Figure 1:** The relationship between physical science goals of education, overall curriculum expectations and specific curriculum expectations

From the above diagram it is clear that the goals define the overall expectation of each unit. Again, the specific expectations are developed from the corresponding overall curriculum expectation. So ultimately the goals are reflected in each specific expectation via overall curriculum expectation.

The goals of physical Science at secondary level were identified as follows:

1. To relate science to technology, society, the environment and vocation.
2. To acquire the skills and understand the methods and processes of science and developing and nurturing scientific temper, curiosity, aesthetic sense and creativity and values.
3. To understand the basic concept of science and its application.

#### **Identifications of the Overall and Specific Curriculum Expectations:**

As mentioned in methodology three units were taken for content analysis to identify the curriculum expectations. Each specific expectation related with the respective overall expectations and an example of the strategy of teaching it in classroom was provided. As for example:

The specific expectation,

**E.1.2** Cite examples, from daily life, of kinetic energy (A cricket ball, although having a small mass when thrown by a fielder, can have a large amount of kinetic energy due to its fast velocity.)

Here 'E' denotes the specific unit, '1' denotes the overall expectation of unit 'E' and '2' denotes the specific expectation. This specific expectation was further supported with an

example a teacher could use in the classroom. In order to make relation between specific expectation and goal of physical science of secondary level clear, the specific expectation was written under respective goal, like, here it is “Relating science to technology, society, the environment and vocation.” The findings of every unit were designed in this manner.

### **Unit E: Energy in Action: Work, Power and Energy**

#### **Overall expectations:**

By the end of this unit students will:

**E.1** Assess the relation between daily human activity and the science behind work, power and energy.

**E.2** Investigate through hands on activity related to mechanical energy and inter conversion of energy.

**E.3** Demonstrate an understanding of the concepts related to work, power and energy.

#### **Specific Expectations:**

##### **E.1 Relating science to technology, society, the environment and vocation**

By the end of this unit, student will:

**E.1.1** Cite examples, from daily life, of acquiring potential energy by a body due to its change of position and change of shape ( e.g. a hammer when raised to a certain height from normal lower position possesses potential energy is an example of change of position)

**E.1.2** Cite examples, from daily life, of kinetic energy (A cricket ball, although having a small mass when thrown by a fielder, can have a large amount of kinetic energy due to its fast velocity.)

**E.1.3** Apply the principles of conservations of energy in situation of daily life (e.g rubbing of hands, switch on a torch etc.)

##### **E.2 Developing skills of investigation and communication**

By the end of this unit, student will:

**E.2.1** Investigate, whether a force is doing positive, negative or zero work ( e.g. in case of positive work, point of application moves in the direction of applied force. Example is, a stone is released from a certain height. Here gravitational force acts on the stone downwards and the stone also falls in the same direction. In the same way the student can predict the other kind of works.)

**E.2.2** Demonstrate activities related to potential and kinetic energy (e.g. a simple toy paper wheel can be used for demonstrating kinetic energy. Here, air current strikes the blades of the

paper wheel which is held in windy atmospheres. The moving air particles possess kinetic energy that is manifested as mechanical work done in rotating the wheel.)

**E.2.3** Solve numerical problems related to work, power and energy (by using the concepts and formula derived from the concepts).

### **E.3 Understanding the basic concept of science and its application**

By the end of this unit, student will:

**E.3.1** Define work, power, energy, kinetic and potential energy( e.g. work = force x displacement, power = work/time)

**E.3.2** Differentiate potential and kinetic energy (e.g. potential energy of a body or a system is the mechanical work obtainable from it when it undergoes a change of position or a change of shape.)

**E.3.3** List some event where conversion of energy from one form to another form happens (e.g. rubbing of hands is an example of conversion of mechanical energy to heat energy)

### **Unit F: Heat**

#### **Overall expectations:**

By the end of this unit students will:

**F.1** Assess the importance of fundamental principle of calorimetry, relation between heat and work, role of calorimetry behind some natural phenomena like formation of dew, fog and mist and humidity, anomalous expansion of water and its effect on human life and nature.

**F.2** Investigate, through hands on activity, the fundamental principle of calorimetry and role of heat in change of state.

**F.3** Demonstrate an understanding of different concepts related to heat and relation among them.

#### **Specific Expectations:**

### **F.1 Relating science to technology, society, the environment and vocation**

By the end of this unit, student will:

**F.1.1** Apply the knowledge related to heat in daily life like keeping the water cool in a bottle by making it an adiabatic system.

**F.1.2** Analyze the science behind the natural phenomena like formation of dew and fog (e.g. dew: if the temperature decreases slightly more than the temperature at which a certain volume of air is saturated with the water vapour present in it, the capacity of the air to hold

water vapour decreases, so the excess water vapour deposits as tiny water particles on grass and other suitable object near the ground.)

**F.1.3** Identify the effect of humidity on human life (e.g. if humidity is high the sweat from human body cannot evaporate and body feels hotter and sticky. In order to cool off, human body works harder resulting in excessive sweating which increases the rate of blood circulation and respiration.)

**F.1.4** Explain the effects of anomalous nature of water on marine life (the anomalous expansion of volume of water helps the fishes in the pond to survive even in the frozen condition of weather.)

**F.1.5** Cite examples of equivalence of work and heat from daily life and also explain the facts (e.g. when a bicycle tyre is pumped, the body of the pump gets heated. Here, due to push of the piston, the motion of the air particles inside the pump increases i.e. their kinetic energy increases. The kinetic energy of the air particles is converted to heat energy.)

## **F.2 Developing skills of investigation and communication**

By the end of this unit, student will:

**F.2.1** Show, through an experiment the phenomena – thermal equilibrium ( take hot water in a big beaker and cold water in a small beaker. Measure the temperature of both by separate thermometer. Say, the temperature of hot water is  $80^{\circ}\text{C}$  and that of cold water is  $20^{\circ}\text{C}$ . Now, put the small beaker containing cold water into the beaker containing hot water. Measure the temperature of both the water. It will be seen that, after some time, the temperature of beaker containing hot water decreases and that of cold water increases and after certain time the temperature of both the beaker will be same, say  $50^{\circ}\text{C}$ . this proves that when hot body is in the contact with cold water the energy flows from hot body to cold body until the temperature of both the body become same.)

**F.2.3** Perform an experiment to understand the change of state ( e.g. some water is taken in a beaker and the bulb of a thermometer is dipped in the water. Let the initial temperature of the water be  $30^{\circ}\text{C}$ . The water in the beaker is now heated. It will be observed that water gradually increases and when observed in short intervals, the thermometer shows rise of temperature. After some time when the temperature reaches  $100^{\circ}\text{C}$  the water starts boiling. But even if heating is continued, the temperature of the water is found to remain static at  $100^{\circ}\text{C}$ .)

**F.2.4** Solve numerical problem by analyzing and applying knowledge related to the different concepts related to heat and calorimetry (e.g. work = J x heat, where J= Joule's constant)

### **F.3 Understanding the basic concept of science and its application**

By the end of this unit, student will:

**F.3.1** Explain the concepts - heat, specific heat, latent heat and internal energy. (e.g. latent heat is the heat which changes the state of a substance. Internal energy of a body is the sum total energy of the atoms and molecules which constitute the body.)

**F.3.2** Describe the fundamental principle of Calorimetry (if during the process of thermal equilibrium, (i) no heat escapes from the system to the surroundings, (ii) no heat comes into the system from the surroundings, (iii) no chemical reaction takes place between those bodies, and (iv) no solution is produced, then, heat lost by the hot bodies = heat gained by the cold bodies.)

**F.3.3** Differentiate latent heat and sensible heat (e.g. latent heat is related to change of state of matters whereas sensible heat is related to changes in temperature of matter with no change of state.)

**F.3.4** Define thermal capacity (thermal capacity of a body is the amount of heat required to raise the temperature of the body by unity.)

**F.3.5** Assess the relationship between work and heat ( if W amount of work produces H quantity of heat or H quantity of heat produces W mechanical work, according to joule,  $W \propto H$  or  $W = J \times H$ , where J is known as Joule's constant.)

**F.3.6** Define saturated and unsaturated vapour ( e.g. at a constant temperature and pressure if a volume of air cannot absorb water vapour or vapour of other liquids any more, the air is said to be saturated with water vapour and the vapour so formed is known as saturated vapour.)

**F.3.7** Define humidity and relative humidity (e.g. humidity is a measure of water vapour in atmosphere and relative humidity is the ratio of mass of water vapour present in a certain volume of air and mass of water vapour required to saturate the same volume of air at the same temperature.)

### **Unit G: Sounds**

#### **Overall Expectations:**

By the end of this unit students will:

**G.1** Assess the importance of using the science related to sound in the field of communication, industry, and medical sciences and also the adverse effect of noise pollution on human and animal life.

**G.2** Investigate, through hands on activities, the various characteristics of sound.

**G.3 Demonstrate an understanding of the various concepts related to sound.**

**Specific Expectations:**

**G.1 Relating science to technology, society, the environment and vocation**

By the end of this unit, student will:

**G.1.1.** Explain the working system of Human or animal ear (e.g. it can be demonstrated by showing a model of human ear or by animated film.)

**G.1.2.** Assess the application of ultrasonic vibrations in industry, medical science, underwater communication and measurement of depth of the sea and by some animals (e.g. it is used for homogenising milk and cosmetics, to weld plastics and to detect the crack and faults in metals; ultra sounding of internal organs of human body helps in diagnosing disease and echocardiography uses ultra sound waves to find images of human heart. Dolphins and whales communicate under sea using ultrasound waves)

**G.1.3** Assess the causes and effects of noise pollution (e.g. causes: industrialization, transportation, poor urban planning etc. effects: hearing problem, health issues, cardiovascular issues, effect on wildlife etc.)

**G.2 Developing skills of investigation and communication**

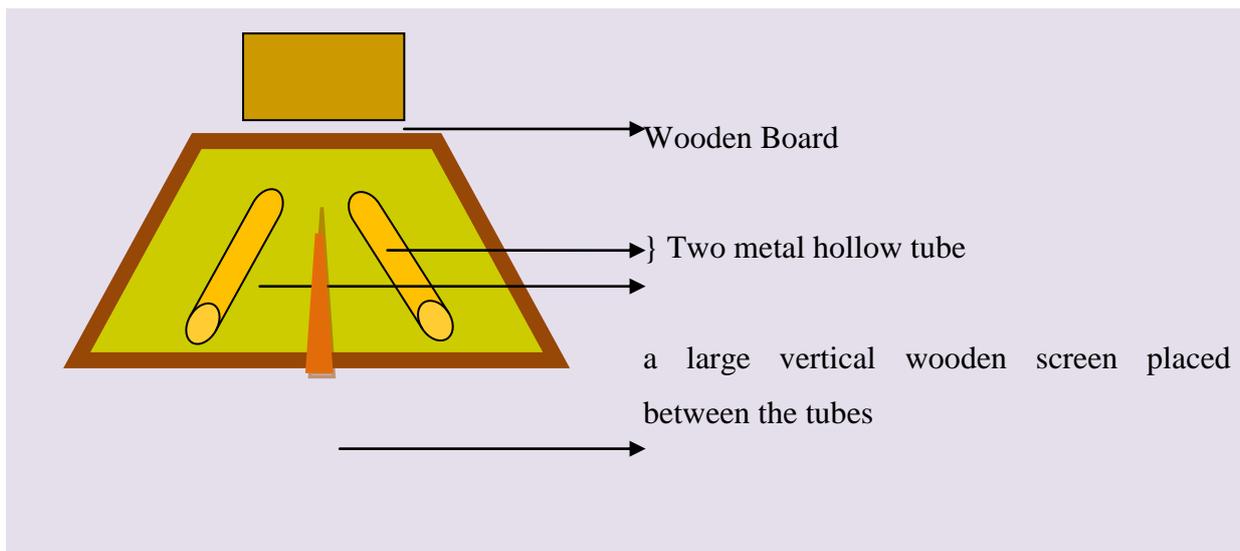
By the end of this unit, student will:

**G.2.1** Demonstrate by an activity that sound is produced by vibration (E.g. it can be demonstrated with using a stretched thin metallic wire tied between two stout supports and one inverted V-shaped paper rider)

**G.2.2** Assess by an experiment that sound need material medium for propagation (e.g. It can be shown in the class with using an electric bell, a glass bell jar with a suction pump.)

**G.2.3** Solve numerical problem related to velocity of sound, frequency and wave length (sample question: a tuning fork has frequency 256 Hz. Sound produced with it travels 20 m when the fork makes 16 vibrations. Find the wavelength and the velocity of the sound wave.)

**G.2.4** Explain the phenomena, reflection of sound by an experiment (e.g. it can be shown by an experiment which requires a large plane of a wooden board, two hollow tubes made of metal and a large vertical wooden screen placed between the tubes to cut off the direct sound from one hollow tube to another one.)



**Figure 2:** An experimental set up for reflection of light

**G.2.5.** Communicate the practical application of reflection of sound (e.g. stethoscope: by demonstrating its working system in class)

**G.2.6.** Demonstrate the practical application of echo by an power point presentation and if possible by an animated film (e.g. determination of height of an aeroplane above ground)

### **G.3 Understanding the basic concept of science and its application**

By the end of this unit, student will:

**G.3.1** Explain why voices of females and babies are more sharp than that of a grown up male person (explanation: vocal chords of female and babies are tender, so, while they speak or sing the chords vibrate with high frequency. That is why their voices are very sharp. Vocal chords of males are usually stiff, so their frequency of vibration is low and hence, male voices are generally flat.)

**G.3.2** Site examples related to the events of absence of material medium surrounding different sources of sound (e.g. the continuous explosive sounds occurring in the Sun because of conversion of hydrogen to helium by nuclear fusion is not heard from due to presence of a large space without any medium.)

**G.3.3** Explain the concept-wave (a disturbance produced in a medium by the to and fro motion of its particles about their mean position is called wave)

**G.3.4** State the characteristics of wave motion and medium (e.g. Wave motion requires a material medium to propagate. Medium must be elastic so that the particles of the medium, after displacement during wave propagation, have a tendency to come back to the original position.)

**G.3.5** Differentiate transverse wave and longitudinal wave (e.g. in case of transverse wave when wave passes through a medium, the particles of the medium vibrate at right angle to the direction of propagation. in case of longitudinal wave, when wave passes through a medium, the particles of the medium vibrate parallel to the direction of propagation.)

**G.3.6** Understand the concepts related to sound waves like amplitudes, times period and frequency of vibration ( e.g. amplitude: the maximum displacement of a vibrating particle in a medium on either side of its mean position.)

**G.3.7** State the factors on which velocity of sound is dependent and how (e.g. temperature: velocity of sound increases with temperature.)

**G.3.8** Differentiate between audible and in-audible sound (explanation: audible sound: frequency range is 20 vibrations per second to 20000 vibrations per second where any vibration is more or less than this range it is in-audible to human being)

**G.3.9** Differentiate between musical sound and noise (e.g. musical sound: when the vibration of source of sound is regular, continuous and periodic. Noise: when the vibration of source of sound is irregular, discontinuous and non-periodic.)

### **Conclusion**

Curriculum expectation explains those knowledge and skills that a student is expected to learn from the curriculum. Identification of the curriculum expectations regarding physical science at the secondary level of West Bengal Board of Secondary Education will help the various stakeholders in many ways. For example, the parents will get a brief idea of the physical science curriculum at the secondary level. They will understand what their children are going to learn and hence will be able to comprehend their roles by helping the school in achieving those expectations. Thus, it will provide a path of collaboration between the school and the parents which will further help the students to have a greater learning. The identified specific expectations of each unit will aid the teachers in developing their instructional objectives. Thus, the identified expectations can be treated as the guideline for the classification of instructional objectives. This will further help the teachers in assessing their students. The students must know before studying what they are expected to achieve after the completion of the physical science curriculum at the secondary level. This will provide them with a clear vision and will help them to set their mission in achieving the curriculum expectations. It will also help them to develop broader mental capacities and scientific attitudes which are extremely important for a universal progress towards scientific endeavour. Thus, it can be concluded that the identification of curriculum expectation of any subject at

any level is an important task as it provides a direction and helps to understand the role of the different stakeholders.

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