

North American Envirothon

SUGGESTED

TEST WRITING GUIDELINES:

Amended 2010

Table of Contents

SITE SPECIFIC QUESTIONS THAT STRESS HANDS-ON AND PROBLEM SOLVING	3
DEVELOPMENT OF A TEST QUESTION RUBRIC	7
BLOOM’S TAXONOMY	9
CHECKLIST FOR TEST ITEM READABILITY	11
SUGGESTED REFERENCE MATERIALS GUIDELINES	12
SUGGESTED GUIDELINES: % CATEGORY BREAKDOWN FOR STATION TESTS	12
GUIDELINES FOR MULTIPLE CHOICE QUESTIONS	13
GUIDELINES FOR MATCHING QUESTIONS	15
GUIDELINES FOR FILL-IN-THE-BLANK QUESTIONS	17
SAMPLE TEST QUESTIONS	19
OVERALL TEST WRITING CHECKLIST	29

Suggested Test Writing Guidelines: A Check List

Using Site Specific Questions That Stress Hands-on and Problem-Solving

Adapted from a report by Jim Chandler of the Maine Envirothon

One of the outstanding aspects of the Envirothon competition is its emphasis on hands-on, problem solving activities. In addition we would like to encourage questions that involve site assessment. The intent is to encourage Canon Envirothon tests that make the most of testing sites while actively involving participants. Since Canon Envirothons are held outdoors, you should be developing tests that relate to that setting rather than a test that could just as easily be given in a classroom.

Caution About Question Type: The easiest kind of question to grade is a multiple-choice question. With multiple-choice questions it is quite easy to create a question that requires only rote memorization. However, it is also possible to create a multiple-choice question that requires problem solving and application of concepts. Whether a question is multiple choice or not should not be the determining factor as to whether it is a useful question. The important factor is whether it encourages problem solving, or application of knowledge or a skill which demonstrates the understanding of a concept. Sometimes the only practical way to test for certain information is a recall-type question, but they should makeup only a small part of station test questions.

Don't shy away from writing questions other than multiple choice for fear that the scoring will be subjective. In many instances these kinds of questions will better test problem-solving skills. With clearly defined scoring system, most questions can be scored consistently and precisely.

However, please remember,

TRUE/FALSE QUESTIONS WILL NOT BE ALLOWED ON CANON ENVIROTHON TESTS.

CAUTION: Active questioning will most likely take more time to grade. If your station tests contain a large number of these types of questions you may need to have a number of people assisting in scoring. It is strongly recommended that each page of the test be graded by the same judge to insure consistency in scoring. You should have people checking their work and the addition of points to be sure, but if judge 'A' grades page 1, that judge should grade all page 1's.

Environmental Assessment

Environmental assessment activities provide excellent opportunities for hands-on involvement. The following suggestions are traditional kinds of questions found on Envirothon tests. In time you will come to recognize them as the backbone of many station tests. The result of these hands-on activities can also be referred to in later questions by asking teams to interpret and apply the results. Beyond the more traditional

Envirothon questions you can also utilize the site conditions around the station or incorporate more first-hand experiences into your questions. For example: don't just ask teams to list erosion prevention practices, but asks for ones they see at the station.

Soil pit analysis: Use a soil-judging sheet to rate the soil characteristics. The results of the soil description can then be utilized in problem-solving question regarding the meaning of the soil description related to the suitability of various land uses. Some types of hands-on questions are suggested below.

1. Use of the "tools of the trade"- clinometers, augers, color charts, test kits, and meters
2. Familiarity with soil judging/ soil pits
3. Determination of soil type by ribboning or use of particle screens
4. Ability to quickly and effectively locate needed information in a soil survey
5. Basic ability to determine land use class
6. Identification of wetland indicators
7. Identify landform at site
8. Determine permeability of soil
9. Identify drainage class, depth to bedrock, depth of rooting
10. Measure thickness of topsoil, subsoil
11. Analyze soil structure and texture
12. Using soil survey:
 - Identify hydrologic soil group
 - Analyze chemical properties of soil
 - Estimate erosion potential
 - Identify soil-mapping unit
 - Evaluate soil type for its suitability for crops and pasture, woodland productivity, wildlife habitat, recreation, building site development and sanitary facilities

Wildlife habitat analysis: An excellent resource for these kinds of questions is the Wildlife habitat Evaluation Handbook developed by the National 4-H. Sample activities could include assessing the suitability of a habitat for a given wildlife species when the students are given a fact sheet on that animal. Management practices could also be recommended to improve the habitat for a given range of species. Some additional hands-on questions are listed below.

- 1) Assess suitability of habitat for given wildlife species
- 2) Suggest management practices for this site that would improve habitat for a given range of species. Develop rural and urban wildlife management plans.
- 3) Identify signs of wildlife
- 4) Cite examples of food chains based on specific site conditions
- 5) Analyze/Interpret site factors that limit or enhance population growth, both in the field and with aerial photos
- 6) Interpret significance of habitat alteration due to human impacts on site
- 7) Evaluate factors that might upset ecological balance of specific site
- 8) Use field guides to identify wildlife by their tracks, skulls, pelts, etc.
- 9) Interpret how presence of wildlife serves as an indicator of environmental quality
- 10) Identify common wildlife food
- 11) Assess the amount of edge and size in acres in one successional stage

Water quality analysis: A kick net sample for a local stream could be taken. The students could be asked to identify macro invertebrates either from a key or based on resource materials they studies. Comparisons could be made between different samples regarding the diversity of the sample or which sample was more likely to indicated poor water quality. Definition of a watershed of a water body given a topo map is also a good activity. Below are additional suggested topics for hands-on aquatics questions.

1. Assess water quality using pH meter, secchi disk, turbidity tube, thermometer, chemical test kits, etc.
2. Identify macroinvertebrates & vertebrates taken from a stream or pond using a key or field guide
3. Compare water samples taken from different parts of wetland, stream or pond
4. Make inferences about species diversity based on water quality tests or measurements
5. Complete a portion of a wetlands determination / SQM-water quality form
6. Assess physical components of a stream using a stream reach screening tool
7. Identify existing nonpoint source management practices in place or make recommendations for other site-specific best management practices
Use hand lenses, microscopes and field guides to identify plankton or algae samples. Submerged, emergent or floating plants ... terrestrial plants (riparian trees & shrubs).

Forestry: Hands-on activities in this area could include tree identification measurement of tree diameter, height, log measurements, interpreting measurements using volume tables, identifying trees that could be thinned or trees to be saved as a wildlife tree, etc. Below are suggested question topics.

1. Identify common trees without a key and unusual species through the use of a key
2. Use appropriate tools and measuring devices to determine tree diameter and height, log measurement, available board feet, crown spread, cordwood volume
3. Use appropriate charts and tables to calculate number of feet per acre needed for planting at any given spacing
4. Use current timber price list to calculate state stumpage value of specific trees
5. Use aerial photos to compare land use changes over time

It cannot be overemphasized that you should avoid questions that just require rote regurgitation of the facts. When you write a fact-based question, ask yourself: “Is knowing this fact important for understanding the subject?” An example of a question that is NOT very productive would be:

Question: How many lakes in the state have been affected by acid rain?

- a. 100
- b. 500
- c. 1000

A better question is one that takes the knowledge presented to the student and asks them to apply it to answer the question. A sample of this would be:

Question (3 pts): For each pair of situations, circle the lake that is more likely to be affected by acid rain? Circle one in each pair:

A high altitude lake OR a lake at lower elevations?

A lake with granite bedrock OR a lake with a limestone bedrock?

A lake with deep soils OR a lake with shallow soils?

Questions that teach a new concept and then ask the students to apply that concept are valuable in that the students learn something new while also being tested for their problem-solving ability. An example of this follows:

Question (3 pts): Fish continue to grow as they age, and their scales grow as the fish grow. This allows fisheries biologists to age fish by the pattern of the rings similar to the way foresters age a tree. Closely spaced rings are laid down in winter when growth is slow. In spring and summer the rings are further apart. The scale shown at this station is from a White Perch, a spring spawning species that was collected in July. How many winters had this fish lived? (The scale in question could either be displayed with a photocopy of the scale, or shown under a magnifying glass.)

The following is an example of an excellent question in this area. Students were given a short paragraph on tag and release methods for estimating populations. The students were then presented with a pan of tagged and untagged fish. They were told the number of tagged sunfish that had been collected the week before and released. The specimens in the pan were the results of the recent sample. Based on the sample they were asked to estimate the population of sunfish in the pond.

Questions that utilize equipment also are good hands-on questions:

Question (4 pts): Use the meter at the station to measure the pH of the water sample. What is the pH? Is this acidic or basic?

Each testing station will present numerous opportunities for teams to be active. Reading maps; interpreting charts and graphs; using mathematical formulas; using keys and

locating information in resource manuals are all question topics that demand critical thinking from the team. Engaging teams physically and challenging them mentally using some of the suggestions given here will significantly impact the quality of station tests and the training that goes into preparation for your Envirothon.

DEVELOPMENT OF A TEST QUESTION RUBRIC

Because time is critical in all aspects during a competition, grading short answer questions consistently across all tests is extremely important. Developing a rubric for short answer questions is one way to make it easier on station captains while establishing grading consistency. **It is important to include the point value on each test question.**

A rubric is a point scale (example: 5 point scale), and the corresponding answers that make up this scale. Below is an example of a test question and its rubric.

Question 4 pts: Explain why the Red Cedar River may recharge the area's aquifers at the highest water level or drain area aquifers at the lowest water levels.

Answer: A seasonal water budget simply shows water flows from higher elevations to lower. During high river levels, the top of the aquifer is lower and water goes into the area aquifer. During lowest river levels, the top of the aquifer is above the river and the aquifer flows into the river, making the river both a recharge and discharge area.

Rubric: Four points: 1 point for each aspect; a) at high river levels, water goes into aquifer and b) at low river levels, aquifer flows into river. 2 points for c) designating the river as both a recharge and discharge area.

When developing an objective scoring system to a fill in the blank format or a short essay, define a range of acceptable answers or list all the elements that would be included in a well-rounded answer and distribute the points among them. Some examples of rubrics for short answer questions are as follows:

Question 3 pts: Is this site suitable habitat for the Red Wolf? Why or why not?

Answer: This site is not suitable habitat for the Red Wolf because its major food sources (white-tailed deer, raccoon, hares) cannot survive here.

Rubric: Three points: 2 points for determining if the site is suitable Red Wolf habitat and b) 1 point for the explanation why

Question 2 pts: List two practices at this station that reduce non-point source pollution.

Answer: Buffer next to the pond, grass lined ditches, silt fence, diversion ditch, mulch

Rubric: 1 point for each practice listed

Question 8 pts: Wildlife management planning for a given area is based on the goals of the landowner and the many different need of wildlife for survival. Imagine a landowner would like to increase songbirds in the area around the station. List FIVE management practices that the landowner could implement to achieve this goal. **You will be scored on how well your answer matches the goal of increasing songbirds and to what extent you cover all the basic survival needs of the songbirds.**

The scoring rubric for this would include 1 point each for including the following aspects of wildlife needs: food, shelter, water. One point (up to a maximum of 5) will be awarded for each unique practice that would help achieve the goal of increasing the songbird population (8 points maximum)

CAUTION: In these kinds of questions it is especially important that you give the students a clear understanding of the grading criteria (as in the bold type above). It is important when asking open-ended questions that students understand what is expected of them or the question may be more confusing and frustrating than instructive.

An example of a rubric for a test question using a map is as follows:

Question 4 pts: Given the topo map of _____, define the watershed of _____.

An objective way to grade such a question is to set up specific criteria for awarding points. If the example above is worth 4 points, values can be awarded as follows:

Answer: Topographic map has watershed boundary drawn on it.

Rubric: 4 points:

- 1 point for having the watershed boundary around the body of water*
- 1 point for boundary line through the mountain peaks around the body of water*
- 1 point for boundary lines drawn generally at right angles to the contour lines*
- 1 point for the watershed boundary that matched map in the answer key*

Rubrics help the test graders to look for key answers and then assigns points for each of those answers. Many times there can be more than one answer, and this is the most important reason to have the station captains (who are experts in their fields) grade unusual answers to prevent incorrect scoring.

BLOOM'S TAXONOMY

Bloom's taxonomy is a system of categorizing thought processes into six levels as follows:

1. Knowledge
2. Comprehension
3. Application
4. Analysis
5. Synthesis
6. Evaluation

Knowledge Level

This level of questioning requires students to remember information they have already learned. Students are not asked to use this information in any way. Tested information may include factual data, definitions or observations.

Words used to write knowledge-level questions include:

When
Where
Who
What
Define

Knowledge level questions do not test in-depth understanding and should be used sparingly when constructing Canon Envirothon test questions.

Comprehension Level

These type of questions ask students to consider factual information they have learned and interpret it. Students are required to make comparisons and interpret graphs, tables, charts and even cartoons.

Words used to write comprehension-level questions include:

Compare
Contrast
Describe
Show
Explain

Application Level

Application level questions require students to give solutions to problems.

Words used to write application-level questions include:

- Solve
- Which
- Use
- Classify
- Choose
- How much
- What is

Analysis Level

These types of higher level thinking questions test how deep a student's understanding of information. A student must show understanding of the parts to an entire concept.

Phrases used in analysis questions include:

- Analyze
- Support
- Provide evidence
- Identify reasons
- Why
- Provide conclusions

Synthesis Level

These types of questions do not have only one correct answer or perspective. Students are required to analyze information and give explanations. The Canon Envirothon Oral Competition Problem is an example of a synthesis problem in which teams are required to comprehend concepts, apply solutions and analyze information.

Phrases used in synthesis questions include:

- Write
- Predict
- Develop
- Design
- Synthesize
- Produce
- Solve
- Devise
- Construct

Evaluation Level

This level of Bloom's taxonomy tests the most complex level of thought process. As in synthesis questions, these types of questions do not have one correct answer. These types of questions ask students to make judgments on ideas, solutions, methods or even products. Answers that provide reasons for the evaluation demonstrate knowledge and understanding of the topic, requiring the use of all the previous levels of thought processes.

Phrases used in evaluation questions include:

- Assess
- Decide
- Judge
- Argue
- What is your opinion
- Appraise
- Do you agree or disagree
- Give an evaluation

CHECKLIST FOR TEST ITEM READABILITY

When writing test questions, consider reducing possible reading difficulties that could keep students from demonstrating what they know about science. You may consider using diagrams and illustrations to make the test questions clearer. The following checklist gives one system to rate questions to determine suitability for a particular group of students ("Test Item Readability Checklist" by Rakow and Gee, 1987).

Rate the questions using the following system:

- 5 – Excellent
- 4 – Good
- 3 – Adequate
- 2 – Poor
- 1 – Unacceptable
- NA – Not applicable

- _____ 1. Students would likely have the experiences and prior knowledge necessary to understand what the question calls for.
- _____ 2. The vocabulary is appropriate for the intended grade level.
- _____ 3. Sentence complexity is appropriate for the intended grade level.
- _____ 4. Definitions and examples are clear and understandable.
- _____ 5. The required reasoning skills are appropriate for the students' cognitive level.
- _____ 6. Relationships are made clear through precise, logical connectives.
- _____ 7. Content within items is clearly organized.
- _____ 8. Graphs, illustrations, and other graphic aids facilitate comprehension.
- _____ 9. The questions are clearly framed.
- _____ 10. The content of items is of interest to the intended audience.

SUGGESTED REFERENCE MATERIAL GUIDELINES

1. All reference materials must be easy to access. Online reference materials are preferable.
2. Make sure reference materials provided are specific and not too overwhelming. Unnecessary to have student read an entire textbook on a particular topic.
3. Online references **MUST** be provided for all Canon Envirothon Goals and Objectives. In addition, the Host Committee will identify additional online references for any unique goals and objectives focused on at that particular competition.
4. The Teaching/Learning Day should not be the first time students see a particular skill demonstrated or a particular topic referred to. Reference material to support Canon Envirothon Goals and Objectives would eliminate 'teaching to the test' on the Teaching day.

SUGGESTED GUIDELINES FOR %/CATEGORY BREAKDOWN FOR STATION TESTS

Questions written for stations tests can fall into many categories. Some of these categories may include current resource issues, technical skills and management planning. One way to breakdown a station test to more efficiently test student knowledge across all categories and all topics has been charted below.

<u>Category</u>	<u>% of Questions on EACH STATION TEST</u>
Terminology	5%
Identification	10%
Equipment/Career Information	5%
BMP and Management Planning	25%
Overall Importance of the Resource	5%
Problem Solving and Technical Skills	50%

Site Specific Questions from ALL TESTS 30% overall

The above breakdown is one way to avoid the possibility of one category making up the 30% overall site specific criteria.

Beginning with the 2013 competition, the following are the revised “Suggested Guidelines for % Category Breakdown for Station Tests”.

“Suggested Guidelines for % Category Breakdown for Station Tests”

Category	Recommended percentage of Questions on EACH STATION TEST
Terminology	10%
Identification	20%
Equipment/career	10%
Management planning	50%
Overall importance of resource	10%
Problem solving & technical skills	50 % of the overall test
Site Specific	30% of the overall test
Hands -on	50% of the overall test

Multiple Choice Questions: Suggested Guidelines

As you are developing test questions for the Canon Envirothon competition, please refer to **CE “Goals and Objectives”** when formulating questions. Check off those you feel are most important, add others, and then develop questions related to those key points.

A variety of questions should be used on Canon Envirothon tests, including fill in the blank/short answer, matching, and, of course, multiple choice. Multiple-choice questions involve a statement or question (the "stem"), followed by several alternative responses. One of these responses is the answer; the others are distracters. There should be a maximum of 5 alternative responses.

Multiple choice questions allow the instructor to:

- ◆ evaluate learning in any content area
- ◆ evaluate learning at all cognitive levels
- ◆ grade more easily
- ◆ assess more content information in a shorter period of time
- ◆ reduce ambiguity and decrease the chance of scoring bias
- ◆ prepare learners for standardized tests.

On the negative side, multiple-choice questions are difficult and time consuming to construct, especially when assessing at higher levels of thinking. And they do not evaluate how well students are able to communicate their understanding. Considering the number of

tests that must be graded in a short period of time, however, multiple choice questions can be scored much more quickly.

Guidelines for Question Development (*examples of test questions on following page*)

1. The stem should not be written in the form of an unfinished sentence. It should be meaningful by itself and ask a question (who, what, where, when, why, how, which) or present a problem.
2. Avoid using negative questions or statements in the stem or response, as they tend to be ambiguous and confusing.
3. Do not give grammatical clues to the correct answer. Using the article "a" or "an" at the end of a stem indicates whether the answer starts with a vowel or consonant.
4. Write stems that have only one correct answer, but make the distracters plausible.
 - Write the correct response first, then generate 3-4 reasonable alternatives.
 - Write alternative responses of roughly equal length and parallel construction.
 - Arrange the alternative responses in alphabetical order to avoid establishing a pattern.
5. Use the responses "all of the above" or "none of the above" sparingly or not at all.
6. Place the entire item (stem and alternative responses) on the same page. Use upper case letters before each of the responses.
7. Make a deliberate effort to stress comprehension, application, analysis, synthesis, and evaluation when you write questions. *Guard against writing too many knowledge-level questions.* (See **Bloom's Taxonomy**) **-- over --**

<i>Multiple Choice Guidelines and Sample Questions</i>		
Guideline	Weak Question	More Effective Question
1. The stem should not be written in the form of an unfinished sentence. It should be meaningful by itself and ask a question or present a problem.	The natural soil drainage class of this soil is: A. Excessively well drained B. Well drained C. Well drained, wet substratum D. Somewhat poorly drained E. Poorly drained	Soil drainage classification is a method of indicating how well water moves off the surface or through the soil. Which of the following best describes this soil's natural soil drainage class? Same answer choices
2. Avoid using negative questions or statements in the stem or response, they tend to be ambiguous and confusing.	Which swan is not considered to be a true wild swan but an exotic bird? A. Whistling Swan B. Trumpeter Swan C. Mute Swan D. None of the above	Which swan is considered to be an exotic bird rather than a true wild swan? A. Mute Swan B. Trumpeter Swan C. Tundra Swan D. Whistling Swan
3. Do not give grammatical clues to the correct answer.	The tree marked with a red flag is an: A. Norway Spruce B. Austrian Pine C. White Pine D. Pin Oak	Identify the tree marked with the red flag from the list below. Same answer choices
4. Write stems that have only	Now found in every county in Ohio, this	What common predator, now found in

one correct answer, but make the distracters plausible.	common predator has extended its range to the east coast in recent years. A. Polar bear B. Alligator C. Coyote D. Lion	every county in Ohio, has extended its range to the east coast in recent years. A. Badger B. Black bear C. Coyote D. Marmot
5. Use the responses "all of the above" or "none of the above" sparingly or not at all.	The material that is the biggest money-maker in recycling is: A. Aluminum cans B. Paper C. Glass D. All of the above	What material is the biggest money-maker in community recycling programs? A. Aluminum cans B. Glass C. Paper D. Plastic
6. Place entire question on the same page. Use upper case letters to distinguish responses.	Question in which several answers are listed on following page. Lower case letters used to distinguish responses.	Entire question is contained on single page. Upper case letters used to distinguish responses.
7. Make a deliberate effort to stress higher level thinking skills.	The soil at this site has developed from which of the following? A. Bedrock B. Glacial outwash C. Lacustrine sediments D. Glacial till	If a septic tank absorption field were installed at this site, which soil feature would be most restrictive and likely to cause groundwater pollution problems? A. Depth to bedrock B. Seasonal wetness or drainage C. Slow subsoil permeability D. Underlying sand and gravel

Matching Questions: Suggested Guidelines

As you are developing test questions for the Canon Envirothon competition, please refer to **CE "Goals and Objectives"** when formulating questions. Check off those you feel are most important, add others, and then develop questions related to those key points.

A variety of questions should be used on Canon Envirothon tests, including short answer, multiple choice, identification, and, of course, matching. Matching items are objective and will test the relationship between a term and its definition. In general, matching items consist of a column of stimuli presented on the left side of the exam page and a column of responses placed on the right side of the page. Students are required to match the response associated with a given stimulus.

Some relationships that might be tested with a matching exercise are:

- 1) Historical events and dates
- 2) Tools and their uses
- 3) Problems and their solutions
- 4) Elements and their symbols
- 5) Causes and their effects
- 6) Drawings and their interpretations

Matching questions allow the instructor to:

- ◆ evaluate learning in any content area

- On the negative side, it is difficult to write reliable matching items, and this type of question can be subject to guessing.

1. Include directions, which clearly state the kind of relationship you are testing, and the basis for matching the stimuli with the responses. Explain whether or not a response can be used more than once and indicate where to write the answer.
2. Use only homogeneous material in matching items.
3. Arrange the list of responses in some systematic order if possible (e.g., chronological, alphabetical).
4. Avoid grammatical or other clues to the correct response.

- Keep matching items brief, limiting the list of stimuli to fewer than 10.
- Include more responses than questions to help prevent answering through the process of elimination. One of the lists should be approximately 2 or 3 items longer than the other list. This makes it difficult to mark correct matches by the process of elimination.
- When possible, reduce the amount of reading time by including only short phrases or single words in the response list.

15

		4. ___Potassium D. H ₂ O E. NH ₃														
3. Arrange the list of responses in some systematic order if possible (e.g., chronological, alphabetical).	a. nematodes b. ozone c. leaching d. soil characteristics	A. caterpillars B. girdling C. mycorhizzal fungi D. nematodes														
4. Avoid grammatical or other clues to the correct response.	<p>Directions: Match the following to complete the sentence on the left.</p> <p>1.Permeability depends on A. hydric soils</p> <p>2. Compaction reduces B. infiltration of water into the soil</p> <p>3. Manure contains C. buffer strips</p> <p>4. Wetlands have D. organic N</p> <p>E. on the amount of organic matter present</p>	<p>Directions: On the line to the left of each phrase in Column I, write the letter of the phrase in Column II that best defines the concept. Each phrase in Column II may be used only once.</p> <table><thead><tr><th>Column I</th><th>Column II</th></tr></thead><tbody><tr><td>1. Compaction</td><td>A. increases infiltration of water into the soil</td></tr><tr><td>2. Permeability</td><td>B. is a sign of hydric soil</td></tr><tr><td>3. Manure</td><td>C. depends on the amount or organic matter present</td></tr><tr><td>4. A wetland</td><td>D. reduces infiltration of water into the soil</td></tr><tr><td></td><td>E. contains organic nitrogen</td></tr><tr><td></td><td>F. helps establish buffer strips</td></tr></tbody></table>	Column I	Column II	1. Compaction	A. increases infiltration of water into the soil	2. Permeability	B. is a sign of hydric soil	3. Manure	C. depends on the amount or organic matter present	4. A wetland	D. reduces infiltration of water into the soil		E. contains organic nitrogen		F. helps establish buffer strips
Column I	Column II															
1. Compaction	A. increases infiltration of water into the soil															
2. Permeability	B. is a sign of hydric soil															
3. Manure	C. depends on the amount or organic matter present															
4. A wetland	D. reduces infiltration of water into the soil															
	E. contains organic nitrogen															
	F. helps establish buffer strips															

Fill In The Blank/Short Answer Questions: Suggested Guidelines

As you are developing test questions for the Canon Envirothon competition, please refer to **CE “Goals and Objectives”** when formulating questions. Check off those you feel are most important, add others, and then develop questions related to those key points.

A variety of questions should be used on Canon Envirothon tests, including multiple choice, matching, identification, and, of course, fill in the blank/short answer. Fill in the Blank questions require the student to answer a question or to finish an incomplete statement by filling in a blank with the correct word or phrase.

Fill in the Blank/Short Answer questions allow the instructor to:

- ◆ Provide a wide sampling of content
- ◆ Can efficiently measure lower levels of cognitive ability
- ◆ Can minimize guessing as compared to multiple choice

On the negative side, fill in the blank/short answer questions can be ambiguous and can be difficult to construct so that the desired response is clearly indicated. Can be difficult to score if the question allows two possible correct answers. However, blind guessing is eliminated.

Guidelines for Fill in the Blank Question Development (examples on next page)

1. For Fill In the Blank, omit only significant words from the statement.
2. Do not omit so many word from the statement that the intended meaning is lost.

3. Avoid grammatical or other clues to the correct response, such as: a, an, he, she.
4. Be sure to list in the answer rubric, all possible CORRECT answers.
5. To minimize answer clues for Fill In the Blank, make the blanks of equal length.
6. When possible delete words at the end of the statement after the student has been given a clearly defined problem.
7. Avoid lifting text from study materials or other resources to avoid memorized answers.
8. Limit the desired response to a single word or phrase.

Developing a Scoring Rubric

Because time is critical in all aspects during a competition, developing a rubric for fill in the blank/short answer questions is one way to establish grading consistency. When developing a rubric to a fill in the blank format/short answer, define a range of acceptable answers or list all the elements that would be included in a well-rounded answer and distribute the points among them. A rubric is a point scale (example: 5 point scale), and the corresponding answers that make up this scale. Below is an example of a test question and its rubric.

Question: List two practices at this station that reduce non-point source pollution.

Answer: Buffer next to the pond, grass lined ditch, silt fence, diversion ditch, mulch

Rubric: 1 point for each practice listed

<i>Fill in the Blank / Short Answer Guidelines and Sample Questions</i>		
Guideline	Weak Question	More Effective Question
1. Omit only significant words from the statement.	Mycorrhizal fungi improve the uptake of <u>(water)</u> and nutrients.	Mutually symbiotic <u>(mycorrhizal)</u> fungi improve the uptake of water and nutrients.
2. Do not omit so many words from the statement that the intended meaning is lost.	_____ are toxic.	Heavy metals such as <u>(lead and mercury)</u> are toxic in high quantities.
3. Avoid grammatical or other clues to the correct response.	An <u>(aquifer)</u> is an underground area of porous rock or sand that is capable of holding water.	What is an underground area of porous rock or sand capable of holding water called? <u>(aquifer)</u>
4. Be sure to list in the answer rubric, all possible CORRECT answers.	Trees which shed their leaves annually are <u>(seed-bearing)</u> .	Trees which shed their leaves annually are <u>(deciduous, seed-bearing, common)</u> .
5. Makes the blanks of equal length.	<u>(Eutrophication)</u> is when a pond or stream is nutrient <u>(rich)</u> resulting in a heavy growth of algae and plants.	<u>(Eutrophication)</u> is when a pond or stream is nutrient <u>(rich)</u> resulting in a heavy growth of algae and plants
6. When possible delete words at the end of the statement after the student has been given a clearly defined	A <u>(keystone species)</u> is a species that has a significant influence on many other species of animals.	What type of species has a significant influence on many other species of animals? <u>(keystone species)</u>

problem		
7. Avoid lifting text from study materials or other resources.	“Although a showy wetland plant that many find beautiful, <u>(Purple Loosestrife)</u> forms impenetrable mats where few other plant species can live.”	Each plant of this showy wetland species can produce up to 2 million seeds each year, forming dense mats of vegetation. <u>(Purple Loosestrife)</u>
8. Limit the desired response to a single word or phrase.	What do legumes (nitrogen fixing plants) do to gaseous nitrogen from the environment? <u>(Legumes convert gaseous nitrogen to a usable form so plants can take it up)</u>	Nodulated legumes convert <u>(gaseous nitrogen)</u> to a usable form so that plants may take it up.

SAMPLE TEST QUESTIONS

Here are some sample test questions from past Envirothon Competitions. These sample questions come from station tests. At the national level, a minority of questions is site specific, with the majority of test questions focused on the study materials posted on the web, and in study packets prepared by the Host Team. Test writing in this manner prevents unfair advantage against teams who have prepared for the national competition for the previous several months (as opposed to advantage to teams who have mastered learning station information on-site, possibly scoring highest on tests).

FORESTRY LEARNING STATION TEST QUESTIONS

Notes to test writers: provide background information on measurements in both cm and inches. Questions must be applicable to BOTH Canada and US.

1. (___ pts) Identify the following trees by their common name without the use of a key.
Answer depends on the site and the trees chosen by the station captain.
Two-points for each tree correctly identified. Station captain's discretion as to the number of trees to be identified and to what degree of accuracy is required e.g. maple versus the more specific identification of sugar maple.

2. (2 pts) Name two of the functions of roots

Roots serve as structure and support to hold the tree up, to absorb water and nutrients, they actively transport amino acids, and roots provide storage.

Two-point question: a) one point for each correct function that is listed.

3. (4 pts) What are two benefits to maintaining riparian zones when harvesting timber near a stream?

Maintaining riparian corridors provides habitat cover for animals to move along the water, helps to moderate water temperature, prevents erosion and sedimentation of the stream, and maintains aesthetics.

Four-point question: a) two-points for each benefit

4. (3 pts) From a biodiversity point of view describe the main disadvantage of establishing a pine plantation. Why doesn't this encourage biodiversity?

A pine plantation is usually a monoculture with one type of tree species and usually at one age. This can limit the amount of biodiversity that exists there because it is not as complex an ecosystem (relatively speaking) as other mixed stands of trees.

Three-point question: a) two points for it being a monoculture and b) one point for it limiting biodiversity

5. (4 pts) How does the diversity of an animal population relate to maintaining a forest with a high diversity of plants and trees at a variety of ages? Give two reasons.

Diversity of animals increases as the complexity of an ecosystem increases. A wider variety of plant and tree species provides a broader base of food and habitat for more species of animals.

Four point question: a) two points for the complexity of the forest encouraging biodiversity and b) two points for a broader base of food in a forest with a high diversity of tree species.

6. (___ pts) Use a clinometer to determine the height of the designated tree(s)

Answer depends on the tree or trees chosen by the station captain.

The point scheme is dependent on what the site captain sets up. The development of a sliding point scale based on the accuracy of the measurement would provide partial credit instead of having this question be an all or non situation.

Assumption: a clinometer is available for the students to use and the station captain is able to designate a tree for the students to measure.

7. (4 pts) Explain the difference between multiple use management and ecosystem management?

Multiple use management is managing for sustainable forest products, recreation, wildlife, watershed, and uses other than just timber. Ecosystem management looks to

manage forests in a sustainable manner, as well as the components, systems, and processes that support the ecosystem.

Four-point question: two points for what multiple use is and b) two points for what ecosystem management is.

8. (2 pts) When a site starts off with a relatively high amount of organic matter and available nutrients (such as after a clear-cut or abandoned farmland) which type of tree species establishes itself first.

- A) invasive species
- B) primary species
- C) exotic species
- D) pioneer species**
- E) flagship species

Two point question

9. (4 pts) Would you expect to find a great amount of organic matter and available nutrients in the soil of a coniferous forest or a northern mixed hardwoods stand? Give two reasons.

Hardwood forests generally have more organic matter and nutrients in them. Conifers generally are found in sandy, dry and nutrient poor soil. Additionally the organic layer in a coniferous stand is deep and poorly decomposed because the needles make a thick mat that does not mix very well with the mineral soil, and does not contribute as much organic matter to the soil.

Four-point question: a) two-points for conifers growing on nutrient poor sandy soil and b) two points for conifers not adding as much organic matter.

10. (3 pts) Describe the role of mycorrhizae fungi in maintaining the health of the tree.

Mycorrhizae fungi form a mutualistic symbiotic relationship with the roots of the tree. The fungi take nutrients from the tree, allow the tree to absorb more nutrients because they hold the nutrients in the tissue of their bodies, and reduce some tree roots diseases.

Three-point question: a) one point for it being a symbiotic relationship and b) two points for the relationship allowing more nutrients to be taken up by the tree.

SOIL LEARNING STATION TEST QUESTIONS

1. (6 pts) Using the soil pit at this site evaluation the following aspects (A-F) of the soil profile.

- A) What is the depth of the O horizon?
- b) What are the major components of the O horizon?
- C) What is the depth of the A horizon
- D) What is the texture of the A horizon
- E) What is the depth of the B horizon?
- F) What is the texture of the B horizon?

Answers A-F are dependent on the site.

Six-point question: one point for each correct answer.

Assumption: the station captain is able to dig a soil pit at the site. Labeling the horizons ahead of time will help to save time for the students taking the test.

2. (4 pts) Based on the color of the A and B horizons in the soil pit, does this soil have a greater amount of organic matter in comparison to the sample provided by the station captain? Explain your answer.

Answer is based on the site. Assuming that the two soils being compared have a similar texture in most instances (but not all) if the soil pit horizons A and B are darker than the sample provided then it has more organic matter than the sample. If it is lighter in color then it has less organic matter than the sample.

Four point question: a) two points for the correct analysis and b) two points fore the justification.

Assumption: the station captain is able to dig a soil pit at the site. Labeling the horizons ahead of time will help to save time for the students. The station captain is also able to provide a sample of A and B horizons from another area.

3. (2 pts) The dry bulk density of soil is?

- A. it is the ratio of mass to the volume of dry soil**
- B. it is the difference in weight between wet and dry soil
- C. the difference in mass between dry and wet soil
- D. it is the volume of soil at one atmosphere of air pressure
- E. it is the ratio of the volume of soil to the volume of water in the soil

Two point question

4. (4 pts) Based on the characteristics of the soil and the location of the site would it be appropriate to put a septic field in at this site. Describe your soil evaluation and explain your answer.

Answer depends on the site. In general if the soil is very sandy or near a body of water then it might not be appropriate to build a septic field because of the likelihood of waste getting into the body of water.

Four-point question: a) two points for correctly evaluation the soil and b) two points for the explanation why.

5. (6 pts) Rank the soil particles according to their relative size. Ranking is 1-7, 1 designating the smallest particle and 7 the largest particle.

Medium sand 4

Clay 1

Fine sand 3

Very coarse sand 6

Silt 2

Gravel 7

Coarse sand 5

Six-point question: one point for each correct answer

6. (4 pts) Rank the following soil particles according to the cation exchange capacity of each soil particle. Ranking is 1 – 4, having the highest cation exchange capacity (CEC) and 4 having the lowest CEC

Sand 3

Clay 1

Gravel 4

Silt 2

Four point question: one point for each correct ranking

7. (4 pts) Utilizing the soil survey for this county, name two tree species that are likely to grow here.

The answer depends on the site

Four-point question: a) two points for each tree species correctly listed.

Assumption: a soil survey is available to be used by the students.

8. (2 pts) Explain how soil filters out water. Describe two soil functions.

As water percolates through the soil profile toxins such as heavy metals are removed

from the water by adsorption associated with clays and humus. Soil also traps physical debris.

Two points for filtering out solid particles and binding heavy metals.

9. (4 pts) Explain how soil colloids can bind heavy metals. Why this important?
Heavy metals (e.g. lead and mercury) are toxic in high quantities. Negatively charged soil colloids adsorb these metals and clean the water as it passes through the soil profile. This is important to keep our groundwater clean.

Four point question: a) two points for binding heavy metals to colloids and b) two points for keeping ground water clean.

10. (5 pts) Describe two ways that farmers can reduce water erosion in their fields. Why is this particularly important near streams and lakes?

Farmers can reduce water erosion by terracing, contour stripping, establishing no till areas, creating buffer strips, and orientating crop rows perpendicular to the slope of the hill. This is particularly important where the run-off from erosion will end up in lakes and streams.

Five-point question: a) two points for each solution and b) one point for the importance of erosion control near water.

AQUATICS LEARNING STATION TEST QUESTIONS

1. (12 pts) Using the keys provided, identify the Order or Family (as indicated on the specimen) of the following organisms

	Order	Family
A.	_____	_____
B.	_____	_____
C.	_____	_____
D.	_____	_____
E.	_____	_____
F.	_____	_____

Answers depend on the organisms the station captain has chosen.

Twelve point question: one point for each correct answer

2. (2 pts) Transpiration is defined as

A) the transport of materials within a plant

B) the loss of water vapor from land plants

C) the process where aquatic plants take in dissolved oxygen

D) the process that allows oxygen to dissolve into the leaf tissue

Two point question

3. (4 pts) What would happen if water became denser when it froze, relate this to the effect it would have on ponds and lakes?

If water became denser when it froze, it would sink. This would be very detrimental to life in a pond, or lake, since the pond could eventually freeze solid and most life in the pond would be non-existent.

Four point question: a) two points for ice sinking and b) two points for pond freezing solid and death to most aquatic life.

4. (5 pts) Define adhesion and capillary action, demonstrate these two principles with a glass of water and straw (or water bottle if handy), explain how these principles are significant in respect to soil particles.

Adhesion is where water molecules stick to other surfaces (molecule other than H₂O) such as the side of a glass. Capillary action is a combination of cohesive and adhesive forces that allows water to move up a small column of water. The significance is that soil particles, particularly clay can hold on to particles of water, which makes them available to plants.

Five point question: a) one point for definition of adhesion b) one point for definition of capillary action c) two points for demonstration of both principles, and d) one point for relation to soil particle

Assumption: water and a straw are available

5. (2 pts) What effect does nitrate poisoning have on people and animals?

Nitrate poisoning can cause oxygen depletion.

Two point question

6. (4 pts) Explain the difference between a driven well and a drilled well. How do their maximum depths differ?

A driven well is a well that is a series of pipes with a point at the end that is driven into the ground; this well can go about 50 feet. A drilled well requires special drilling equipment and can go as deep as 1000 feet.

Four point question: a) two points for definition of a driven well and its depth and b) two points for definition of a drilled well and its depth.

7. (3 pts) What is groundwater? Describe the natural cleansing process that groundwater goes through.

Groundwater is water that is contained beneath the surface of the earth in areas of porous rock or sand. It is filtered by the soil as it travels through the soil stratum.

Three-point question: a) two points for the definition and b) one point for it being filtered by the soil.

8. (2 pts) Coliform bacterial is an indicator organism used when assessing water quality. What is Coliform bacteria an indicator of?

Coliform bacteria is an indicator organism because it shows the relative amount of human and animal feces contamination of a body of water.

Two point question

9. (4 pts) Give one example of a non-point source and point source pollution. Which is more difficult to control and why?

An example of non-point source would be fertilizer run-off from the laws in an urban area where the sewage runs directly into a body of water. An example of point source would be a sewer pipe dumping sewage into the river. The non-point source is harder to control because its origins are much more difficult to identify and it is usually the result of more than one person or organization.

Four point question: a) one-point for an example of non-point source, b) one-point for an example of point source, and c) two points for non-point being more difficult to control.

10. (4 pts) What is summer-kill? How does it relate to Dissolved Oxygen and Biological Oxygen Demand?

Summer kill is fish mortality due to lack of oxygen and high temperatures. It is relation to DO and BOD because when the temperature increases the streams are at a low surface level there is a synergistic effect that reduces the amount of dissolved oxygen to a level where it is below the BOD and the fish die.

Four point question a) two points for the definition of summer kill and b) two points for its relation to DO and BOD

WILDLIFE LEARNING STATION TEST QUESTIONS

1. (8 pts) Identify the animal skulls/hides without the use of a key.

- A. _____
- B. _____
- C. _____
- D. _____
- E. _____
- F. _____
- G. _____
- H. _____

Answers depend on the items the station captain has chosen.

Eight point question: one point for each correct answer

2. (5 pts) Define forest fragmentation. Explain what effect it can have on the diversity of the wildlife species living on the altered section of land.

Forest fragmentation is the breaking up of large tracts into smaller ones. This results in a decline in the number of wildlife species that depend on large undisturbed tracts of land, and it causes an increase in the number of generalist

species, and species that are tolerant of edge.

Five point question: a) one point for the definition of fragmentation b) two points for a decline in species that require large tracts of land and c) two points for an increase in generalist species an edge tolerant species.

3. (10 pts) Listed below are species of wildlife common to _____. Match each animal to its specific adaptation to the environment. Choose the adaptation that best describes the animal. Not all choices will be used.

Raccoon - **E**

Hawk - **H**

Perch - **F**

Mosquito - **B**

Hummingbird - **I**

Badger - **J**

Sandhill crane - **C**

Mallard duck - **L**

Copes gray tree frog - **G**

Beaver - **A**

- A. has a thick flat leathery tail
- B. has the ability to reproduce rapidly and numerous times a year
- C. has long legs and long beak to hunt while wading in water
- D. drops tail when threatened
- E. has tapetum in eyes providing excellent night vision
- F. has dark coloration on top half of body light coloration on bottom half of body
- G. has large toe pads
- H. has keen eyesight to see prey on ground
- I. characterized by small size, agility, and ability to hover
- J. excellent sense of smell for hunting small mammals, exudes musky odor when threatened
- K. sightless animal with a keen sense of smell and touch
- L. has a coating of oil on feathers to repel water
- M. secretes toxins from the skin behind its ears if threatened
- N. thick mats of fur between toes allow it to walk on the top of the snow

Ten point question: one point for each correct answer

4. (5 pts) Label the plants and animals listed below according to where they fit in the food chain. Use the number 1 to designate the lowest member of the food chain and sequence them in ascending order with the top organism in the food chain being the highest number.

Grass plant - **1**

Marsh hawk - **4**

Smooth green snake - 3
Red fox - 5
Cutworm - 2

Five point question: one point for each animal in the correct position

5. (3 pts) Is this site suitable for the prairie chicken? Explain your answer by describing ideal Prairie Chicken habitat and describing your evaluation.

Prairie Chickens prefer grassland areas characterized by sedges and grasses with little trees or shrubs. Answer depends on site.

Three point question: a) two points for knowing the habitat needs of the prairie chicken and b) one point for being able to determine if this site is suitable habitat

6. (4 pts) When harvesting managed timberlands “wildlife trees” can be left uncut. What is a wildlife tree and what capacity does it serve in the ecosystem?

A wildlife tree is typically a large old mature tree that animals use to nest on or in. Wildlife trees provide shelter (from predators and severe weather), serve as great nesting sites, and provide places for raptors to perch.

Four point question: a) two points for definition of wildlife tree and b) two points for their capacity in ecosystem

7. (4 pts) Define limiting factor. Give one example of an animal and a limiting factor affecting that animal.

A limiting factor is a resource or an environmental force that holds back the population of an animal. Salamanders need vernal pools to breed, if there are no pools there are no salamanders. The dependency of a wolf population on moose is another example.

Four point question: a) two points for the correct definition of limiting factors and b) two points for a correct example.

8. (5 pts) Define exotic species. Give two examples of exotics that currently inhabit _____.

An exotic species is an introduced species, either intentional or accidental, to an ecosystem. Examples are zebra mussels, pheasants, buckthorn, purple loosestrife, Cuban anole, etc.

Five point question: a) three points for a correct definition and b) one point for each correct example species

9. (4 pts) Describe two forms of habitat destruction, and give one example of an animal species affected by habitat destruction.

Fragmentation of forestland, pollution of waterways, filling in wetlands changing

forest types after a harvest (changing a hardwood forest to pine plantation). Passenger pigeon went extinct because of loss of habitat. The spotted owl is a threatened species due to lack of continuous old growth forest. The loss of prairie land due to urban development and conversion to farmland has negatively affected the greater prairie chicken population in Wisconsin, the filling in of marshland along the Gulf coast has reduced juvenile habitat for species of shrimp, crabs and fish.

Four point question: a) one point for each form of habitat destruction and b) two points for a correct example

10. (2 pts) Why is it important to not hunt or fish out of season?

Hunting seasons and limits on what you can take are designed to maintain the health of the animal population being hunted. It is based on the life cycle of the animal and is timed so that it does not negatively impact the animal population.

Two point question: a) point for health of animal population and b) one point for life cycle of animal.

OVERALL CHECKLIST FOR TEST WRITERS

- _____ Are there any True/False questions on any portion of any test? (pg. 1)
- _____ Are Rubrics clearly written for each test question? (pg. 5)
- _____ Are there point values assigned and visible next to each test question? (pg. 5)
- _____ Have questions been formulated using the higher levels of Bloom's Taxonomy? Comprehension, Application and Analysis? (pgs 7, 8)
- _____ For Fill-In-The-Blank/Short Answer questions, does the rubric contain as many correct answers as possible? (pg. 6)
- _____ Does each test question give information, in specific terms, on the number of requested answers? (pg. 6)
- _____ Have reference materials been provided for each objective? (pg. 10)
- _____ Is each station test within recommended Category Breakdown? (pg. 10)

Category	% of Q	Aquatic	Forestry	Soils	Wildlife
Terminology	5%	_____	_____	_____	_____
Identification	10%	_____	_____	_____	_____
Equip/Career Info	5%	_____	_____	_____	_____
BMP/Mgt planning	25%	_____	_____	_____	_____
Resource Importance	5%	_____	_____	_____	_____
Problem Solve/Tech	50%	_____	_____	_____	_____

_____ Do all the station test questions combined exhibit a 30% overall Site Specific percentage of questions? (pg. 10)