EVOLUTION OF AN ITEM

(How an Item Changes as a Result of the Review Process)

All assessment items go through an elaborate process of content, style, and language revision. During revision, the structure or wording of an item may be changed dramatically. In fact, there are times when an item is revised so much that all that remains is the rudimentary seed of the original idea. Revision of items is necessary:

- to verify content,
- to improve the Item Stem and/or the Answer Choices,
- to make the item clear and concise,
- to ensure that it appropriately addresses the indicator that it has been designed to measure, and
- to make the item as accessible as possible to all students.

To begin the process, items are reviewed and refined several times by staff from MSDE and CTB, the HSA test development contractor. Next, each item is examined by an independent Item Review Team made up of content experts who have not been part of the development process. Included in this group are biology teachers, coordinators and supervisors of science, representatives from higher education, and teachers of English as a Second Language (ESOL) and Special Education who have experience in teaching biology. Because they have not been involved in the initial development process, these content experts bring a fresh perspective that greatly improves the quality of the items. Their objective eyes detect the subtler elements of content and style that previous reviewers (those more intimately involved in development of the items) did not see. Finally, items are put through a comprehensive Sensitivity Review to detect any form of bias that was inadvertently overlooked during the other reviews. Each of these steps is required before items are approved for use in field tests. After field testing, items may be further revised to reflect changes suggested by scorers and others who analyze the field test data.

MSDE has worked extensively with Special Education and ESOL teachers to develop a set of "Language Guidelines for Biology" (see below). These guidelines have helped to minimize problematic or awkward language constructions that make items less accessible to special education and ESOL students. The guidelines are employed from the start of item development; however, their greatest benefit comes into play when the items are reviewed by the Item Review Team. It is at this stage of the process that accessibility of the items by various student populations becomes of primary concern.

LANGUAGE GUIDELINES FOR BIOLOGY

Item Writing Supplement For The High School Assessment

PROBLEM	EXAMPLE	REWRITE	GUIDELINE	COMMENT
S E M A N T I C S				
1) Complex or unfamiliar vocabulary not related to concept being tested	▪ counted progeny ▪ A geneticist ▪ Is apparent	▪ counted offspring ▪ A scientist ▪ Seems to be/appears to be	Replace less frequently used words with more commonly used words	Retain words appropriate to the Core Learning Goals for skills, processes, and concepts
2) Vocabulary reflecting cultural assumptions or unfamiliar contexts	▪ House call ▪ Amusement park ▪ Soak up		Replace culturally biased words and contexts with culturally neutral words, universal contexts	Retain essential technical terms and common words testing legitimate content
3) Inconsistent use of terminology	A student crossed two fruit flies to observe patterns of inheritance. The offspring of the pairing were counted. The ratio of dominant to recessive traits was 3:1. Which of these are the most likely genotypes of the parent flies which were mated?	Marcia was studying patterns of inheritance in fruit flies. She crossed two fruit flies with different traits, and, then counted the different types of offspring. The ratio of dominant to recessive traits was 3:1. Which of these are the most likely genotypes of the parent flies?	Repeat nouns. Avoid indefinite pronouns (e.g., some, any) and synonyms. Check that all pronouns have clear antecedents.	Retain synonyms if purpose of item is to test synonym/ vocabulary knowledge. Avoid mixing table, chart and graph.
4) Overuse of synonyms	Juan had 8 grams of sugar on the scale. He added some more. Then the balance read 15 grams. How much was the weight increased by?	Juan put 8 grams of sugar on the balance. He added more sugar. Then the balance read 15 grams. How many grams of sugar did he add?		
5) Abstract or impersonal presentations	The weights of three objects were compared by the student.	Sandra compared the weights of three blocks of wood.	Make item stem more concrete and use proper name.	Balance gender and ethnicity when using names
6) Unnecessary expository material	DNA is a molecule in the shape of a double helix. It is able to reproduce an exact copy of itself and is important in cell reproduction. The genetic code in DNA is used to form protein molecules. Explain how the sequence of base pairs in DNA is related to the amino acids used in the synthesis of proteins.	The pairs of bases in a molecule of DNA contain the genetic code which is used to form protein molecules. Explain how the sequence of base pairs in DNA is related to the amino acids used in the synthesis of proteins.	Remove unnecessary expository material, i.e., remove excess words that are not necessary to set the context.	Test specifications require items to be set in a context, e.g. skills and processes set in a life science context.

PROBLEM	EXAMPLE	REWRITE	GUIDELINE	COMMENT
S Y N T A X				
7) Conditional clauses and verb tenses	If some organisms are able to survive without oxygen in the human intestine, by what process are they able to obtain energy?	Some organisms are able to survive without oxygen in the human intestine. Which of these best describes the process by which these organisms obtain energy?	Replace conditional clauses with shorter separate sentences.	Can also reverse the order of the *if* clause and the main clause. Note: Conditional clause may be necessary for assessing knowledge of probability in genetics and prediction in reading.
8) Passive voice verb construction	A graduated cylinder was used.	René used a graduated cylinder.	Replace verbs in the passive voice with verbs in the active voice.	If using a proper name, balance the gender and ethnicity.
9) Unnecessarily long sentences or items, and compound-complex sentences			Reduce the number of words in a sentence or separate long sentences into shorter ones.	Reduce the number of sentences in an item. Try to use the Subject-Verb-Object order.
10) Unnecessarily long noun phrases	Maryland public health agency officials	Health officials	Reduce the number of modifiers in a noun phrase	
11) Complex question phrases or questions that do not begin with a question word.	At which of the following times…	When…	Replace complex question phrases with simple question words.	
12) Relative clauses	An experiment that produced 44 new plant seedlings…	Tom counted 44 new plant seedlings in his experiment.	Remove or restate relative clauses.	If using a proper name, balance gender and ethnicity.
13) Double negatives, negative question forms, and negative terms (e.g., no longer, hardly)	▪ Is not unlike ▪ Which of the following is not a mammal? ▪ Ecological studies are no longer restricted to the laboratory.	▪ Is like ▪ Which of the following is a mammal? ▪ Ecological studies can be done outside the laboratory.	Rephrase negatives in a positive form.	

PROBLEM	EXAMPLE	REWRITE	GUIDELINE	COMMENT
O T H E R				
14) Latin names, common names			When necessary, put Latin names first in *italics* followed by the common English name; use commas to separate e.g. *Dinofilaria*, the heartworm of dogs, …	
15) Labels in text and tables do not match.			Be consistent when labeling tables ▪ Use the same terms as those in the narrative or stem ▪ Use CAPS for titles on tables, charts, and graphs In graphs or tables, include units in parentheses after the labels [e.g. Concentration (mg/L)].	
16) Descriptive material in parentheses is often overlooked by students.			Use commas rather than parentheses to further elaborate on terms or descriptions. “One kind of toxin, a chemical poison, inhibits the production of ATP.”	

SAMPLE ITEMS

The Sample Items which follow use the **Lauguage Guidelines for Biology** (described above) to demonstrate how an item may evolve from its "original form" to its "final form." "Final form" is, however, a relative term. To quote Barbara Smith, Biology Content Editor at CTB/McGraw-Hill in Monterey, CA,

> "*An item is never finished. Even when you think it is as good as it can be, when you look at it the next time, you can still find ways to improve it.*"

The original and revised items included below have been taken from the set of Biology Prototypes found on the MSDE website. Clicking on the Prototype Item Number will link you directly to that item as it appears in the Prototype Item Test Booklet.

SAMPLE #1

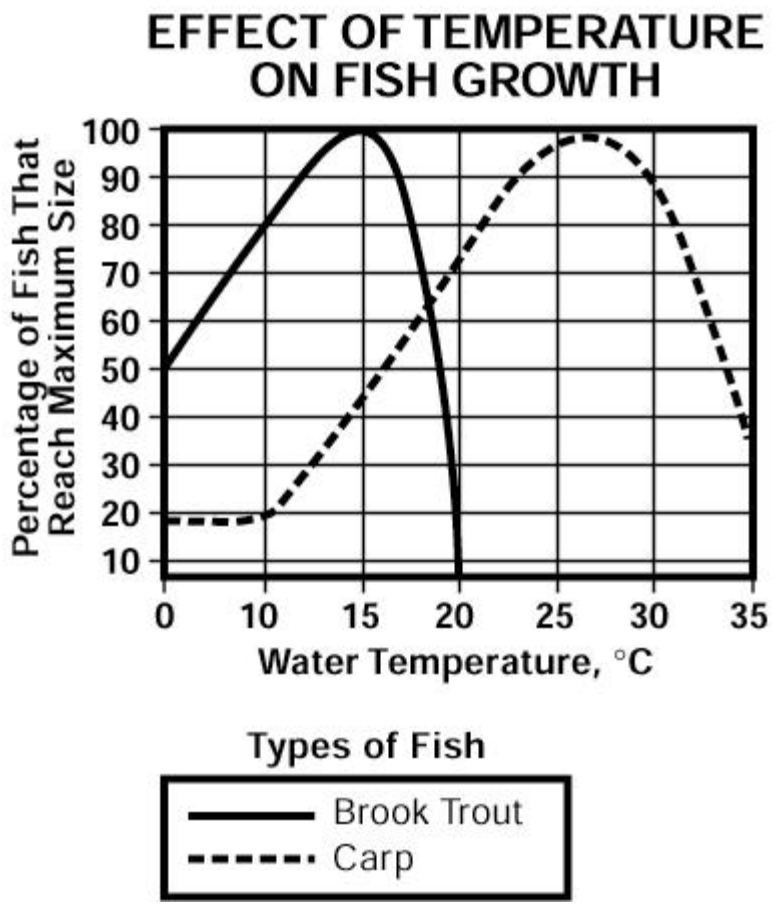
A ***LABORATORY SET*** consists of a cluster of items that are based on the same stimulus. The stimulus is usually provided in the form of a narrative and describes a situation which leads the students into the investigative process. Data tables or graphs may also be provided. The questions that are based on the information provided may ask the student:

- to analyze the content of the scientific investigation or the adequacy of the experimental design and research methods;
- to identify variables or controls;
- to provide an hypothesis or rationale for the experiment;
- to apply the results of this experiment to a new situation; or
- to use the information provided in the narrative to solve a scientific problem.

Prototype Items 4 through 6 demonstrate a *LABORATORY SET* . The Set described below includes a **narrative**, a **graph**, and **three items** which measure Indicators 1.4.2, 1.4.6, and 1.4.2 respectively.

ORIGINAL NARRATIVE and GRAPH:

Scientists were studying conditions for growing fish in hatcheries in order to determine the optimal growth conditions. Fish were grown in several different tanks and the percentage of fish reaching a maximum size was calculated. The computer-generated graph below shows the results of this experiment.



NARRATIVE FOR PROTOTYPE LABORATORY SET ITEMS 4, 5, AND 6.

VERSION I (THE ORIGINAL AS CONCEIVED BY THE ITEM WRITER)	PROBLEMS	VERSION II (AS IT APPEARS IN THE PROTOTYPES)	PROBLEMS	VERSION III (BETTER YET)
"Scientists were studying conditions for growing fish in hatcheries in order to determine the optimal growth conditions. Fish were grown in several different tanks and the percentage of fish reaching a maximum size was calculated. The computer-generated graph below shows the results of this experiment."	• The narrative is stated in passive voice. • The narrative uses vocabulary that exceeds the Assessment Limits: optimal. • The narrative uses words, language conventions, or constructions that may not be understood by Special Education or ESOL students: "growing fish"; "hatcheries"; "fish reaching"; "fish growth." • The narrative is wordy, restating information that is evident in the graphic, and includes unnecessary information.	"The computer-generated graph below shows the results of an experiment measuring the effect of temperature on fish growth. Use the graph to answer Numbers 4 through 6."	Although the wording of the narrative is better than the original, it can be further improved. • An expression like "computer-generated" does not add necessary information and may serve as an impediment. • "Growth of fish" is more easily understood than "fish growth." • The title of the graph should match the title of the experiment.	"The graph below shows the results of an experiment measuring the effect of temperature on the growth of fish. Use the graph to answer Numbers 4 through 6. [Change the title of the graph to "EFFECT OF TEMPERATURE ON GROWTH OF FISH"]

PROTOTYPE ITEM #4: This item measures Indicator 1.4.2, "The student will analyze data to make predictions, decisions, or draw conclusions."

VERSION I (THE ORIGINAL AS CONCEIVED BY THE ITEM WRITER)	PROBLEMS	VERSION II (AS IT APPEARS IN THE PROTOTYPES)	PROBLEMS	VERSION III (BETTER YET)
"If trout and carp are grown in the same tank, which temperature would allow half of the trout and half of the carp to reach a maximum size?" F 15º G 18º H 28º J 35º CORRECT RESPONSE: **G 18º**	• The item stem is stated in passive voice. • There is a problem with verb tense: "are" indicates *now*; "would" indicates a *future event*. This sets up a hypothetical situation, which is hard for some students to understand. • "Half of the trout and half of the carp" is unclear.	"If trout and carp were grown in the same tank, which temperature would allow at least 50% of the trout <u>and</u> at least 50% of the carp to reach maximum size?" • The verb has been changed from "are" to "were" in an attempt to match verb tense. • "At least" was added for clarification. • "Half" was replaced with 50% to match the scale used in the graph. • "And" is underlined for emphasis.	Although the wording of the item stem is better than the original, it can be further improved. • The item is still stated in passive voice. • The item stem is still unclear. • Special education and ESOL students may be confused by "were grown" in the first line and "reach maximum size" in the last line. • There is still a problem with verb tenses. Students may be confused about what the question is asking.	"A scientist is thinking about raising Brook Trout and Carp in the same tank. Which water temperature would be best if he wants at least 50% of <u>both types</u> of fish to grow to maximum size?" • The stem is now stated in active voice. • Adding the first sentence sets up the hypothetical situation without confusing verb tenses. • Fish names match those used in the legend of the graph. • Breaking the stem into two sentences avoids a long, complex sentence. • The question is stated in a simple, straight-forward sentence. • "Grow to maximum size " is clearer than "reach maximum size."

PROTOTYPE ITEM #5: This item measures Indicator 1.4.6, "The student will choose appropriate summary statistics to describe tendencies revealed by data."

VERSION I (THE ORIGINAL AS CONCEIVED BY THE ITEM WRITER)	PROBLEMS	VERSION II (AS IT APPEARS IN THE PROTOTYPES)	PROBLEMS	VERSION III (BETTER YET)
"Which of these variables is being altered in the experiment?" A species of fish studied B maximum growth size of fish C percentage of fish counted D tank water temperature CORRECT RESPONSE: **D tank water temperature**	• The item does not measure Indicator 1.4.6. • The item as written falls outside of the scope of the information provided in the narrative. • The item does not direct the student to examine the graph. • Answer choices B and C are not <u>variables</u> in the experiment; distractors should be *plausible*, yet incorrect.	"When the temperature of the tank is between 10ºC and 15ºC, the percentage of Brook Trout reaching maximum size" A remains constant B increases continuously C decreases continuously D increases, then decreases CORRECT RESPONSE: **B increases continuously** • The item now measures Indicator 1.4.6. • All answer choices are relevant and plausible. • The item stem directs students to examine the graph rather than to speculate about those things that lie outside of the scope of the question.	Although the structure of the item is better than the original, it can be further improved. • The student should be cued to think about *water* temperature, rather than the "temperature of the tank." • "Between 10ºC and 15ºC" does not cue students to examine a range of temperatures. • The phrase, "reaching maximum size," may not be clear to all students. • The item would be clearer if phrased *as a question.*	"How is the percentage of Brook Trout that grow to maximum size affected when the temperature of water in the tank is increased from 10ºC to 15ºC?" A it remains constant B it increases continuously C it decreases continuously D it increases, then decreases CORRECT RESPONSE: **B it increases continuously** • The item stem is now rephrased as a question. • "Grow to maximum size" is clearer than "reaching maximum size" and is consistent with the change suggested for Prototype Item #4. • The student has been cued to examine a range of temperatures rather than the netherworld "between" two temperatures.

PROTOTYPE ITEM #6: This item measures Indicator 1.4.2, "The student will analyze data to make predictions, decisions, or draw conclusions."

VERSION I (THE ORIGINAL AS CONCEIVED BY THE ITEM WRITER)	PROBLEMS	VERSION II (AS IT APPEARS IN THE PROTOTYPES)	PROBLEMS	VERSION III (BETTER YET)
"Which of these is the hypothesis being tested?" F What are the optimal growth temperatures of Carp and Brook Trout? G What is the maximum size of Carp and Brook Trout grown in tanks? H Can Carp and Brook Trout be grown in tanks together? J Do Carp grow at higher temperatures than Brook Trout? CORRECT RESPONSE: **F What are the optimal growth temperatures of Carp and Brook Trout?**	• This item measures Indicator 1.2.3 ("The student will formulate a working hypothesis"), rather than 1.4.2. • An hypothesis is a statement, not a question. • The student is not cued to examine the graph. • The item uses vocabulary that lies outside of the Assessment Limits: optimal	"According to the graph, which of these statements is correct?" F Brook Trout can <u>not</u> reach maximum size in water with a temperature greater than 20ºC. G Brook Trout can <u>not</u> live in water with a temperature greater than 20ºC. H The greater the temperature of water, the greater the percentage of Carp that reach maximum size. J Carp tend to reach their maximum size at lower temperatures than Brook Trout. CORRECT RESPONSE: **F Brook Trout can not reach maximum size in water with a temperature greater than 20ºC.** • The item now measures Indicator 1.4.2. • Students are cued to examine the graph. • Key words in the Answer Choices are underlined for emphasis.	Although the structure of the item is better than the original, it can be further improved. • Students should be cued to think about the effect of water temperature on the growth of fish. • The phrase, "reach maximum size," may not be clear to all students. • The key term is in the item stem ("correct"), not in the Answer Choices. Key terms should be underlined for emphasis. • The syntax of Answer Choice J could be improved.	"According to the graph, which of these statements about the effect of temperature on the growth of fish is <u>correct</u>?" F Brook Trout can not grow to maximum size in water with a temperature greater than 20ºC. G Brook Trout can not survive in water with a temperature greater than 20ºC. H The greater the temperature of the water, the greater the percentage of Carp that grow to maximum size. J To grow to maximum size, Carp require a lower water temperature than Brook Trout. • Students are cued by the change in wording of the item stem to consider the effect of water temperature. • "Grow to maximum size" is clearer than "reach maximum size" and is consistent with the change suggested for Prototype Items 4 and 5. • "Live" in Answer Choice G has been changed to "survive." • Answer Choice J has been changed to improve syntax.

SAMPLE #2

A ***TECHNICAL PASSAGE SET*** consists of a 250 to 350-word reading passage that has been adapted from an actual scientific periodical or journal, and several questions about the information presented in the reading passage. (In certain circumstances, the technical reading passage may be created for test purposes.) The questions may ask students to respond to the background information leading to the issue or discovery, to look for and/or respond to the presence of bias in the article, or to judge the adequacy of the results or conclusion drawn by the author. Additionally, the questions may also ask students to:

- identify the research question or hypothesis;
- evaluate the investigative procedures;
- determine the adequacy of controls or variables;
- evaluate the accuracy of conclusions;
- offer ways in which the investigation could be improved;
- interpret data from graphic representations included with the technical reading passage;
- describe the implications of the scientific findings presented in the technical reading passage;
- use prior knowledge to answer questions about the concepts, processes, or terms mentioned in the passage.

Prototype Items 8 and 9 demonstrate a *TECHNICAL PASSAGE SET* . The example described below includes a **technical passage** and **two items.** The items measure Indicators 1.4.3 and 1.4.7, respectively.

ORIGINAL TECHNICAL PASSAGE:

ULTRAVIOLET RADIATION IS KILLING AMPHIBIANS

Ultraviolet (UV) radiation passing through Earth's thinning ozone layer is responsible for a worldwide decline in frogs, toads, and salamanders.

The impact of UV radiation on some frog and toad eggs was reported by a team of researchers from Oregon State University. The basic conclusion is that UV radiation kills frog eggs in nature. Field experiments indicate that when UV radiation is filtered out, the frogs hatch more quickly and successfully, and the death rate is lowered.

Over the last six years, biologists have reported that many of the world's 4500 known species of amphibians are declining in number. Some species have nearly disappeared. Hard-hit areas include desert, rain forest, lowland, and mountain environments in the western United States, Australia, and Central and South America.

<u>READING PASSAGE</u> FOR PROTOTYPE TECHNICAL PASSAGE SET ITEMS 8 AND 9.
ULTRAVIOLET RADIATION IS KILLING AMPHIBIANS

VERSION I **(THE ORIGINAL AS CONCEIVED BY THE ITEM WRITER)** **(126 words)**	"Ultraviolet (UV) radiation passing through Earth's thinning ozone layer is responsible for a worldwide decline in frogs, toads, and salamanders. The impact of UV radiation on some frog and toad eggs was reported by a team of researchers from Oregon State University. The basic conclusion is that UV radiation kills frog eggs in nature. Field experiments indicate that when UV radiation is filtered out, the frogs hatch more quickly and successfully, and the death rate is lowered. Over the last six years, biologists have reported that many of the world's 4500 known species of amphibians are declining in number. Some species have nearly disappeared. Hard hit areas include desert, rain forest, lowland, and mountain environments in the western United States, Australia, and Central and South America."
PROBLEMS	• Because the summary of the reading passage is very short, a lot of important detail has been lost from the original. • The passage does not flow. • The passage does not engage the students and presents factoids of information in random order. • There is no introduction or conclusion. • Transitions between paragraphs are lacking or awkward. • The passage alternates between active and passive voice. • Verb tense changes from sentence to sentence.
VERSION II **(AS IT APPEARS IN THE PROTOTYPES)** **(193 words)**	"It is widely known that ultraviolet radiation (UV) causes damage to cells by altering the physical structure of DNA and proteins. Over the last six years, biologists have reported that many of the world's 4,500 known species of amphibians are declining in number. Some species have nearly disappeared. Hard-hit areas include desert, rain forest, lowland, and mountain environments in the western United States, Australia, and Central and South America. Researchers have shown that UV radiation passing through Earth's thinning ozone layer is responsible for a worldwide decline in frogs, toads, and salamanders. The impact of UV radiation on some frog and toad eggs was reported by a team of researchers from Oregon State University. The basic conclusion is that UV radiation kills frogs eggs in nature. The researchers performed field experiments which showed that when UV radiation is filtered out, the frog eggs hatch more quickly and successfully, and the death rate is lowered. The researchers need more information to help determine the cause of the decline in the numbers of amphibians. Follow-up studies are being planned to get additional information to test their theory that UV radiation kills the eggs of amphibians." • The introductory sentence presents a better frame for the intent of the article. • The passage is more engaging to students. • The passage has been reorganized for better flow.
PROBLEMS	Although the wording and flow of the technical reading passage is better than the original, it can be further improved. • An introductory sentence has been added; but the information that is presented is still unorganized. • The passage still alternates between active and passive voice. • There are still problems with verb tense. • Transitions between sentences and paragraphs are still lacking or awkward.

READING PASSAGE, Continued: ULTRAVIOLET RADIATION IS KILLING AMPHIBIANS

VERSION III

(BETTER YET)

(272 words)

"Increased amounts of ultraviolet radiation (UV) continually pass through the Earth's thinning ozone layer. It is widely known that exposure to this UV radiation can damage cells by altering the physical structure of DNA and proteins. Cataracts in the eyes and certain types of skin cancer are common examples of the damage that exposure to UV radiation can cause in humans. Other organisms besides human beings are also affected by exposure to UV radiation. Recently, scientists have demonstrated that UV radiation may also be responsible for a worldwide reduction in the numbers of frogs, toads, and salamanders.

Over the last six years, scientists have reported that many of the world's 4,500 known species of amphibians are declining in number. In some parts of the words, some species have nearly disappeared. The most affected areas include deserts, rain forests, and the lowland and mountainous environments in the western United States, Australia, and Central and South America. The scientists who are studying this problem have concluded that exposure to UV radiation is killing frog eggs in nature.

A team of scientists from Oregon State University performed field experiments to show the impact of UV radiation on different species of frog eggs. They determined that eggs hatch more quickly when UV radiation was filtered out of the environment. Additionally, their experiments showed that filtering out UV radiation increases the survival rate of frog eggs and newly hatched tadpoles.

Scientists need more time to study the decline in the numbers of amphibians. They are planning to conduct follow-up studies to obtain additional information to test their theory that UV radiation is killing the eggs of amphibians."

- The introductory paragraph sets up the remainder of the article and provides a human context which is more familiar to students.
- The passage is written in active voice.
- Verb tense is consistent throughout.
- Idiomatic, unfamiliar, or complex vocabulary has been replaced with more familiar vocabulary: "hardest-hit" → "most affected"; "researchers" → "scientists"; "death rate is lowered" → "increases the survival rate."
- Awkward constructions ("passing through Earth's thinning ozone layer") have been replaced with more descriptive phrases.

PROTOTYPE ITEM #8: This item measures Indicator 1.4.3, "The student will use experimental data from various investigators to validate results."

VERSION I (THE ORIGINAL AS CONCEIVED BY THE ITEM WRITER)	PROBLEMS	VERSION II (AS IT APPEARS IN THE PROTOTYPES)	PROBLEMS	VERSION III (BETTER YET)
"Which of these additional studies would best support the author's claim that increases in UV radiation are responsible for a decline in the worldwide population of amphibians?" A The number of amphibians should be measured in regions of the world where amounts of UV radiation are lowest. B The death rates of amphibians should be compared with those of animals that are not as sensitive to UV radiation. C Field measurements of UV radiation should be made at the equator and the poles. D Field measurements of UV radiation should be made in regions of the world where the amphibian populations are declining and regions where they are stable. CORRECT RESPONSE: **D Field measurements of UV radiation should be made in regions of the world where the amphibian populations are declining and regions where they are stable.**	• It is misleading to suggest that the study states the "author's" claim. • "Worldwide" in the item stem is an unnecessary term. • Answer Choice C is too similar to Answer choice D. • A good rule of thumb is to use parallel constructions in pairs of Answer Choices to minimize the chance that a single Answer Choice will become an outlier: e.g., Answer Choices A and B should be parallel in construction to match the parallel constructions of Answer Choices C and D.	"Which of these additional studies would best support the claim that increases in UV radiation are responsible for a decline in the population of amphibians?" A The birth rates of amphibians should be compared with those of animals that are not as sensitive to UV radiation. B The death rates of amphibians should be compared with those of animals that are not as sensitive to UV radiation. C Field measurements of UV radiation should be made in regions of the world where the amphibian populations are declining. D Field measurements of UV radiation should be made in regions of the world where the amphibian populations are declining and in regions where they are stable. • Answer Choices A & B and C & D are parallel in construction. Now, no one Answer Choice stands out.	Although the wording of the item stem is better than the original, it can be further improved. • "Population" and "birth rate" are not consistent with the terminology used in the technical passage. • The syntax of Answer Choices A and B could be improved. • Answer Choice D implies but does not state that a comparison between two areas should be made.	"Which of these additional studies would best support the claim that increases in UV radiation are responsible for a decline in the numbers of amphibians?" A The survival rates of amphibian eggs and young should be compared with the survival rates of animals which are not as sensitive to UV radiation. B The death rates of amphibians should be compared with those of animals which are not as sensitive to UV radiation. C Field measurements of UV adiation should be made in regions of the world where the numbers of amphibians are declining. D Field measurements of UV radiation in regions of the world where the numbers of amphibians are declining should be compared to regions where numbers are stable. • The terminology is more consistent with that used in the technical passage. • The syntax of Answer Choices B, C, and D is improved. • Parallel constructions are evident in A & B and C & D.

PROTOTYPE ITEM #9: This item measures Indicator 1.4.7, "The student will choose appropriate summary statistics to describe tendencies revealed by data."

VERSION I (THE ORIGINAL AS CONCEIVED BY THE ITEM WRITER)	PROBLEMS	VERSION II (AS IT APPEARS IN THE PROTOTYPES)	PROBLEMS	VERSION III (BETTER YET)
"The field researchers claim that by filtering out UV radiation, frog eggs hatch more quickly and have a higher survival rate. Which of these should be done to improve their study?" A show that ozone levels are higher in hard-hit areas of the world B determine if increases in hatching rates lead to a decrease in survival rates C show that amphibian populations in coastal areas are unaffected by UV radiation D control for other variables in the local environment that might affect amphibian reproduction CORRECT RESPONSE: **D control for other variables in the local environment that might affect amphibian reproduction**	• From the information described in the technical passage, the student would not know if any coastal areas were included in the study. Therefore, Answer Choice C is not fair game.	"The field researchers claim that by filtering out UV radiation, frog eggs hatch more quickly and have a higher survival rate. Which of these should be done to improve their study?" A show that ozone levels are higher in hard-hit areas of the world B determine if increases in hatching rates lead to a decrease in survival rates C show that DNA damage in frog eggs is increased by filtering out UV radiation D control for other variables in the local environment that might affect amphibian reproduction • Answer Choice C is improved by reference to DNA damage which is mentioned in the technical passage.	Although the wording of the item stem and Answer Choices is better than the original, there is opportunity for further refinement. • The item stem is ambiguous and should ask what follow-up studies should be done to verify the claim that frog eggs hatch more quickly when UV radiation is filtered out. • Terms like "hard-hit" are idiomatic and may be unfamiliar to students. • Answer Choice A is not aligned with the informationpresented in the technical passage. • Answer Choice C is written in passive voice. • The syntax of the Answer Choices could be improved.	"The field scientists claim that filtering out UV radiation allows frog eggs to hatch more quickly and increases the survival rate of the eggs and tadpoles. Which of these follow-up studies should be done to <u>verify</u> this claim?" A show that the eggs of species other than amphi-bians are not affected by UV radiation B determine if an increase in the hatching rate of frog eggs leads to a decrease in the survival rate of tadpoles C show that DNA damage in frog eggs increases when UV radiation is filtered out D control for other variables in the local environment that might also affect amphibian reproduction • The item stem is more clearly stated. • Syntax has been improved. • Idiomatic expressions have been eliminated. • Answer Choice A is more aligned with the information provided in the passage. • "<u>Verify</u>" in the item stem is underlined for emphasis.

SAMPLE #3

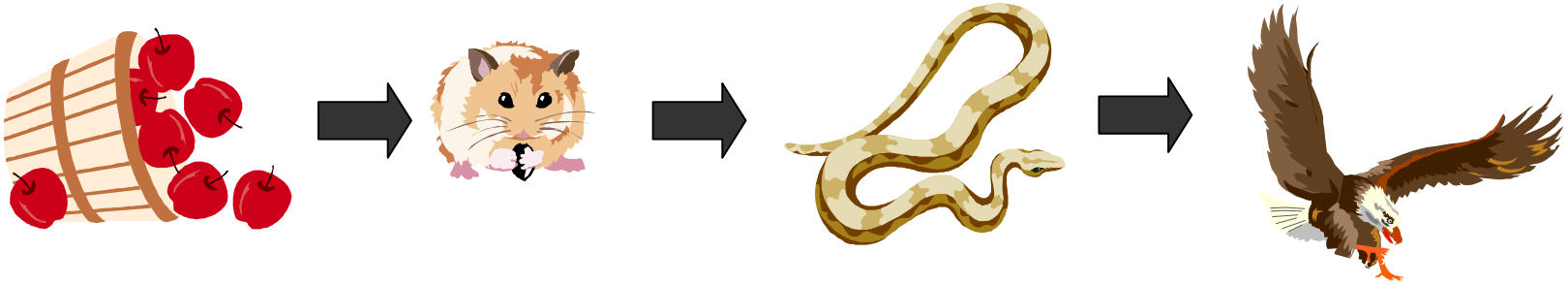
The following item is an example of a *discrete* Selected Response. Discrete items are those that stand alone rather than as part of a set.

PROTOTYPE ITEM 15, DISCRETE SELECTED RESPONSE: This item measures Indicator 3.5.2, "The student will illustrate and explain how expressed traits are passed from parent to offspring."

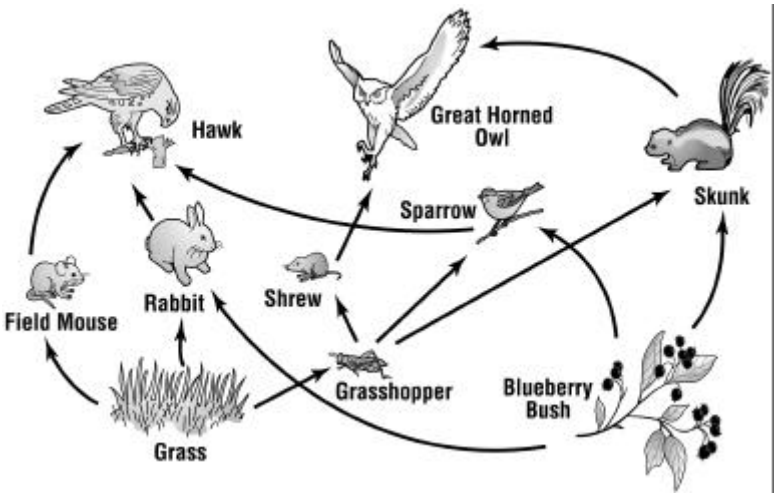
VERSION I (THE ORIGINAL AS CONCEIVED BY THE ITEM WRITER)	PROBLEMS	VERSION II (AS IT APPEARS IN THE PROTOTYPES)	PROBLEMS	VERSION III (BETTER YET)
"Norma and Jeff are both affected by colorblindness, a trait that is sex-linked and recessive. When their daughter Jessica grew up, she married a man named Mark who was not color-blind and they had several sons and daughters. Which of these statements best describes Jessica and Mark's children?" A All their sons are colorblind. B All their daughters are colorblind. C Both their sons and daughters are color-blind. D Neither their sons nor their daughters are colorblind. CORRECT RESPONSE: **A All their sons are color-blind.**	• Although students study sex-linked traits and should know how they are inherited, more information needs to be provided in the narrative. • When using names, it is important to balance gender and ethnicity.	"Norma and Jamal are both affected by colorblindness, a trait that is sex-linked and recessive. Their genotypes can be represented by the following symbols: Norma, X^rX^r and Jamal, X^rY. When their daughter Jessica grew up, she married a man named Miguel who was not colorblind, and they had several sons and daughters. Which of these statements <u>best</u> describes Jessica and Miguel's children?" A All their sons are colorblind. B All their daughters are colorblind. C Both their sons and daughters are color-blind. D Neither their sons nor their daughters are colorblind. • The genotypes of the parents have been clarified in the narrative. • There is better balance of ethnicity in the use of names. • "<u>Best</u>" is underlined for emphasis.	Although the wording of the item stem is better than the orginal, it can be further improved. • Sentence structure is long and complex. • The narrative seems to lack transitions and fluency. • Syntax errors are present in the Answer Choices. • The item names too many individuals, which may tend to confuse students.	"Colorblindness is a recessive, sex-linked trait that affects less than 8% of the human population. Affected males have the X^rY genotype, while affected females have the X^rX^r genotype. Jessica's parents are <u>both</u> color-blind. Jessica marries Miguel, who is <u>not</u> colorblind. They have several sons and daughters. Which of these statements <u>best</u> describes the presence of the trait for colorblindness in Jessica and Miguel's children?" A Only their sons are colorblind B Only their daughters are colorblind. C Both their sons and their daughters are colorblind. D Neither their sons nor their daughters are colorblind. • The narrative clearly presents a sufficient amount of background information. • Students can now focus on Jessica, Miguel, and their children. • Separating the item into short paragraphs improves its clarity. • Key terms are underlined for emphasis. • Syntax has been improved.

SAMPLE #4

Sometimes the stimulus of an item is rich enough to spawn a whole set of items. Such is the case with the following piece of stimulus material.



The food chain above gave rise to the food *web* below that was used for Prototype Items 18 – 21. Even though the item writer's original intent was to ask one question based on the food chain, four questions evolved from the stimulus material. Prototype Items 18, 19, and 20 are selected response items that measure the student's basic understanding of the feeding relationships in an ecosystem and the impact that increases or decreases in the population of one organism may have on another.



Item 21, a Brief Constructed Response Item (BCR) from the Laboratory Set, is the original item that was conceived in the mind of the item writer.

PROTOTYPE ITEM 21, BRIEF CONSTRUCTED RESPONSE ITEM: This item measures Indicator 3.5.1, "The student will analyze the relationships among organisms, and between organisms and abiotic factors."

VERSION I (THE ORIGINAL AS CONCEIVED BY THE ITEM WRITER)	**PROBLEMS**	**VERSION II** (AS IT APPEARS IN THE PROTOTYPES)	**PROBLEMS**	**VERSION III** (BETTER YET)
"What would happen to the other organisms if the number of hawks decreased sharply?"	• Organisms in the food chain should be labeled for clarification. • The diagram does not have a title. • The situation created in the item is too contrived: in nature, relationships are never as simple as a food *chain*. • The set up of the item stem is out of context: e.g., what would make the number of hawks decrease?.	"A chemical that is toxic to hawks is accidentally released into the woodland ecosystem. What would happen to the quantity of grass and the populations of the shrew and grasshopper if the number of hawks decreased sharply?" • A more appropriate context has been provided by the food *web*. • A context has been provided for a sudden decrease in hawks.	Although the wording of the item stem is better than the orginal, it can be further improved. • The way in which this item stem sets up a hypothetical situation may be difficult for some students to understand. • The item asks for students to describe two changes. Because two questions are enfolded into one sentence, students may inadvertently overlook one or the other. • Asking "What would happen" may lead students to simply state that the populations increase or decrease.	"When a chemical that is toxic to hawks is accidentally released into this woodland ecosystem, the number of hawks decreases suddenly." • Describe and explain the changes that will occur in the populations of the shrew and grasshopper as a result of this decrease in the number of hawks. • Describe and explain the changes that will occur in the quantity of grass as a result of this decrease in the number of hawks?" COMMENTS: • The narrative (first sentence) sets up the situation using a more easily understood "IF – THEN" scenario. • The question is bulleted to direct students to consider two different sets of changes. • The item stem provides two verbs to cue students to explain why the changes occur. • Words are underlined for emphasis. • Asking students to "describe changes" encourages them to provide a richer and more thorough response. • "Suddenly" is more understandable than "sharply."