

TEC_Science: Textbook Evaluation Checklist for Science

TEC_Science is a checklist for quality evaluation of science textbook and the support materials that may come with it like teacher manuals and/or digital support like simulations/animations/videos. A textbook can contain the following, apart from content explanation - examples, chapter summary, [formative assessment](#) questions that students can solve in-class, [experiments](#) that they can try out, [summative assessment](#) questions, answers to [summative assessment](#), notes to the teacher etc. TEC_Science can be used by school principals, head of the departments and teachers to select a textbook, from the vast array that is available, such that it would support effective teaching of science for their students.

TEC_Science has 22 questions along 3 dimensions of evaluation - content quality (5 questions), pedagogical alignment (14 questions) and technology integration (3 questions).

How to use TEC_Science:

1. Select some representative chapters from the textbook. Representative chapters can be those chapters that deal with topics that students are known to find difficult to grasp.
2. Go through the representative chapters and all the support materials related to those chapters. Record your overall score for each question in TEC_Science by judging across all the representative chapters and simply ticking against the 3-point scale – Missing, Partially satisfied and Adequate. Tick ‘Adequate’ if you find the textbook and support materials have addressed all the relevant points pertaining to the question. Tick ‘Partially satisfied’ if only a subset of relevant points have been addressed. Tick ‘Missing’ if none of the relevant points have been addressed.
3. Use the additional ‘Remarks’ column to give recommendations to improve quality of the textbook and/or support materials. In this column, you may make notes of the following nature about the textbook and support materials: i) If you have given partial ratings, write those missing requirements which would need to be included or, ii) Write what you liked about the textbook and support materials, citing examples.
4. Click on the hyperlinked terms in this document to get their detailed explanation from the ‘Glossary’ section.

Content Quality (C)	0 (Missing)	1 (Partially satisfied)	2 (Adequate)	Remarks
Score				
Questions				
C1. Is the content <u>accurate</u>? <u>To score this question:</u> Tick 'Adequate' if all of the following points are satisfied by the textbook and support materials: use of a) precise and accurate content, b) accurate scientific terminology and c) correct representations of scientific phenomena (e.g., pictures, symbols, expressions, equations, and graphics). Tick 'Partially satisfied' if any of the above points are not satisfied				
C2. Are grade-appropriate <u>scientific knowledge and skills</u>, as outlined by the Board, addressed? <u>To score this question:</u> Tick 'Adequate' if the textbook and support materials address all the following points: 'student inquiry, reflection, critical thinking, problem-solving, and sense-making, making connection to prior knowledge and process skills like observation, design, analysis, argumentation, prediction, drawing inference'. Tick 'Partially satisfied' if only some of the above points have been addressed.				
C3. Is the content situated in an appropriate <u>context</u> to illustrate the scientific concepts? <u>To score this question:</u> Tick 'Adequate' if relevant and sufficient context is presented to explain the content. Tick 'Partially satisfied' if context presented is relevant but not sufficient to explain the content. Tick 'Missing' if either no context is presented or context presented is irrelevant.				

Content Quality (C)	0 (Missing)	1 (Partially satisfied)	2 (Adequate)	Remarks
<p>C4. Are the <u>formative</u> and <u>summative</u> assessment questions <u>correct, clear and unambiguous</u>?</p> <p><u>To score this question:</u> Tick 'Adequate' if the following points are satisfied by assessment questions: a) correct and b) clear & unambiguous. Tick 'Partially satisfied' if the assessment questions satisfy a subset of the above points.</p>				
<p>C5. Is the spelling and grammar correct, and the <u>formatting consistent</u>, in various parts of the textbook and/or support materials?</p> <p><u>To score this question:</u> Tick 'Adequate' if all the following points are satisfied: a) spelling and grammar correct, b) formatting consistent. Tick 'Partially satisfied' if any one of the points is not satisfied.</p>				

Pedagogical alignment (P)	0 (Missing)	1 (Partially satisfied)	2 (Adequate)	Remarks
<p style="text-align: right;">Score</p> <p>Questions</p>				
<p>P1. Are all <u>necessary</u> learning objectives <u>stated explicitly</u> for each chapter?</p> <p><u>To score this question:</u> Tick 'Adequate' only if all the following points are satisfied: a) All necessary learning objectives are stated explicitly. b) The learning objectives are written correctly. c) The learning objectives can be easily found in expected places like at the beginning of the textbook chapter or in the teacher manual or digital support.</p>				

Pedagogical alignment (P)	0 (Missing)	1 (Partially satisfied)	2 (Adequate)	Remarks
<p>P2. Is the content in a chapter organized into sections and alternating with formative assessments and experiments?</p> <p><u>To score this question:</u> Tick 'Adequate' only if textbook and digital support is sectioned in the following way: (a) The chapter is divided into small content sections. (b) Content sections alternate with formative assessment and/or experiments to do sections. There should NOT be continuous content unit with formative assessments and experiments coming only at the end. (c) Sections from (a) and (b) should appear as logically and physically separate units. Tick 'Partially satisfied' if any one of the above points is not satisfied.</p>				
<p>P3. Are common student misconceptions addressed?</p> <p><u>To score this question:</u> Tick 'Adequate' if the textbook and support materials address all major misconceptions. Tick 'Partially satisfied' if only a subset of the major misconceptions are addressed.</p>				
<p>P4. Is guidance provided to students to conduct some experiments through which they can experience a scientific phenomenon as directly as possible?</p> <p><u>To score this question:</u> Tick 'Adequate' if the textbook or digital support outline the materials required and procedure of experiment while the observation and inference is left to the students to unravel. Tick 'Partially satisfied' if the experiment is described in terms of materials required, procedure, observation and inferences.</p>				

Pedagogical alignment (P)	0 (Missing)	1 (Partially satisfied)	2 (Adequate)	Remarks
<p>P5. Are opportunities provided to students to <u>connect multiple concepts within or across subjects</u>, instead of studying in isolation?</p> <p><u>To score this question:</u> Tick 'Adequate' only if both the following points are satisfied: a) Connection between different subjects (e.g. science & mathematics or social science & science) are conveyed to students b) Opportunities are provided to students to apply multiple scientific concepts to arrive at a correct answer.</p>				
<p>P6. Are the <u>formative</u> and <u>summative</u> assessments <u>aligned</u> with the learning objectives?</p> <p><u>To score this question:</u> Tick 'Adequate' if there are one or more assessment questions at the same cognitive level as the stated learning objectives. Tick 'Partially satisfied' if no assessment question is present at the cognitive level of some of the stated objectives.</p>				
<p>P7. Are some <u>formative</u> and <u>summative</u> assessment questions included, that require students to demonstrate higher-order scientific thinking skills (<u>HOTS</u>)?</p> <p><u>To score this question:</u> Tick 'Adequate' only if the assessment questions in the textbook and support materials include all the HOTS important for the chapter. Tick 'Partially satisfied' if some of the important HOTS have been missed.</p>				

Pedagogical alignment (P)	0 (Missing)	1 (Partially satisfied)	2 (Adequate)	Remarks
<p>P8. Are opportunities provided for group activity among students?</p> <p><u>To score this question:</u> Tick 'Adequate' if the group activity satisfies the following points: (a) students discuss & debate the solution within their group, (b) build on each other's expertise to together come up with a correct solution. Tick 'Partially satisfied' if the group activity does not satisfy any one of the above points</p>				
<p>P9. Do the answers given for the <u>summative</u> assessment questions, provide corrective and explanatory feedback?</p> <p><u>To score this question:</u> Tick 'Adequate' if the given answer shows the steps to arrive at the correct answer or gives reasoning for why the answer is true or false, provided the question is beyond recall level. Tick 'Partially satisfied' if answer given is limited to the correct numeric answer without giving any explanation or, simply says true or false.</p>				
<p>P10. Is the <u>diversity among your students</u> represented in the textbook and digital support (for e.g. socio-cultural/ gender/linguistic diversity)?</p> <p><u>To score this question:</u> Tick 'Adequate' if you find the content in the textbook and support materials cover the diversity among your students in terms of gender, religion, economic strata etc. Tick 'Partially satisfied' if the textbook and support materials miss addressing any of your student diversity characteristics.</p>				

Pedagogical alignment (P)	0 (Missing)	1 (Partially satisfied)	2 (Adequate)	Remarks
<p>P11. Are conversational style and <u>human-like characters</u> (e.g. Bhoojo and Paheli in NCERT textbooks) used to communicate with students?</p> <p><u>To score this question:</u> Tick 'Adequate' if textbook and digital support satisfy the following points: uses a) conversational style (such as 'us' and 'we'), b) human-like characters. Tick 'Partially satisfied' if any of the points is not satisfied.</p>				
<p>P12. Is the textbook layout well organized, visually attractive and thoughtfully designed to engage the students at that grade level?</p> <p><u>To score this question:</u> Tick 'Adequate' if the following points are satisfied: a) the text content, tables and graphics are meaningfully organized and b) there are sufficient number of graphics that will visually attract students and also add to the content explanation. Tick 'Partially satisfied' if any one of the points is not satisfied.</p>				
<p>P13. Are links provided for digital support that <u>enhance meaningful learning</u> of the content?</p> <p><u>To score this question:</u> Tick 'Adequate' if textbook or teacher manual provides links to digital support that enhances learning of the content. Tick 'Partially satisfied' if some of the digital support links do not enhance learning but merely serve a cosmetic purpose.</p>				
<p>P14. Is <u>guidance</u> provided to teachers on how to conduct student-centred classroom instructions so that the stated objectives are achieved?</p> <p><u>To score this question:</u> Tick 'Adequate' if stepwise guidance is provided on: a) how to conduct student-centred classroom instruction involving various instructional strategies (e.g., teaching with physical models, pair-share activities etc.) and b) how to effectively teach with digital support in the classroom. (contd.)</p>				

Pedagogical alignment (P)	0 (Missing)	1 (Partially satisfied)	2 (Adequate)	Remarks
<i>Tick 'Partially satisfied' if some top-level guidance is given but no stepwise outline on how to conduct the instruction is given.</i>				

Technology Integration (T)	0 (Missing)	1 (Partially satisfied)	2 (Adequate)	Remarks
Score				
Questions				
<p>T1. Does the digital support balance conceptual understanding, understanding of scientific processes and <u>skill</u> development?</p> <p><i>To score this question:</i> Tick 'Adequate' if you feel the digital support addresses a balance of all three abilities stated in the question. Tick 'Partially satisfied' if you feel the digital support addresses only a subset of the abilities.</p>				
<p>T2. Does the digital support include virtual manipulatives (like magnifying glass, microscopes) or scientific games to help students test their understanding?</p> <p><i>To score this question:</i> Tick 'Adequate' if the digital support enables students to interact with it to test their understanding. This can be possible through interactivity features like drag & drop, drop-down, input boxes, slider bars, radio buttons etc. Tick 'Partially satisfied' if digital support contains some interactivity features but they are superfluous or, some of the given links do not work.</p>				

<p>T3. Are the textbooks and support materials, including worksheets, easy to access online, with all of them located in one place for convenience and ease of use?</p> <p><u>To score this question:</u> Tick 'Adequate' if the textbook and all support materials are accessible online and located at a single place. Tick 'Partially satisfied' if either textbook or support materials is not accessible online.</p>				
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Glossary of terms		
Question No.	Term used	Meaning of the term
C1	Content accurate	Content accuracy includes use of precise and accurate scientific information, accurate scientific terminology and correct concrete representations (e.g., pictures, symbols, expressions, equations, graphics, models).
C2, T1	Scientific knowledge and skills	i) Scientific knowledge refers to the syllabus outlined by the board for the particular grade. ii) Scientific skills outlined by NCF, 2005 covers the following – student inquiry, reflection, critical thinking, problem-solving, and sense-making, making connection to prior knowledge and process skills like observation, design, analysis, argumentation, prediction, drawing inference. [Reference: 'Position paper on Teaching of science' - http://www.ncert.nic.in/new_ncert/ncert/rightside/links/pdf/focus_group/science.pdf]
C3	Context	A context is something that motivates the student to care about the topic. For example, a motivational introductory scenario or a real life example or application may be presented. The context is appropriate when it is relevant and sufficient for the specific content. Like, when introducing sensory organs (grade 5), present familiar contexts like ants gathering round a sweet thing you have dropped or, ears of a sleeping dog pricking up when you walk past.
C4, P2,P7	Formative assessments	These are questions that appear within the content explanation. Students can solve/do them in class and receive immediate feedback from the teacher.
C4, P3, P7, P9	Summative assessments	These are assessment questions like exercises that are present at the end of a chapter. They test the student's understanding about the entire chapter. They are often assigned as homework and teacher feedback is not immediately received.
C4	Correct, clear, unambiguous	i) Correct means the question as well as the solution should contain correct facts and accurate scientific explanations. ii) Clear and unambiguous means - The wording of the assessment questions and solutions should be clear and complete for the student, the question should not be open to more than one interpretation. Example of ambiguous question can be - write a short note on our national emblem. This is ambiguous since it is not clear to students what points they would need to write about.
C5	Formatting consistency	Means font sizes, font styles, font alignment like justification etc. do not vary arbitrarily throughout the textbook and the support materials.
P1	Necessary	Means the learning objectives address the Board-specified knowledge and skills - student inquiry, reflection, critical thinking, problem-solving, and sense-making, making connection to prior knowledge and process skills like observation, design, analysis, argumentation, prediction, drawing inference

Glossary of terms		
Question No.	Term used	Meaning of the term
P1	Stated explicitly	Means the learning objectives can be written as text in textbook and/or teaching manual or orally spoken like in the digital support.
P2	Connect multiple concepts within or across subjects	<p>Connection between multiple subjects like science and mathematics should be conveyed to students to understand the relevance of science in different spheres of life. For example when discussing sleep-wake cycle of different animals in chapter on sense organs (grade 5, CBSE), ask students to interpret the cycle pie-chart to find out how many hours each of the given animals sleep per day.</p> <p>Connection between multiple concepts in science is required for students to see how one concept is linked to the other. For example, while teaching about preventive measures for malaria (grade 5), students can be asked the question what will happen if oil is spread on water? The answer requires connection between two science concepts: 1) Oil is immiscible with water and therefore, prevents oxygen from reaching the water and 2) mosquito larva requires oxygen to survive.</p>
P4, P5	Experiments	Textbook can contain experiments with specified aim and procedure that students can carry out using everyday materials. These experiments can enhance their conceptual understanding of the chapter content. For example, experiment to find out which things sink in water and which ones float (grade 5).
P6	Aligned with the learning objectives	The formative and summative assessment questions must match the cognitive (Bloom's) level of the stated learning objectives. For example, if learning objective is stated at Apply level, then there should be some assessment question(s) at Apply level. The assessment questions, corresponding to these objectives, should not be at a different cognitive level.
P6	HOTS	Higher order thinking skill (HOTS) covers Apply level and above of Revised Bloom's Taxonomy. Ideally, the textbook and the support materials should include those HOTS questions that are important for the topic.
P10	Diversity among your students	Students may come from different strata of our society, from different religions, from different genders, from different economic backgrounds etc. The textbook and support materials should address this diversity. For e.g. when mentioning different characters in word problems, the names taken should represent both boys and girls and from different religions or, if given examples involve foodstuff (pizzas and doughnuts etc.) then these foodstuff should be the ones that students are familiar with.
P11	Human-like characters that communicate with students	Human-like characters are characters that students can identify with. These characters function as co-learners and are used throughout the textbook. For example, these characters (like Bhoojo and Paheli in NCERT textbooks) can converse about the content between themselves like asking probing questions to each other, discussing the observations from experiments etc. Such characters are known to have positive impact on student learning.
P13	Enhance meaningful learning	Digital support will enhance meaningful learning when content involves : a) making the invisible visible like showing spatial arrangement of atoms in isomers or, b) showing a system that dynamically changes with time or space like plotting the distance travelled vs. time for a moving car.
P14	Guidance provided to teachers	Stepwise guidelines provided for teachers on how to conduct student-centred in-class instructions based on established protocols of active learning strategies.