District of Columbia
Office of the State Superintendent of Education

ITEM WRITING SPECIFICATIONS

DC Science Assessment

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Purpose

The purpose of this document is to provide for consistency in the DC science Assessment items. It is to be used by developers, reviewers, and anyone writing, editing, or reviewing items and stimuli for the DC Science Assessment.

Item Sets

For the purposes of development, an item set for DC Science consists of a stimulus and 8 items, 2 of which are multiple choice or multiple select, 4 of which are TEIs, and 2 of which are constructed response. The item sets are phenomena-based, meaning that all items in the set require the student to demonstrate understanding of the science behind the phenomenon.

Cognitive Complexity at the Item Development Stage

Items increase in complexity as the set progresses. At the item development stage, each set is composed of eight items:

- The first two items (items one and two) are multiple choice or multiple select and they should align to PLD 2.
- The technology enhanced (TE) items in the set (items three through six) should align to PLD 3.
- One constructive response (CR) (item seven) should align to PLD 4.
- One CR item (item eight) should align to either PLD 3 or PLD 4.

General Guidelines

General guidelines are as follows:

- When possible, contexts local to Washington, DC should be used. These include organisms from the northeast, Chesapeake Bay, etc.
- Performance Expectation (PE) Performance Level Descriptors should be used to determine the levels of alignment and rigor to NGSS.
- Multiple choice, multiple select, and technology-enhanced items should align to a minimum of 2 NGSS dimensions, both of which are from the same PE.
- Constructed response items should align to a minimum of 3 NGSS dimensions, all of which are from the same PE.
- MC, MS, and TE items (TEIs) are worth 1 point when developed (2-point selection of TEIs follows Content Review).
- Metric units should be used with the exception of weather at grades 5 and 8. In all other cases, units are in metric.
- Proper names are not generally used. Stimuli and items will refer to 'students', or 'scientists', 'researchers', etc. In some instances, the name of a scientist may be used (i.e. Einstein, Watson and Crick, etc.).
- Avoid the use of negative stems (containing words such as except, not, least, worst, etc.) because these items can be more difficult for students. If absolutely necessary, a negative stem should be followed by only positive options to avoid double negatives.
- Avoid absolutes (e.g. "always", "never", "only") unless appropriate.
- Use active voice and present tense when possible.
- Items that require a calculator should contain the language 'You may use the calculator to answer this question.'
- The answers should not be clued by any of the information presented in the stem, the stimulus, or in other items.
- Text should have an ATOS reading level at or below grade level.
- A range of Cognitive Demand Levels are represented in the items.
- A range of Performance Levels are represented in the items.

Overview of NGSS Item Sets for DC Science

It is important that assessment tasks for DC Science meet four essential criteria:

- Each item set should be focused on a single phenomenon or design problem. There should be a high quality in terms of clarity and science accuracy.
- The items should require that the student make sense of the phenomenon by using all 3 dimensions of both Performance Expectations in the assigned bundle.
- The item set should be fair and equitable and accessible to all students regardless of race, ethnicity, background, or geographic location.

Support materials to guide item writers and educators in ensuring that the above criteria are appropriately incorporated in the design of item sets are available at **https://www.nextgenscience.org/sites/default/files/resource/files/Achieve%20Task%20Screener_Final_9.21.18.pdf**.

Phenomenon

The phenomenon should be the very first information presented in the stimulus. It must be designed so that the students demonstrate mastery and understanding of all dimensions of both Performance Expectations in the bundle as they make sense of it. It should be described in the form of observations (for non-ETS Performance Expectations) and as a design problem (for ETS PEs). Care should be taken to incorporate 'productive uncertainty' into the phenomenon, as this will be important for making the task interesting and engaging for the student. This motivates students and gives them a reason to engage in the assessment task, thus helping to ensure that the evidence of student learning elicited by the task is a valid representation of student thinking and progress. It helps demonstrate the need for the Science & Engineering Practices of NGSS and enables the student to experience the SEPs as meaningful ways of developing understandings. Please see the reference here: **http://stemteachingtools.org/brief/60**. 'Productive uncertainties' are often related to how to design an investigation, what to use as evidence, and how to interpret results.

Stimulus

The purpose of the stimulus is to orient the student to the aspect of the phenomenon they should be focusing on. In this way, the items can target the specific knowledge, practices and abilities without detracting from student sense-making.

The stimulus may contain material used to supplement the phenomenon. This material should be directly relevant to the cluster phenomenon, and the student must be required to make use of it when answering the items. For grade 5, there should be a maximum of 3 stimulus tabs and 3 figures and/or tables, with 1 figure or table per tab so as to avoid vertical scrolling and to avoid visual distractions. For grades 8 and Biology, there should be a maximum of 4 stimulus tabs and 4 figures and/or tables. This information is summarized in Table 1.

Table 1. Maximum Number of Stimulus Tabs, Figures and Tables by Grade

Grade	Maximum Number of Stimulus Tabs	Maximum Number of Figures, Tables, and Graphs (Total Number)
5	3	3
8	4	4
Biology	4	4

Where possible, less is preferred provided that the stimulus material is sufficient to support 8 unique, rich items. Care should be taken to minimize the number of words and stimulus complexity, and no extraneous material should be presented. The stimulus should be reviewed after completion of all the items to ensure that ALL of the material presented will be used by the student when answering the items. Any material not explicitly needed to answer the items should be removed at this point.

The stimulus should be designed so that the student can read and understand all of the material within 5 minutes. This includes all text, figures, and tabs.

The reading level should also be minimized. ATOS should be used to evaluate the reading level of stimulus text, per this website: http://www1.renaissance.com/Products/Accelerated-Reader/ATOS/ATOS-Analyzer-for-Text/lang/english

This is the chart for grade levels: http://doc.renlearn.com/kmnet/r00575359d240bc6.pdf

The DC Science Assessment stimulus text should have a reading level at or below the grade level at which the test is administered. Science words should be removed before checking the ATOS grade level. Table 2 gives the ATOS level and the Guided reading levels required for DC Science stimuli at grades 5, 8, and Biology.

Table 2. ATOS and Guided Reading Levels of DC Science Stimuli

Grade	ATOS Level	Guided Reading Level
5	5.5 and below	5 and below
8	6.9 and below	8 and below
Biology	7.0 and below	9 and below

Item text is **not** to be checked using the ATOS tool.

Again, care should be taken to minimize stimulus reading load and complexity. The art, figures and tables should be as simple as possible. Food webs should contain organisms that are relevant to the items. Graphs and tables should only contain data that is relevant to the items. Tables should contain a small number of rows, with the grade level as a good guide for the maximum number of rows and/or columns (5 for grade 5, 8 for grade 8, and 9 for Biology). Graphs should have the smallest number of lines or curves as possible, and the graph should be uncluttered and free of distractions.

In terms of reading load, each tab may contain one paragraph in addition to one figure, table, or graph. Care should be taken that the amount of text presented is only that needed to answer the item, and that 'story-telling' is avoided. All text presented should be used in answering the items. It is acceptable to present a minimum amount of background information that is needed for logical flow of the information and materials included.

Sources

It is essential that reliable, accurate sources be provided for material in the stimulus. Peer-reviewed journals are best. All relevant sources should be attached as pdf files in ABBI, and the URLs should be listed in the metadata. The information being used in the item should be highlighted in yellow, so that reviewers do not need to search long sources for individual numbers or small bits of information. Acceptable sources include .edu, .org, and .com in cases of scientific journals ONLY. If there are doubts as to the acceptability of a source, please ask. The following .com sites are acceptable sources, rich in ideas for phenomena:

www.scientificamerican.com
www.nature.com
www.science.com (equivalent to www.sciencemag.org)

www.nationalgeographic.com

Other excellent sites include, but are certainly not limited to:
https://www.sciencenewsforstudents.org/
https://sciencejournalforkids.org/
https://www.nature.com/news/
http://researchnews.plos.org/
https://www.sciencemag.org/news

Sources must be attached in ABBI as a pdf file (using the attachments tab). The pdf needs to be marked up to indicate the location of relevant information.

In cases where data in tables or art pieces needs to be cited, source lines should be created such as these:

T. Sato, et al., *J.Exp. Bot.*, 2002

D. Van Vuren & B.E. Coblentz, *Biol. Cons.*, 1987

Websites are not used in source lines, but rather, the paper where the work was originally published is used. Journal names should be abbreviated according to this source:

https://woodward.library.ubc.ca/research-help/journal-abbreviations/

The source line is entered in the 'Source Line' metadata field in ABBI, and the Source URL is entered in the 'Source' field.

Multiple Choice Items

Requirements for MC items are as follows:

- Stems should be composed as a direct question instead of an incomplete sentence.
- They are composed of a question and 4 unique options, only 1 of which is correct.
- The student should be able to answer these items in approximately 1 minute.
- Rationales should explain why the correct answer is correct and why the other options are incorrect. The rationale for the correct answer should begin with 'Correct.'
- All options should have parallel structure.

Multiple Select Items

Multiple select items require the student to select 2 correct answers from a total of 5 options.

Requirements for MS items are as follows:

- The functionality should be set up so that no limit is placed on the number of options the student can select.
- They are composed of a stem and 5 unique options, 2 of which are correct.
- The student should be able to answer these items in approximately 1 minute.
- Rationales should explain why the correct answer is correct and why the other options are incorrect. The rationale for the correct answer should begin with 'Correct.'
- All options should have parallel structure.

Gap Match (GM)

Gap match items require the students to drag a word or phrase into a box, thus completing one or two sentences.

The requirements for the number of gaps and draggers for each grade level is given in Table 3.

Table 3. Number of Gaps and Draggers per Item by Grade Level

Grade	Number of Gaps	Number of Draggers Per Gap
5	2	2
8	2	3
Biology	2	3

Requirements for this item type are as follows:

- Draggers should be restricted to appropriate bays in all GM items.
- An item set can have no more than ONE GM item.
- The direction line is 'Drag and drop the correct answer into each box.'
- The rubric should give the complete sentence with the correct answers in bold (i.e. The food web shows that cats are **primary consumers** and that mice are **prey**.)

Inline Choice (IC)

Inline choice items require that the student select the correct answers from dropdown menus, thus completing one or two sentences.

The requirements for the number of dropdowns and options for each grade is given in Table 4.

Table 4. Number of Dropdowns and Options per Dropdown by Grade Level

Grade	Number of Dropdowns	Number of Options per Dropdown
5	2	2
8	2	3
Biology	2	3

Requirements for this item type are as follows:

- The direction line is 'Select the correct answers from the drop-down menus to complete the sentences.'
- The rubric should give the complete sentence with the correct answers in bold (i.e. The food web shows that cats are **primary consumers** and that mice are **prey**.)
- An item set can have no more than two IC items.

Hot Spot (HS)

A hot spot requires that the student select the correct 1 or 2 images, out of a total of 4 or 5.

Requirements for hot spot items are as follows:

- The functionality should be set up so that no limit is placed on the number of options the student can select.
- They are composed of a stem and 4 or 5 unique options, 1 or 2 of which are correct.
- The student should be able to answer these items in approximately 1 minute.
- The rubric should explain why the correct answer is correct and why the other options are incorrect.

Graphic Gap Match (GGM)

GGM items require the student to drag images onto a background image, placing them correctly in gaps on the background image. This item type is particularly useful when the students need to develop a model (a common Science and Engineering Practice).

Table 5 gives the number of gaps and draggers for GGM items at each grade level.

Table 5. Number of Gaps and Draggers for GGM Items by Grade Level

Grade	Number of Dropdowns	Number of Options per Dropdown
5	2	2
8	2	3
Biology	2	3

Point Graph (PG)

Point graph items require the students to place points on a graph. The following considerations are important for point graphs:

- Care should be taken that these items require content knowledge as well as graphing skills. Thus, in no case is it appropriate for the student simply to graph the numbers given in a table (this would only align to one dimension).
- Care should be taken that a point (line) graph is actually the correct way to represent the data. Point (line) graphs are used in cases where the data all falls within a group, and dependent and independent variables are clearly identifiable. Bar graphs are used to compare data for different groups.
- Rubrics for point graph items should list the points the student should plot and give a short explanation as to why these points are correct.

Table 6 shows the number of points the student should be required to graph at each grade level.

Table 6. Number of Points in Point Graph Items at Each Grade Level*

Grade	Number of Points
5	3
8	4
Biology	4

*The first point may be given to the student by fixing its position in ABBI. The student has to graph the other ones (3 at grade 5, 4 at grade 8, 4 at Biology).

Bar Graph (BG)

Bar graph items require the students to raise the heights of bars to make a bar graph. The following considerations are important for bar graphs:

- Care should be taken that these items require content knowledge as well as graphing skills. Thus, in no case is it appropriate for the student simply to graph the numbers given in a table (this would only align to one dimension).

  Care should be taken that a bar graph is actually the correct way to represent the data. Bar graphs are used to compare data for different groups. Point (line) graphs are used in cases where the data all falls within a group, and dependent and independent variables are clearly identifiable.
- Rubrics for bar graphs should list the correct bar heights and give a short explanation as to why these heights are correct.

Table 7 shows the number of points the student should be required to graph at each grade level.

Table 7. Number of Points in Bar Graph Items at Each Grade Level

Grade	Number of Points
5	3
8	4
Biology	4

Match Table Grid

These items require the student to select circles in a table.

- At all grades, there should not be more than 3 rows and 3 columns in thetable.
- At all grades, the student should select 1 correct answer per column or per row.

Order (Gap Match Gap Table)

Order items require the students to place events in order in a table. In ABBI, the Gap Match Gap Table Item type is used for this.

- The student should ALWAYS be given the first step.
- At grade 5, the student should not be required to place more than 4 events in order. At grades 8 and Biology, the student should not be required to place more than 5 events in order. [The first step, which is given to the student, does not count towards this total. So, for example, a Biology order item could give the students the first step and have them place up to 5 additional steps in order.]
- Steps should be labeled, “1,2,3,...”., “High → Low”, “Small effect → Large effect”, etc.

Sliders

These items allow the student to slide a bar to a certain height, similar to a bar graph with 1 bar. They have background art and are generally used for things such as showing the reading of a thermometer, beaker, etc., but can apply in other instances.

Text Entry (TEX)

These items require the student to enter numbers in a box.

- Decimals may not be used in the answers to these items.
- Negative signs may not be used in the answers to grade 5 items.
- At grade 5, the student should not be required to enter more than 4 numbers in the box. At grades 8 and Biology, the student should not be required to enter more than 5 numbers in the box.

Constructed Response (CR) Items

The student provides a text response to these items by typing it in a box. They are used as the place where the student can demonstrate full understanding of the science behind the phenomenon, and relevant implications.

- These must be aligned to 3 NGSS dimensions (PLD Levels) of a single PE.
- Three bullets must be present. There is often 1 bullet per NGSS dimension (PLD level), but this is not required.
- The student should be able to answer these items in 5 minutes.
- These should be focused with no more than 2-3 correct answers per bullet.
- These should target PLD 4 unless doing so results in an item of greater complexity than can be answered within the 5-minute response time. In such cases it is acceptable for the CR item to target PLD 3. However, the majority of CR items should target PLD 4.
- These should be directly related to the phenomenon and rely on 1 or more of the figures, tables, or graphs presented in the stimulus.

Ideally, these items can be scaffolded, with simpler tasks presented first. This allows the student to 'warm up' to the task, and to begin by taking small steps along the way to its solution. This may build confidence and improve student performance. However, it is also noted that there is 1 bullet per dimension and all of the PLD levels will typically be at Level 4. For scaffolding, the dimension that is simplest in a given situation should be targeted in the first bullet.

Exemplary Responses

Each item will contain an exemplary response that provides an example of a full-credit response. The exemplary response itself does not need to contain all of the possible answers that are appropriate for full-credit. However, these should be contained in the form of scoring notes that are presented directly following the exemplary response. Scoring notes are presented in brackets and list the important points of alternative correct answers. They should be in italics for ease of identification.] The text below gives an example of an exemplary response with scoring notes:

Example Exemplary Response:

The student's argument is correct because a goldfish' body is a system of interacting subsystems. The digestive system transfers nutrients from the food to the cells of the body through the circulatory system.

The heart pumps blood throughout the body. The intestines absorb nutrients into the blood stream. These organs are important as part of the systems. *[Note: Other organs, like the esophagus and/or stomach, are also acceptable. The correct answer may include details such as the large or small intestine. The correct answer may include examples other than these.]*

The intestinal tissue is well suited to transport nutrients from the digestive system to the circulatory system.

Summary of Direction Lines - TEIs and Paper

Table 7 gives direction lines for each of the item types for both online and paper versions.

Table 7. Direction Lines

Item Type	Online	Paper
Multiple Select	Select **two** correct answers.	Select **two** correct answers.
Gap Match	Drag and drop the correct word(s) [or phrase(s)] into the boxes to complete the sentence(s).	Write the correct answer in each box. Not all answers will be used. OR Write the correct answer in each box.OR Write the correct answer in each box. All answers will be used.
Hot Spot	Select **X** correct answer(s).	(Check mark boxes should be added next to each option) Place a check mark in the box on the part of the model/picture that shows x.
Graphic Gap Match	Drag and drop the correct word(s) [or phrase(s)] into the boxes to complete the sentence(s).	Write the correct answer in each box to complete the sentence(s).
Inline Choice	Select the correct answers from the drop-down menus to complete the sentence(s).	Circle the correct answer from each list to complete the sentences.
Point Graph	Select a location on the graph for each of the X points.	Draw X points on the graph.
Bar Graph	Drag the top of each bar to the correct location on the graph.	Complete the graph to show x by drawing and shading each of the bars to the correct height.

Match Table Grid	Select **one** correct answer in each row. OR Select **one** correct answer in each column.	Place a check mark in the circle to indicate your answer choice in each row.
Constructed Response	Analyze the information carefully. Then enter your answer in the space provided. Support your answer with details.	Analyze the information carefully. Then write your response in the space provided. Support your answer with details.