SCIENCES OVERVIEW
GRADES IX AND X

Delhi Board of School Education (DBSE)

Directorate of Education, Government of National Capital Territory of Delhi

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ABBREVIATIONS AND ACRONYMS

ASoSE	Ambedkar School of Specialised Education
DBSE	Delhi Board of School Education
TA	Term-end Assessment
IA	Internal Assessment
IB	International Baccalaureate
IGCSE	International General Certificate of Secondary Education
KP	Knowledge Partners
MYP	Middle Years Programme

1. Introduction

1.1. Developing curriculum for Sciences

Science may be defined as a systematic, rigorous, social endeavour that satisfies the human curiosity about nature through testable explanations and predictions (Science curriculum development team, DBSE). It has been described as a dynamic, expanding body of knowledge that covers ever new domains of experience. It involves: observations; identifying regularities and patterns; making hypothesis; devising quantitative & qualitative or mathematical models and; deducing their consequences.

Like every other source of knowledge, science is also not without limitations. The explanatory power of science is limited when it comes to dealing with non-linear complex systems of nature like human society. Moreover, the end results obtained through science are not fixed. These may change in light of new evidence obtained through more advanced techniques of observations.

Now a general question may be asked regarding why someone should study Science. The reason that may be stated is that it is the most reliable, objective and powerful knowledge system which works on a consensual approach that can resolve the threats of conflicts posed by other knowledge systems. As stated by NCERT, 2006, 'Science tempered with wisdom is the surest and the only way to human welfare'. Therefore, science must be learnt and practiced by every person in a progressive, democratic society. To cater to this vision, science education must involve following agencies: (a) learner (b) environment (c) object of learning.

With a consideration of the above needs this science curriculum has been developed. To be in accord with the local, national and international context of Delhi, due importance has been given to some factors, which are as follows:

- Equal importance has been given to product, process and attitudinal nature of science.
- The subjectivity of experiential learning has been given due value.
- The learner centricity of the curriculum has been ensured to cater to creativity.
- The science curriculum gives opportunities to learners to collaborate for learning through inquiry.
- Inquiry-based learning through a constructivist approach has been adopted, that is closest to the natural way of learning and that ensures learning by doing.
- The emergent structure of this science curriculum overcomes the limitations of pre-defined curriculum.
- The curriculum develops higher order thinking skills among learners through inquiry-based science learning that requires learners in the role of knowledge creators rather than being merely at the recipient end of knowledge.
- Multilingualism and the power of language in science has been realized and the curriculum focuses on local or regional language in learning science.
- Holistic education (as expressed in NEP, 2020) has been focused.
- Transdisciplinary nature is the characteristic of this science curriculum, that breaks the barrier of subject disciplines and intermingles with each and every aspect of learning.
- Highest importance has been given to conceptual learning in science to overcome rote learning and learning for exams.
- Importance has also been given to ethics, human and constitutional values and critical thinking.
- Use of technology has been adopted as an integral part of the learning process.

- The emergent science curriculum focuses on developing abilities in cognitive, affective and psychomotor domains.

The development process of this emergent science curriculum is as interesting as the curriculum itself. The steps that have led to this curriculum began with the survey of the science curriculum of different state boards of India and NCERT by the curriculum development team. On the basis of this survey a list of chapters and topics was developed which was followed by a discussion among the team members regarding the what, why and how of topics in the curriculum. The selection of topics was made on the basis of the scope of experiential learning, appropriateness according to the age of learners and the learning needs as per the global and local contexts.

After the selection of various themes and topics a rigorous exercise was done to ensure spirality of learning topics, which has been a characteristic of all the earlier science curriculums in India too. For this the progression of topics from class VI to X was carefully placed. All these exercises helped to develop the curriculum overview as per the guidelines of International Baccalaureate by considering appropriate global contexts, key concepts, connecting concepts and the statements of enquiry for each unit. All the topics that were interconnected and could provide content for pursuing the statement of inquiry were kept in one unit, which formed the basis of the development of drafts of Unit plans.

The next step was co-creation with practitioners through a 5-day workshop, during which each and every component of the curriculum, i.e. curriculum overview, unit plan, pedagogy companion, assessment prototypes and students' companions were discussed. The curriculum was then co-created on the basis of agreement among the curriculum development team and the practitioners.

The co-created curriculum was still not finalized because the logistics of actual implementation were yet to be analysed. For this purpose, the actual implementation of co-created curriculum in real classrooms was observed by the curriculum development team along with the peers of practitioners. On the basis of these observations, the strengths and weaknesses of the co-created curriculum were documented, on the basis of which, the curriculum was once again revised.

This revised curriculum can be considered as the one which is being piloted during the session of 2022-2023.

1.2. Aims of MYP Sciences

The aims of all MYP subjects state what a teacher may expect to teach and what a student may expect to experience and learn. These aims suggest how the student may be changed by the learning experience.

The aims of MYP Sciences are to encourage and enable students to:

- understand and appreciate science and its implications.
- consider science as a human endeavour with benefits and limitations.
- cultivate analytical, inquiring and flexible minds that pose questions, solve problems, construct explanations and judge arguments.
- develop skills to design and perform investigations, evaluate evidence and reach conclusions.
- build an awareness of the need to effectively collaborate and communicate.
- apply language skills and knowledge in a variety of real-life contexts.
- develop sensitivity towards the living and non-living environments.
- reflect on learning experiences and make informed choices.

1.3. Objectives of MYP Sciences

The objectives of MYP Individuals & Societies encompass the factual, conceptual, procedural and metacognitive dimensions of knowledge and these objectives relate directly to the assessment criteria.

A. Knowing and understanding: Students develop scientific knowledge (facts, ideas, concepts, processes, laws, principles, models and theories) and apply it to solve problems and express scientifically supported judgments. In order to reach the aims of sciences, students should be able to:

i. explain scientific knowledge
ii. apply scientific knowledge and understanding to solve problems set in familiar and unfamiliar situations
iii. analyse and evaluate information to make scientifically supported judgments

B. Inquiring and designing: Intellectual and practical skills are developed through designing, analysing and performing scientific investigations. Although the scientific method involves a wide variety of approaches, the MYP emphasizes experimental work and scientific inquiry.

In order to reach the aims of sciences, students should be able to:

i. explain a problem or question to be tested by a scientific investigation
ii. formulate a testable hypothesis and explain it using scientific reasoning
iii. explain how to manipulate the variables, and explain how data will be collected
iv. design scientific investigations

C. Processing and evaluating: Students collect, process and interpret qualitative and/or quantitative data, and explain conclusions that have been appropriately reached. MYP sciences helps students to develop analytical thinking skills, which they can use to evaluate the method and discuss possible improvements or extensions.

In order to reach the aims of sciences, students should be able to:

i. present collected and transformed data
ii. interpret data and explain results using scientific reasoning
iii. evaluate the validity of a hypothesis based on the outcome of the scientific investigation
iv. evaluate the validity of the method
v. explain improvements or extensions to the method.

D. Reflecting on the impacts of science: Students gain global understanding of science by evaluating the implications of scientific developments and their applications to a specific problem or issue. Varied scientific language will be applied in order to demonstrate understanding. Students are expected to become aware of the importance of documenting the work of others when communicating in science.

Students must reflect on the implications of using science, interacting with one of the following factors: moral, ethical, social, economic, political, cultural or environmental, as appropriate to the task. The student's chosen factor may be interrelated with other factors.

In order to reach the aims of sciences, students should be able to:

i. explain the ways in which science is applied and used to address a specific problem or issue
ii. discuss and evaluate the various implications of the use of science and its application in solving a specific problem or issue
iii. apply scientific language effectively
iv. document the work of others and sources of information used

2. Science as a subject

2.1. Approach to subject

It is very important that anyone who observes a science classroom in a school affiliated to Delhi Board of School Education, must be aware of what is expected there. The first important thing to understand is that the role of teacher in such a classroom is that of a facilitator. It would be very much normal, if someone finds learners to be sitting in groups, facing each other and discussing or brainstorming, rather than a teacher giving learning instructions and all the learners facing towards him/her.

The next important feature is inquiry-based learning, which means that the learners' natural tendency to ask questions must be engaged for promoting learning. This would require a facilitator to create an environment that stimulates learners to ask questions, formulate hypotheses, conduct surveys, do experiments, visit places and sites to make and record observations, draw inferences and present findings to the facilitator and peers. For this, the statement of inquiry, knowledge-based questions, conceptual questions and debatable questions would be helpful. The learners will be the agents of learning in such classes and will take the responsibility of constructing their own learning. Regarding the context, in which the learners must get opportunity to learn, it must be local, national as-well-as global.

A session would be called inquiry based, emergent and constructivist, where the facilitator induces a topic of learning (from a unit) that develops curiosity among learners, due to which students ask some questions. The facilitator instead of giving readymade answers, asks learners to plan activities in groups to get answers of those questions and also guides the groups of learners to execute those activities. The groups then collaborate to get answers, record the whole process of learning and present the findings before the class. During and after the presentations the facilitator and other groups discuss the findings and give feedback to the presenters.

The assessment here will be learner centric, continuous and based on process as-well-as products of science learning. The purpose of assessment will be as, for and of learning.

3. Key Concepts in Sciences

3.1 Change

Change is a conversion, transformation or movement from one form, state or value to another. Inquiry into the concept of change involves understanding and evaluating causes, processes and consequences. In sciences, change is viewed as the difference in a system's state when observed at different times. This change could be qualitative (such as differences in structure, behaviour, or level) or quantitative (such as a numerical variable or a rate). Change can be irreversible, reversible or self-perpetuating.

3.2 Relationships

Relationships are the connections and associations between properties, objects, people and ideas—including the human community's connections with the world in which we live. Any change in relationship brings consequences—some of which may occur on a small scale, while others may be far reaching, affecting large networks and systems such as human societies and the planetary ecosystem. Relationships in sciences indicate the connections found among variables through observation or experimentation. These relationships also can be tested through experimentation. Scientists often search for the connections between form and function. Modelling is also used to represent relationships where factors such as scale, volume of data, or time make other methods impractical.

3.3 Systems

Systems are sets of interacting or interdependent components. Systems provide structure and order in human, natural and built environments. Systems can be static or dynamic, simple or complex. Systems in sciences describe sets of components that function due to their interdependence or complementary nature. Common systems in science are closed systems, where resources are not removed or replaced, and open systems, where necessary resources are renewed regularly. Modelling often uses closed systems to simplify or limit variables

4. Sciences curriculum overview for grades IX and X

An academic year at DBSE consists of two terms. Grade IX and X curriculum is clustered into 6 units. These units are delivered in two terms of an academic year. Unit names, content, duration and the learning resources are provided in the subsequent sections.

4.1. Grade IX Curriculum overview

Table 1: Unit names, content, duration and the learning resources in grade IX units

Grade IX			
Term 1			
Unit	**Content**	**Duration**	**Resources**
Structural Organisation In Living & Our Wellness	• Cell- the fundamental unit of life • Tissues • Health and diseases	4 weeks	• Pedagogue Companion • Student Companion • NCERT, e-Pathshala • DIKSHA PORTAL
The Material World	• Matter in our surroundings • Matter around us- pure or impure	4 weeks	
Motion, Force And Energy	• Motion • Force and laws of motion • Work and Energy	4 weeks	

Grade IX - Term 2			
Understanding The World Around Us	• Atoms and molecules • Structure of atom • Gravitation	5 weeks	• Pedagogue Companion • Student Companion • NCERT, e-Pathshala • DIKSHA PORTAL
Harmony & Diversity In Biological And Physical World	• Diversity in living organism • Sound	5 weeks	
Balance In Nature	• Our environment • Environmental problems and their solutions • Food resources	5 weeks	

4.2. Grade X curriculum overview

Table 2: Unit names, content, duration and the learning resources in grade X units

Grade X			
Term 1			
Unit	**Content**	**Duration**	**Resources**
Energy: Needs And Interactions	• Food habits and shortage • Chemical reactions • Light	5 weeks	• Pedagogue Companion • Student Companion • NCERT, e-Pathshala • DIKSHA PORTAL
The Living World And Its Interactions	• Human eye • Acids, Bases, Salts • Linkages in Body systems part 1	5 weeks	
Elements: Journey From Physical To Biological World	• The universe • Elements in our life • Linkages in body systems part 2	5.5. weeks	
Term 2			
Transformations In Physical And Biological World	• Elements: Classification and periodicity • Genetics and evolution • Electricity	4 weeks	• Pedagogue Companion • Student Companion • NCERT, e-Pathshala • DIKSHA PORTAL
Managing Energy And Nature	• Magnetic effects of current • Human coexistence with nature • Carbon	4 weeks	
Matter And Environment	• Some important Carbon compounds • Sources of energy • Moving towards a sustainable world	4 weeks	

5. Assessment Overview

DBSE approach to assessment and reporting is based on the IB specified assessment criteria and grades. Criterion based assessments enable students to self-monitor and build self-belief as they can see the evidence of the progress they are making over time. Students can track their progress using level descriptors, they can clearly understand how their work can be improved over time.

The four core criteria assessed in Sciences are:

- Criterion A – Knowing and understanding
- Criterion B – Inquiring and designing
- Criterion C – Progressing and Evaluating
- Criterion D – Reflecting on the impacts of science

DBSE promotes multiple ways of assessing students. There are three types of assessments conducted at DBSE schools throughout a learning period.

Assessment for learning: It is the process of gathering and interpreting evidence for use by students and teachers to know where the students are on their learning pathway, decide where they need to go and how best to get there. The teacher plays a supportive role wherein the student responses in the assessment tasks are analysed to help students progress on their learning pathway. Consequently, it is important that these assessments must always be accompanied by feedback and feed-forward mechanisms to enable deep learning and help improve teaching. Example tasks include homework, classwork, class tests, assignments, projects, etc. The assessments should provide the right amount of challenge to students based on learning levels so that appropriate feedback can be provided.

Assessment of learning: It takes place at key points in the learning cycle, such as at the end of a learning period, e.g. a term, to measure if students have achieved the learning objectives. Example tasks include exams, final projects, essays, etc. The primary purpose is to assess what students can do at a point in time to understand their readiness to move to the next stage of education.

Assessment as learning: Students are provided with opportunities to monitor their own progress, self-assess and reflect on their learning. Example tasks include self-assessment, peer assessment, student portfolio, etc.

The assessment tasks and methods used in internal assessment are criterion related, student-centric and provide feedback for further enhancement of learning. There are two types of assessments used for reporting student performance.

- Internal assessments (IA) (20%)
- Term-end assessments (TA) (80%)

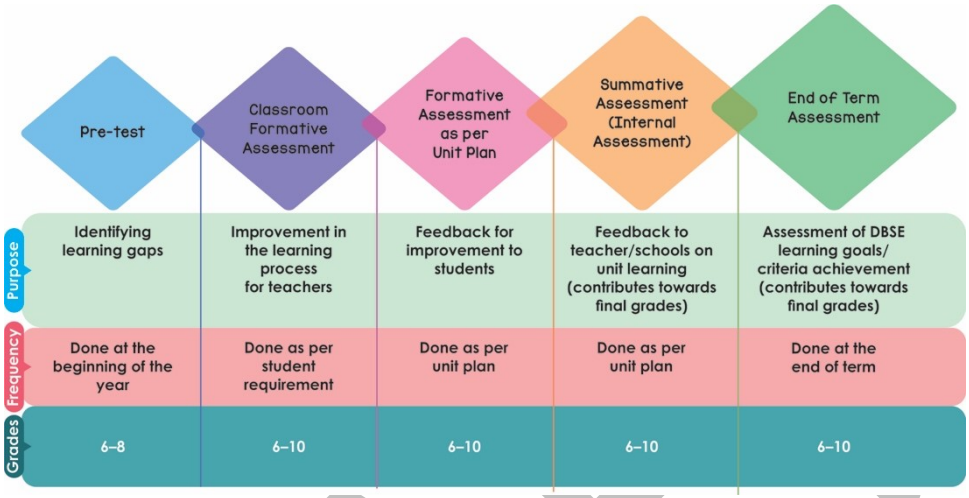
The assessment tasks and methods used in internal assessments provide opportunities for students to show their academic achievements in multiple ways and provide feedback for further enhancement of learning. External assessment tasks are based on curriculum objectives defined for Sciences.

DBSE assessments used for reporting for grades 9 & 10 can be school-led and/or board-led. School-led assessments are based on an item pool provided by DBSE and Board-led assessments are developed and administered by DBSE. In grade 10, DBSE monitor internal assessments and readiness assessments. Term-end assessments are conducted by DBSE.

5.1. Assessment structure

Global best practices suggest a multifaceted assessment structure. That is, students should be assessed in multiple ways and at multiple times without increasing the workload of teachers or students, to the extent possible. A schematic representation of the DBSE assessment structure is presented below:

Figure 1: Assessments in DBSE



5.2. Assessment calendar

The assessment calendar for internal and external assessments for academic year 2022- 23 grade IX assessments is given below.

Table 3: Grade IX School assessment calendar

Unit	Duration		Assessment	Criteria Assessed	Assessment Strategies
1	4-Jul	30 - Jul	IA - Unit 1 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	Performance tasks: • Analysis and reflection. • E-portfolios /portfolios of coursework • Group discussions • Hands-on experimentation • Organized debates • Presentations – verbal (oral or written), graphic (through various media) • Planning the steps of inquiry projects • Research projects • Project reports • Model making • Field trip notes
2	1- Aug	27-Aug	IA - Unit 2 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	
3	29-Aug	24 - Sep	IA - Unit 3 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	
10 – 24 October 2022			**Term-end 1**	**All 4 Criteria**	**Competency based assessment**
4	1-Nov	3- Dec	IA - Unit 4 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	Performance tasks: • Analysis and reflection. • E-portfolios/portfolios of coursework • Group discussions • Hands-on experimentation • Organized debates • Presentations – verbal (oral or written), graphic (through various media) • Planning the steps of inquiry projects • Research projects • Project reports • Model making • Field trip notes
5	5-Dec	21 -Jan	IA - Unit 5 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	
6	23-Jan	12-Feb	IA - Unit 6 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	
1 - 20 March 2023			**Term-end 2**	**All 4 Criteria**	**Competency based assessment**

Table 4: Grade X Schools assessment calendar

Unit	Duration		Assessment	Criteria Assessed	Assessment Strategies
1	4-April	5-May	IA - Unit 1 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	Performance tasks: • Analysis and reflection. • E-portfolios/portfolios of coursework • Group discussions • Hands-on experimentation • Organized debates • Presentations – verbal (oral or written), graphic (through various media) • Planning the steps of inquiry projects • Research projects • Project reports • Model making • Field trip notes
2	9-May	5-Aug	IA - Unit 2 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	
3	8-Aug	10-Sep	IA - Unit 3 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	
12 Sept – 24 Sept 2022			Readiness Assessment	All 4 Criteria	Competency based assessment
10 – 24 October 2022			**Term-end 1**	**All 4 Criteria**	**Competency based assessment**
4	1-Nov	30-Nov	IA - Unit 4 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	Performance tasks: • Analysis and reflection. • E-portfolios/portfolios of coursework • Group discussions • Hands-on experimentation • Organized debates • Presentations – verbal (oral or written), graphic (through various media) • Planning the steps of inquiry projects • Research projects • Project reports • Model making • Field trip notes
5	1-Dec	31-Dec	IA - Unit 5 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	
6	16-Jan	4-Feb	IA - Unit 6 Summative	A: Knowing and understanding B: Inquiring and Designing C: Processing and evaluating D: Reflecting on the impacts of science	
12- 24 February 2022			Readiness Assessment	All 4 Criteria	Competency based assessment
1 - 20 March 2023			**Term-end 2**	**All 4 Criteria**	**Competency based assessment**

5.3. Assessment levels and grades

The Assessment Criteria directly relate to the Objectives of the curriculum and carry equal weightage. The student achievement levels will be reported as a number grade as done in IB with an associated description.

The grade descriptions are based on assessment criteria levels. The level descriptors of an assessment criterion depict clear progression of improvement of skills and competencies for a learning period.

All the assessment tasks used to report students' achievements are based on task specific, hierarchical, and qualitatively defined rubrics. The categories used in rubrics represent increasing quality or sophistication of response to a task. They provide a basis for evaluating and recording students' responses to an assessment task. A rubric makes assessment expectations transparent.

In order to show the degree of competence in each criterion, fine grained descriptions of various levels are used. These descriptions indicate the progression of achievement in each criterion. IB Sciences criteria levels and grade descriptions are given in the following tables

Table 5: Criterion A: Knowing and understanding

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. state scientific knowledge ii. apply scientific knowledge and understanding to suggest solutions to problems set in familiar situations iii. interpret information to make judgments.
3-4	The student is able to: i. outline scientific knowledge ii. apply scientific knowledge and understanding to solve problems set in familiar situations iii. interpret information to make scientifically supported judgments
5-6	The student is able to: i. describe scientific knowledge ii. apply scientific knowledge and understanding to solve problems set in familiar situations and suggest solutions to problems set in unfamiliar situations iii. analyse information to make scientifically supported judgments.
7-8	The student is able to: i. explain scientific knowledge ii. apply scientific knowledge and understanding to solve problems set in familiar and unfamiliar situations iii. analyse and evaluate information to make scientifically supported judgments.

Table 6:Criterion B: Inquiring and Designing

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. state a problem or question to be tested by a scientific investigation ii. outline a testable hypothesis iii. outline the variables iv. design a method, with limited success.
3-4	The student is able to: i. outline a problem or question to be tested by a scientific investigation ii. formulate a testable hypothesis using scientific reasoning iii. outline how to manipulate the variables, and outline how relevant data will iv. be collected v. design a safe method in which he or she selects materials and equipment.
5-6	The student is able to: i. describe a problem or question to be tested by a scientific investigation ii. formulate and explain a testable hypothesis using scientific reasoning iii. describe how to manipulate the variables, and describe how sufficient, iv. relevant data will be collected v. design a complete and safe method in which he or she selects appropriate materials and equipment.
7-8	The student is able to: i. explain a problem or question to be tested by a scientific investigation ii. formulate and explain a testable hypothesis using correct scientific iii. reasoning iv. explain how to manipulate the variables, and explain how sufficient, v. relevant data will be collected vi. design a logical, complete and safe method in which he or she selects vii. appropriate materials and equipment

Table 7: Criterion C: Processing and Evaluating

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. collect and present data in numerical and/or visual forms ii. interpret data iii. state the validity of a hypothesis based on the outcome of a scientific investigation iv. state the validity of the method based on the outcome of a scientific investigation v. state improvements or extensions to the method.
3-4	The student is able to: i. correctly collect and present data in numerical and/or visual forms ii. accurately interpret data and explain results iii. outline the validity of a hypothesis based on the outcome of a scientific iv. investigation v. outline the validity of the method based on the outcome of a scientific vi. investigation vii. outline improvements or extensions to the method that would benefit the viii. scientific investigation
5-6	The student is able to: i. correctly collect, organize and present data in numerical and/or visual forms ii. accurately interpret data and explain results using scientific reasoning iii. discuss the validity of a hypothesis based on the outcome of a scientific investigation iv. discuss the validity of the method based on the outcome of a scientific investigation v. describe improvements or extensions to the method that would benefit the scientific investigation.
7-8	The student is able to: i. correctly collect, organize, transform and present data in numerical and/or visual forms ii. accurately interpret data and explain results using correct scientific reasoning iii. evaluate the validity of a hypothesis based on the outcome of a scientific investigation iv. evaluate the validity of the method based on the outcome of a scientific investigation v. explain improvements or extensions to the method that would benefit the scientific investigation.

Table 8: Criterion D: Reflecting on the Impacts of Science

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. outline the ways in which science is used to address a specific problem or issue ii. outline the implications of using science to solve a specific problem or issue, interacting with a factor iii. apply scientific language to communicate understanding but does so with limited success iv. document sources, with limited success
3-4	The student is able to: i. summarize the ways in which science is applied and used to address a specific problem or issue ii. describe the implications of using science and its application to solve a specific problem or issue, interacting with a factor iii. sometimes apply scientific language to communicate understanding iv. sometimes document sources correctly.
5-6	The student is able to: i. describe the ways in which science is applied and used to address a specific problem or issue ii. discuss the implications of using science and its application to solve a specific problem or issue, interacting with a factor iii. usually apply scientific language to communicate understanding clearly and precisely iv. usually document sources correctly
7-8	The student is able to: i. explain the ways in which science is applied and used to address a specific problem or issue ii. discuss and evaluate the implications of using science and its application to solve a specific problem or issue, interacting with a factor iii. consistently apply scientific language to communicate understanding clearly and precisely iv. document sources completely.

Table 9: Description of Grade points

Grade	Grade Description
7	Produces high-quality work with frequent insightful scientific discussion that is fully justified. Communicates comprehensive, nuanced understanding of concepts and contexts demonstrating proficient use of scientific and technical communication modes. Consistently demonstrates sophisticated analytical thinking and critical evaluation to make scientifically supported judgments. Frequently transfers scientific knowledge and applies scientific skills, with independence and expertise, in complex classroom and real-world situations.
6	Produces high-quality work with occasionally insightful scientific discussion and justification. Communicates extensive understanding of concepts and contexts demonstrating proficient use of scientific and technical communication modes. Demonstrates analytical thinking and critical evaluations to make scientifically supported judgments, frequently with sophistication. Transfers scientific knowledge and applies scientific skills, often with independence, in classroom and real-world situations.
5	Produces generally high-quality work with scientific discussion and justification. Communicates good understanding of concepts and contexts demonstrating proficient use of scientific and technical communication modes. Demonstrates analytical thinking and critical evaluations to make scientifically supported judgments, sometimes with sophistication. Usually transfers scientific knowledge and applies scientific skills, with some independence, in classroom and real-world situations.
4	Produces good-quality work with some evidence of scientific discussion and justification. Communicates basic understanding of most concepts and contexts with evidence of appropriate scientific and technical communication modes, with few misunderstandings and minor gaps. Often demonstrates analytical thinking to make scientifically supported judgments. Transfers some scientific knowledge and applies some scientific skills in classroom and real-world situations, but requires support in unfamiliar situations.
3	Produces work of an acceptable quality with occasional evidence of scientific description. Communicates basic understanding of many concepts and contexts, with occasional significant misunderstandings or gaps. Begins to demonstrate some analytical thinking and begins to make scientifically supported judgments. Begins to transfer scientific knowledge and apply skills, requiring support even in familiar classroom situations
2	Produces work of limited quality. Communicates limited understanding of some concepts and contexts with significant gaps in understanding. Demonstrates limited evidence of scientific thinking. Limited evidence of transfer of scientific knowledge and application of skills.
1	Produces work of a very limited quality. Conveys many significant misunderstandings or lacks understanding of most concepts and contexts. Very rarely demonstrates evidence of scientific thinking. Very inflexible, rarely shows evidence of knowledge or skills.