

Agriscience Reading and Comprehension Sets

Spring 2008

Agricultural Science Teachers,

Thank you for considering the use of these materials to help your students read and comprehend more effectively in your agriscience courses. Ours is a slightly difficult and immensely compelling task. We offer a unique opportunity to help our students develop key skills for lifelong learning: the ability to READ. We are the last opportunity for many students. We are the most interesting context for many students. We attempt to incorporate comprehension instruction into an already busy schedule. We know our students better than any other teacher in the school. Thus, we are likely the teachers who are best positioned to help our students.

What follows are 11 disciplinary reading passages and assessments within the context of agriscience. These assessments should be used as formative assessments. They provide the teacher with information about students' reading abilities. They also help students in agriscience learn about the format of standardized tests. They are not intended to be summative assessments.

First, immediately following this opening section is a one-page piece about the need for literacy instruction in agricultural science courses. This is background information providing justification for this endeavor. Hopefully you will find the information useful and relevant.

Next, we present the diagnostic features of the texts. The table presents information that should help you select passages to use with your students. Most pertinent are the following features: (a) total words, (b) percent passive sentences, (c) Flesch-Kincaid Reading Level score, (d) Simple Measure of Gobbledygook (McLaughlin, 1969, SMOG) readability score, and (e) major vocabulary. The passages range from 745 – 825 words. Normal students read about 250 words per minute, so the passages may require some students nearly five minutes to read the passage.

Readability is a relatively complex feature of texts (actually, the reader has as much to do with readability as the text, but we'll stick with features of the text). Readability is affected by things such as the vocabulary, sentence structure, and cognitive weight of words. Passive sentences are generally more difficult to read, so a range of passive structures are available with this material. Flesch-Kincaid Reading Level and SMOG reading level scores are one indication of grade level of text. There is much debate about the value of these scores, because they derive their calculations from syllables and word length. Thus, these give us an idea about the reading level, but are not the sole determinant of grade level reading (in other words, USE WITH CAUTION). Vocabulary is highlighted in the final column because of its importance in reading and comprehension. If you have students who struggle with reading, highlighting the key vocabulary before giving the assessment should raise their scores.

We wrote the assessments with varying levels of readability, ranging from 8.7 to 12.3 on the Flesh-Kincaid scale. This provides you with the ability to scaffold the use of the assessments with your students. You could start with a lower readability passage and then move to a more difficult set with your students. While our target grade level was grade 10, many of the sets are written somewhat above the tenth grade. This provides the opportunity to challenge your students. If when practicing using these assessments, students read material that is written at the upper end of their zone of proximal development, a.k.a. the upper range of their abilities, then they should be ultra prepared for grade level reading that is characteristic of standardized tests. (By the way, this first piece is 10.5 on Flesh-Kincaid, and the next section is 15.9).

These texts were written to coincide with the Illinois Agricultural Education's Core Curriculum Clusters. Some of the topics will overlap with a couple of curricular areas. This was intentional so that teachers could experiment with a couple of areas. The passages were selected to present information and ideas in an agricultural context, but one that teachers may not have taught to students. With this type of learning tool, we try to balance familiarity with novelty. When we read familiar texts, we tend to measure core knowledge about a topic. When we read novel texts, we tend to measure reading and comprehension skill.

Each assessment contains a mix of literal, inferential, and extension questions. Literal questions are those whose answers are found directly in the text. Inferential questions are those whose answers are found by combining pieces of information from various parts of the text. Extension questions are those whose answers must be found beyond the text. Students use their own background knowledge and/or information from agriscience courses to answer the question. Often these questions are an application of concepts from within the text. In the answer key section on of the reading set, we designate which questions are literal, inferential, and extension.

As you score the test, you may want to score these types of questions separately. Most of your students should answer the literal questions correctly. Then, progressively fewer students should be able to answer the inferential and extension questions correctly. Inferential and especially extension questions require additional cognitive and literacy skills to answer successfully.

After giving the assessment, if you want to re-read the passage with your students, you could talk through how you, an expert teacher, would attempt to understand the passage and answer the questions. Show them how to identify the kind of information needed to answer the question, as well as how you read and think about the ideas in the passage. Even though reading/thinking aloud is difficult, embarrassing, and seems elementary, much research suggests that struggling readers benefit immensely from this practice. This is probably the most powerful use of these assessments. (HINT: before reading/thinking aloud to your students, preview the passage and practice. It's not as easy as you'd think.)

What can you do to help your students read and comprehend prior to giving one of these assessments? There are literally hundreds of reading strategies. I'm not sure that any one strategy is the silver bullet, or fool-proof, for that matter. Rather, as agriculture teachers I surmise it's best to think about what we want to accomplish with our reading and strategy use. If we're problem-solving, then using a strategy that triggers question generation is appropriate. If we're teaching something new, but related to what students may already know, then a strategy that activates background knowledge is most effective.

In general, we want to help students (a) develop relevant purposes for reading, (b) activate background knowledge, (c) generate questions, (d) organize information, and (e) determine how to fix lapses in comprehension. I've not forgotten summarizations or discussions; it's just that we agriculture teachers tend to help students with those aspects of reading pretty effectively. And, if we don't help students prepare to read and monitor their reading, then the summary or discussion is almost a final attempt to help them learn or an attempt to tell them that they didn't read, which they already know. Further, as agriculture teachers, we have the whole application of concepts, ideas, and reading at our disposal. Students studying Romeo and Juliet will never stand on a balcony and earnestly say, "But soft, what light through yonder window breaks?" But, agriculture students studying IPM will likely apply mechanical, biological, and/or chemical measures to control aphids in a greenhouse.

If you have any questions or concerns about these materials, please feel free to contact me. We're all on the same team that helps students learn about agriculture. I'm learning, too.

Finally, as I tell my future teachers, these are but tools to use wisely as a professional teacher. You may not use all of them all the time. But, judicious use of the tool at the appropriate time can create a masterpiece.

Sincerely,



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Significance of Disciplinary Literacy in Agricultural Science Education

Today's demands on students' literacy skills are more intense than at any other time in history (Moore, Bean, Birdyshaw, & Rycik, 1999; National Governors Association (NGA), 2005; Snow & Biancarosa, 2004). The consequences of illiterate graduates are severely detrimental and often limit individuals from full participation in society (National Association of Secondary School Principals (NASSP), 2005; National Association of State Boards of Education (NASBE), 2006). High school graduates need proficient literacy and reading skills in order to succeed in school, participate in our democracy, navigate the information age, and make informed decisions about food, fiber and natural resources (Kamil, 2003; Meltzer, 2001; Snow, 2002; Vacca, 2002).

Even our brightest students, those pursuing further education, lack the necessary literacy skills for success. A bare majority of high school students completing the ACT are ready the type of reading needed to excel in college (ACT, 2006). American students compare poorly with students in other countries where disciplinary knowledge and literacy are central to the curriculum, let alone when they need to comprehend other sources of text, propose solutions, and make decisions (National Center for Educational Statistics (NCES), 2001; Organisation for Economic Co-Operation and Development, 2004; Wirt, Choy, Rooney, Provasnik, Sen, Tobin, 2004). In order for students to succeed in making decisions within our complex, information-based world, it is vitally important that they possess the ability to create knowledge from text, analyze arguments, propose solutions, and make decisions about real-world issues (Alvermann, 2006; NGA, 2005).

With this emphasis on applied literacy across the curriculum, intentional and explicit instruction using texts as learning tools cannot be relegated solely to language arts courses. Helping students read must occur in *all* disciplines, including secondary agriscience. The powerful combination in instructional strategies with exciting and relevant agricultural content can enhance student learning about agricultural and life science issues, such as food production, renewable energy, biotechnology, and animal welfare.

Agricultural science is an especially compelling context for reading because of the global nature and importance of its issues, the complexity of those issues, and the difficulty and diversity of text sources of information. As the world's population continues to increase, providing safe, abundant, and ethical supplies of food, fiber, and renewable energy to *all* people, while also maintaining the sustainability of our planet, is the nexus for all of agriculture. Students enrolled in agricultural science are the future decision-makers and problem-solvers of agriculture. Reading in agricultural science involves actual, relevant applications of the knowledge constructed from a variety of texts, including textbooks, Internet resources, popular magazines, technical reports, chemical labels, and other forms of text.

As a student moves through school, literacy demands increase, especially in complex applied sciences such as agricultural science. Students must become more adept at meeting the challenges of more sophisticated disciplinary reading and information (Meltzer, 2001; NASBE, 2006; Snow, 2002; Snow & Biancarosa, 2003). This is vitally important when the topic is unfamiliar and the reading is demanding (Allington, 2002). The task is especially difficult when students attempt to make decisions about agricultural issues, because they must rely upon diverse texts for information and formulation of arguments. Additionally, making informed decisions about complex issues, such as global warming, food security, and sustainability, often involve gathering information from and evaluating the arguments contained in widely varying texts beyond the single textbook (Gartin, Varner-Friddle, Lawrence, Odell, & Rinehart, 1994). These factors challenge the incorporation of reading instruction in a vocational or career oriented context.

Diagnostic measures and major vocabulary.

Title	Total Words	Sentences per paragraph	Words per sentence	Passive sentences (%)	Flesch Reading Ease	Readability Grade Level		Major vocabulary
						Flesch Kincaid	SMOG	
1) Extinction of the Ivory-Billed Woodpecker	810	5.4	14.5	12	53.5	9.4	11.6	extinct, habitat, old-growth, range
2) Animal Cloning	763	6.0	14.1	31	41.4	10.9	13.0	animal model, clone, embryo splitting, monoculture, nucleus transplantation, ovum, somatic cell nuclear transfer
3) Plant tissue culture	754	5.5	17.0	59	51.6	10.2	12.2	androgenesis, anther, aseptic, auxin, cultivar, cytokinin, differentiated cell, embryo rescue, germinate, haploid, hardened off, hybrid, <i>in vitro</i> propagation, media, medium, meristem, micropropagation, plant tissue culture, protoplast fusion, recessive, totipotent, transgenic, translocated
4) Budgeting in Agricultural Operations	825	5.0	16.5	26	40.9	11.6	13.6	budget, fixed expense, partial budget, statement of cash flows, tangible expense, unit budget, variable expense
5) Hydroponic Plant Production	813	4.4	15.3	28	50.9	9.9	12.3	aeroponics, aquaponics, arable, capillary action, coir, ebb and flow system, hydroponics, nutrient film technique, rafting, wick system
6) MIG Welding	814	5.6	15.9	25	50.8	10.1	11.3	bead, direct current, electrode, inert, oxidation, Metal Inert Gas (MIG) welding, welding

Title	Total Words	Sentences per paragraph	Words per sentence	Passive sentences (%)	Flesch Reading Ease	Readability Grade Level		Major vocabulary
						Flesch Kincaid	SMOG	
7) Vermiculture	798	5.8	16.9	57	58.9	9.2	11.5	amend, decomposers, vermicompost, vermiculture, windrows
8) Eutrophication	745	5.3	14.0	20	41.9	10.8	12.5	algae bloom, anaerobic, aquatic ecosystem, buffer zones, eutrophication, global positioning systems, growing season, hypoxia, precision farming, riparian zones, terrestrial ecosystems
9) Alternative Energy Sources from Agriculture	751	4.7	19.7	50	41.9	12.3	13.7	biodiesel, biofuel, ethanol, fuel cell, geothermal energy, non-renewable energy, photovoltaic, solar energy
10) Invasive Plant Species	770	5.8	16.3	21	42.9	11.3	13.0	competitive species, dispersal, emigrate, ground cover, habitat, invasive species, native species, predatory species, range, rhizome, weeds
11) Maple Syrup Production	774	4.8	17.5	52	63.5	8.7	9.9	spile, sucrose, sugar house

Agricultural Science Reading and Comprehension Set 1

Travis Park, Cornell University

Environmental Science. Extinction of the Ivory-Billed Woodpecker.

1 The Ivory-billed Woodpecker (IBW) became extinct in the
mid-1940s. Hunters in old-growth forests no longer hear the unique
“kent-kent” call. Hikers no longer hear the double-knock of the IBW
searching for beetle larvae. The last IBW was photographed in the
5 old-growth swamps of the southern United States in 1935. Today,
because of a potential rediscovery in Arkansas, major efforts are
underway to find the IBW.

 Once called the “Lord God Bird,” the IBW is the largest
woodpecker north of Mexico. It is the third largest woodpecker in the
10 world. It stands nearly 20 inches tall. In flight, the IBW’s wings span
30 inches. Large patches of white feathers on the trailing edge of the
wing and the ivory colored bill define the male IBW.

 The IBW’s range once included the American South from
eastern Texas to North Carolina, and from southern Illinois
15 throughout Florida. Like many woodpeckers, the IBW’s main food
source is insects. Beetle larvae is its favorite food. Beetle larvae are
scavenged from recently dead but still standing trees. To find the
beetle larva, the woodpecker pecks holes in trees and strips these
recently dead trees of their bark. Typically, the IBW prefers swampy
20 bottomland hardwood forests. These old-growth forests provided a
smorgasbord of insects from dead, but still standing trees.

 Several factors contributed to the extinction of the IBW by the
mid-1940s. Habitat destruction is believed to be the major factor in
the extinction of the IBW. Large paper and lumber companies bought
25 huge tracts of land within the IBW’s range. Logging destroyed the
habitat by removing the nesting trees and dead standing trees that
were the sources of insects for the IBW. The last remaining known
habitat of the IBW was the Singer Tract in Louisiana. The National
Audubon Society’s efforts to stop logging of the land only
30 accelerated the Chicago Mill and Lumber Company’s cutting and
destruction of the old-growth forest in this area. Today, less than 20%
of these old-growth forests remain in the South, especially in the
Mississippi Delta region.

 The IBW as not able to adapt to the habitat destruction like
35 other animals. IBW could not simply move to new habitat. The old-
growth forests were uniquely qualified to support the IBW. The dead,
standing trees provided nesting places and beetle larvae for food.

40 A second contributing factor to the IBW's extinction was the drainage, damming, and altering of the courses of swamps and rivers within its range. Draining and damming swamps provided vast agricultural fields after the trees were cleared. The remaining tracts of old-growth forests suffered from the lack of water to nourish and regenerate the trees. Those forests that do remain are located in isolated pockets surrounded by agricultural lands.

45 By creating isolated islands of old-growth forests, the wildlife that previously inhabited the area either died out or migrated to other habitat. As the areas of swampy old-growth forests diminished, so did the forests' ability to support larger animals such as wolves, panthers, and IBW. In smaller patches of forests, with the ebb and flow of
50 water altered, water quality becomes an issue. Sediments, fertilizers, and chemicals from surrounding agricultural lands, lawns, and roads wash into the remaining swamps and creeks. This alters the water quality and impacts life in the water. Gone are the riparian buffers with which to filter these pollutants out of the water.

55 Bird collecting also contributed to the IBW extinction. In the late 1800s bird collecting was one of the main fads of the day. As the IBW numbers began to decline in the late 1800s, bird collectors sought to add the rare bird to their collections. Thus, collectors and preservationists captured and stuffed IBW in large numbers to add to
60 their personal collections.

In February 2004, Gene Sparling observed an IBW while kayaking in the Cache River National Wildlife Refuge in Arkansas. Since 2004, several other sightings have been documented by
65 ornithologists, those who study birds. The Nature Conservancy, the Arkansas Game and Fish Commission, the Cornell Lab of Ornithology, and the U.S. Fish and Wildlife Service are conducting ongoing searches. However, no actual photographs or sound recordings have proven conclusive. Thus, large disagreement exists as to whether or not the IBW has been rediscovered.

70 Oftentimes, ensuring that one species is not confused for another requires careful documentation and analysis. The IBW closely resembles the more common and smaller Pileated Woodpecker (PW). The PW inhabits much of the same territory as the IBW. The PW peels the bark from trees in search of beetle larvae.
75 One difference between the two woodpeckers is that the PW has a black trailing wing edge. Skeptics of the recent sightings have indicated that the rediscovered IBW is really a PW. To date, no further conclusive sightings, photographs, or recordings have been found.

Please select the *best* answer from the choices provided for each question.

1. The passage asserts that the major cause of the ivory-billed woodpecker extinction was
 - a. hunting IBW for bird collections.
 - b. DDT and other petrochemicals.
 - c. habitat destruction.
 - d. global warming that caused the loss of the IBW's range.
2. What is a plausible explanation for why the IBW was called "Lord God Bird"?
 - a. This name is a translation from the bird's Native American name.
 - b. Because of its large size and unique markings.
 - c. IBW has seemed to come back to life after being thought to be dead.
 - d. "Lord God" sounds like the call of the IBW.
3. A difference between the IBW and the PW is
 - I. IBW has a white trailing wing edge and the PW has a black trailing wing edge.
 - II. PW has a silvery grey bill and the IBW has a white colored bill.
 - III. PW is much larger than the IBW.
 - a. I only.
 - b. II and III only.
 - c. I and II only.
 - d. I, II, and III.
4. If loggers did not cut dead trees for lumber, then how was the IBW's habitat destroyed?
 - a. Standing dead trees were removed to harvest the more valuable lumber trees.
 - b. Loggers cut roads through the swamp to harvest trees.
 - c. The IBW were pests that attacked loggers harvesting trees.
 - d. Logging caused the water to become filled with sediment.
5. The passage states that the Audubon Society's efforts to stop logging actually sped the Chicago Mill and Lumber Company's cutting efforts. What is a possible explanation for this?
 - a. The Audubon Society wanted to hunt the final IBW to add to their bird collections.
 - b. The lumber company wanted to cut the trees before the courts could stop the timber harvest.
 - c. The Audubon Society did not care about the IBW, so it did not allocate much money to stop the timber harvest.
 - d. The lumber company was paid by the Audubon Society to cut only living trees, not the standing dead trees where the IBW lived.
6. From the passage, it can be deduced that the size of the PW is
 - a. a wingspan of less than 40 inches.
 - b. less than 40 inches tall.
 - c. less than 20 inches tall.
 - d. less than 30 inches tall.

7. The loss of riparian buffers contributed to...
 - a. the death of live trees where the IBW fed on beetle larvae.
 - b. additional agricultural lands to provide corn and rice as food for IBW.
 - c. higher water quality in old-growth forests.
 - d. poorer water quality in old-growth forests.
8. The passage asserts that bird collecting contributed to the IBW extinction. Why?
 - a. Birds were trapped and moved to museums and zoos.
 - b. Bird collectors wanted to move the birds to better habitat.
 - c. The IBW were hunted and killed to the point of extinction.
 - d. Bird collectors took pictures of the IBW, which introduced lead poisoning into its habitat.
9. Why is the rediscovery of the IBW controversial?
 - a. Some sense that the US government has been lying to people about the IBW extinction.
 - b. The rediscovery happened in areas outside of the traditional IBW range.
 - c. Paintings and stories about recent sightings of the IBW seem more likely to be the PW.
 - d. Pictures and recordings in the past few years have been inconclusive.
10. For conservationists, what is one plausible lesson to learn from the IBW?
 - a. Habitat destruction may be an indirect route to extinction for some species.
 - b. DDT and other petrochemicals can cause the extinction of bird species.
 - c. Rivers and swamps may be drained as long as standing dead trees remain for bird nesting and feeding.
 - d. IBW had markings that were too bright and too white, thus contributing to its being hunted for food by other animals.

Environmental Science. Extinction of the Ivory-Billed Woodpecker.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	C	Habitat destruction.	Literal
2	B	Because of its large size and unique markings.	Inferential
3	A	I only. IBW has a white trailing wing edge and the PW has a black trailing wing edge.	Literal
4	A	Dead trees were removed to harvest the more valuable lumber trees.	Extension
5	B	The lumber company wanted to cut the trees before the courts could stop the timber harvest.	Extension
6	C	Less than 20 inches tall.	Inferential
7	D	Poorer water quality in old-growth forests.	Literal
8	C	The IBW were hunted and killed to the point of extinction.	Literal
9	D	Pictures and recordings in the past few years have been inconclusive.	Inferential
10	A	Habitat destruction may be an indirect route to extinction for some species.	Extension

Agricultural Science Reading and Comprehension Set 2

Travis Park, Cornell University

Animal Science. Animal Cloning.

1 Animal cloning is a form of biotechnology that scientists call
somatic cell nuclear transfer. Somatic cells are simply body cells. The
nucleus is the central “brain” of a cell containing all of the genetic
information in the cell. Thus, somatic cell nuclear transfer simply
5 means to take the “brain” of one body cell and move it into another
body cell to create a new animal. A clone is an individual that is
genetically identical with another individual. Plants commonly
produce clones during asexual reproduction in the forms of tubers,
plantlets, rhizomes, and stolons. Single-celled organisms commonly
10 reproduce via clones by division. However, cloning is not common
among higher-order animals, such as humans, swine, or cattle.

 Cloning gained notoriety in the mid-1990s. The procedure was
first used to create Dolly, a cloned sheep in England in 1996. This
cloning procedure sparked much debate about science, ethics, and
15 medicine. Since the time that Dolly was cloned, many different
animals have been cloned, including cows, pigs, goats, and horses.

 There are two main procedures for cloning animals. These are
called embryo splitting and nucleus transplantation. Both processes
involve the female egg or embryo cells. During embryo splitting, an
20 embryo of one organism is physically split into two separate
individuals. Both of these individuals are genetically identical to one
another. During nucleus transplantation, the nucleus of the recipient
individual’s ovum or egg cell is removed. It is replaced with genetic
material from another individual.

25 Why have artificial cloning techniques been developed? One
potential use for cloned or transgenic animals is in the medical field
as drug producers. In this system, animals produce human proteins
using biological processes already in place. For example, a cow that
produces human blood factors or insulin in milk is one potential use.
30 Using animals, large amounts of the human protein could be
produced. This provides the potential to help more people than could
be helped through conventional means. Potential disadvantages are
difficult to foresee, but can include possible transmission of diseases.

 Another potential use for animal cloning is for the use of animal
35 models for human diseases. Animal models are currently used by
scientists to study how biochemical and physiological processes are
affected by experimental drugs and therapies. These effects are then

used to determine how humans might react to the new drug or therapy. However, animal models and humans differ in their anatomy and physiology. These differences mean that humans and animal models are often incompatible, resulting in inaccurate effects. Cloning can solve the incompatibility problem by introducing the specific human genes that are being studied into the animal model. For example, a disease that is often not observed in mice can be introduced into mice that have been cloned with human genes. Scientists can then test potential drug treatments for the human disease. This use would reduce the need to subject humans to such experimentation.

Animal cloning could also potentially lead to the production of replacement human tissues outside of the human body. These tissues would be genetically identical to the human recipient. This would minimize the rejection that often occurs with transplanted organs and tissues. This cloning process would use the nucleus transfer technique in order to place human embryo cells into an animal embryo. This is an extremely controversial subject because of ethics concerning human embryo use.

There are several issues that surround animal cloning. One major concern is regarding animal welfare. Because of the low rate of success in animal cloning, there is a potential for a tremendous amount of loss of animal life. Also, questions exist about quality of life that the cloned animal endures. The few cloned animals that do exist have a high incidence of severe health problems. They have respiratory ailments, weakened immune systems, and deformities.

Some people express concern over the safety of the human food supply if cloned animals are to be eaten. Environmental concerns include the potential disastrous effects of entire animal populations with similar genetic makeup. In plants, monocultures of genetically identical plants can be devastated by a single disease or pest that the clones are not well adapted against. The same effect can potentially be seen in animal populations that all contain the same genetic traits. Ethical issues are controversial concerning whether cloned pets and food will be accepted by the general public.

Still, animal cloning holds the promise of new medical procedures to save human lives. Of course, like all medical and scientific advancements, concern must be observed and much testing must be done before full implementation. Cloning opens doors to many opportunities in agriculture and science.

Please select the *best* answer from the choices provided for each question.

1. A plant that reproduces via seeds...
 - a. undergoes the cloning process.
 - b. uses asexual reproduction.
 - c. produces offspring that are not genetically identical to the parent.
 - d. produces offspring that are genetically identical to the parent.
2. What might be another name for the nucleus of the cell?
 - a. The heart.
 - b. The brain.
 - c. The lungs.
 - d. The feet.
3. Why are people concerned about the safety of eating cloned animals?
 - I. They are unsure about the safety of the genetics of the cloned animal.
 - II. They believe that the animal experienced a lower quality of life than other food animals.
 - III. They are unsure of the science and technology involved in animal cloning.
 - a. I only.
 - b. II and III only.
 - c. I and II only.
 - d. I, II, and III.
4. What are the two main procedures for cloning animals?
 - a. Division and embryo splitting.
 - b. Division and nucleus transplantation.
 - c. Nucleus transplantation and embryo splitting.
 - d. Embryo splitting and asexual reproduction.
5. What are benefits of animal cloning?
 - a. More food, new species of animals, and regeneration of extinct animal species.
 - b. Medical models, replacement human tissues, and drug testing.
 - c. Replacement human tissues and regeneration of extinct animal species.
 - d. Medical models, replacement tissues, and increased food production.
6. According to the author, what are reasons to support further experimentation with animal cloning?
 - a. Animal cloning may offer new cures for human diseases.
 - b. Cloning is the latest scientific technology.
 - c. Cloning provides careers for agriculturalists and scientists.
 - d. Animal cloning offers possibilities for providing more food to feed the world's hungry.
7. According to the author, why should we be cautious about cloning animals?
 - a. Cloned animals experience health problems, and scientists do not know why they experience these problems.
 - b. Cloning may subject animals to a lower quality of life.
 - c. Cloning may contribute to the development of monocultures in animals.
 - d. None of the above.
 - e. All of the above.

- 8.** According to science fiction and movies such as *Jurassic Park*, scientists can use genetic information from extinct species to create new, living individuals. Why is this not currently possible according to this passage?
- a.** There are no living somatic cells in which to insert living nuclei.
 - b.** The nuclei of extinct species are no longer living and thus not viable.
 - c.** The DNA of extinct species may have decayed to the point that it is no longer usable.
 - d.** Living embryos of extinct species are difficult to find and use in science laboratories.
- 9.** What is the name given to an individual that is genetically identical to another?
- a.** Somatic.
 - b.** Clone.
 - c.** Transgenic.
 - d.** Embryo.
- 10.** Animal cloning is an example of...
- a.** cooperation among scientists and agriculturalists.
 - b.** career possibilities in agriculture.
 - c.** controversial science in agriculture.
 - d.** All of the above.

Animal Science. Animal Cloning.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	C	produces offspring that are not genetically identical to the parent.	Inferential
2	B	The brain.	Literal
3	D	I, II, and III. They are unsure about the genetics of the cloned animal. They believe that the animal experienced a lower quality of life than other food animals. They are unsure of the science and technology involved in animal cloning.	Inferential
4	C	Nucleus transplantation and embryo splitting.	Literal
5	B	Medical models, replacement human tissues, and drug testing.	Literal
6	A	Animal cloning may offer new cures for human diseases.	Literal
7	E	All of the above. Cloned animals experience health problems, and scientists do not know why they experience these problems. Cloning may subject animals to a lower quality of life. Cloning may contribute to the development of monocultures in animals.	Inferential
8	A	There are no living somatic cells in which to insert living nuclei.	Extension
9	B	Clone.	Literal
10	D	All of the above. ...cooperation among scientists and agriculturalists, career possibilities in agriculture, and controversial science in agriculture.	Extension

Agricultural Science Reading and Comprehension Set 3

Travis Park, Cornell University

Plant Science. Plant Tissue Cultures.

1 Plant tissue culture is the growth of plant cells or other tissues
detached from the organism. It is also called micropropagation. The
tissues or cells are grown on an artificial growing surface, or media,
5 in an aseptic environment using filtered air, free of the presence of
microbial pathogens.

 Tissue culture is used widely in the horticulture industry in
order to produce a large number of identical individuals quickly. An
example of this is with the many cultivated varieties of plants used in
10 ornamental garden beds. Popular species of orchids used as
houseplants are often germinated in sterile conditions using tissue
cultures because their seeds are extremely small and fragile.

 Tissue culture is also used in research that involves experiments
on seeds. Scientists easily observe which plants possess desired or
unusual characteristics. This is common in transgenic plant research.
15 Transgenic plant research is research involving genes from one plant
specifically inserted into another different plant. Tissue culture helps
scientists quickly see which plants have successfully expressed these
translocated traits. It is also useful to observe plants that have been
20 exposed to unusual environmental conditions, like radiation or a
chemical treatment.

 Tissue culture can be used to help grow plants that might not
otherwise reproduce and grow. For example, embryo rescue is a
tissue culture technique where a scientist breaks into the ovary of a
25 plant and removes the developing embryo from a seed before the
plant might otherwise abort it. This technique is commonly used with
breeding new cultivars of grapes, maize, and chrysanthemum.
Scientists also use tissue culture to artificially germinate grains of
pollen from the anthers of plants. This process is called androgenesis,
30 and produces plants with half of the number of chromosomes that
plants of that species would normally have. Plants that contain half of
the number of chromosomes they would naturally have are called
haploids. Scientists use this technique because generating haploid
plants can make the expression of recessive character traits more
35 visible in a shorter amount of time when compared to using hybrid
plants. It is used to observe different traits like cold tolerance easily in
forages and agronomic crops.

 Tissue culture is also commonly used to remove viruses from

infected plants. This is a common technique used for removing viruses from infected orchid and rose species. To remove a virus from a plant using tissue culture, a very small growing shoot, called a meristem, is removed from the infected plant. Because viruses are most commonly found on older tissues, this younger meristem tends not to be infected. The meristem tissue is then grown to regenerate the adult plant.

Scientists also use tissue culture to produce novel hybrid plants by fusing two plant cells together without intact cell walls in a process called protoplast fusion. There are two main methods for removing plant cell walls. One process involves the cell walls being ruptured mechanically and removed by hand. The other, more common process is to use chemical enzymes to digest the cell walls. Once the cell walls are removed, the protoplasts are then fused together, and then grow into complete plants. This process is used with improving African Violet species as well as some tree species, although it is of limited success.

The medium on which cultured plant tissues and cells are grown contains plant hormones, vitamins, and a nutrient source such as ammonium salts or amino acids. Auxin results in root growth, while cytokinin results in shoot growth. The amounts of these two hormones can be varied in order to cause different parts of the plant to grow. Unlike adult animal cells, adult plant cells are totipotent, meaning that one single cell can be used to produce all differentiated cells in the plant.

There are four common stages in tissue culture. Stage I is also called *in vitro* propagation and establishes the initial aseptic culture of the plant. It can be done by taking small sections of growing tips of adult plants, cutting away differentiated leaves from the meristem, and washing the tip with a disinfectant. The disinfectant cleans any microorganisms from the surface of the plant. Stage II is where plant tissues and organs begin to proliferate and increase in number. Stage III is characterized by rooting the shoot cuttings in order to prepare them for the eventual transfer to soil. In this stage, plants are hardened off. This means that they are gradually accustomed to the environment they will encounter once they are transferred to the soil. Stage IV is when the plants are transferred into the soil.

Please select the *best* answer from the choices provided for each question.

1. What is the artificial surface upon which plants grow called?
 - a. Soil.
 - b. Dirt.
 - c. Press.
 - d. Media.
2. Why is tissue culture used in the horticulture industry?
 - a. To quickly produce many offspring that are genetically identical to their parents.
 - b. To produce plants that have double the normal amount of flowers.
 - c. To develop new species of plants.
 - d. To quickly produce many offspring that are hybrids of their parents.
3. Why would a horticulturalist want to use tissue culture with a prize plant specimen?
 - a. Tissue culture allows the horticulturalist to reproduce the exact genetics of the prize plant.
 - b. Tissue culture allows the horticulturalist to improve the plant's genetics through sexual reproduction.
 - c. The horticulturalist may want to breed two prize plants to create a new hybrid.
 - d. None of the above.
4. With which of the following statements would the author of this passage agree?
 - I. Tissue culture uses science to remedy plant diseases and shortcomings, which would not be possible with natural reproductive means.
 - II. Tissue culture uses science to create new varieties of plants to appeal to consumers.
 - III. Tissue culture uses science to create plants that are more beneficial to humans.
 - a. I only.
 - b. II and III only.
 - c. I and II only.
 - d. I, II, and III.
5. Why are aseptic conditions important when conducting tissue cultures?
 - a. To produce as many new plants as possible.
 - b. To reduce microorganisms who feed on plant seeds.
 - c. To reduce disease contamination during fragile plant tissue transfers.
 - d. To create new plant species.
6. During the stages of plant tissue cultures, the best place to perform these processes would be which of the following?
 - a. A laboratory.
 - b. A greenhouse.
 - c. A nursery.
 - d. A classroom.

7. What is the process of producing plants with half of the number of chromosomes contained in normal plants of that species called?
- Tissue culture.
 - Androgenesis.
 - Haploidosis.
 - Nuclear transfer.
8. What do plant growth media contain?
- Soil, water, and pore space.
 - Plant hormones, vitamins, and minerals.
 - Iron, selenium, and calcium.
 - Plant hormones, vitamins, and a nutrient source.
9. With which of the following statements would the author of this passage agree?
- Tissue culture is inexpensive.
 - Tissue culture is labor intensive.
 - Tissue culture is easy.
 - Tissue culture is dangerous.
10. Which tissue culture processes may be used to grow plants that would not normally reproduce and grow?
- Androgenesis and natural selection.
 - Embryo rescue and haploid.
 - Embryo rescue and androgenesis.
 - Haploid and meristem.

Plant Science. Plant Tissue Cultures.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	D	Media.	Literal
2	A	To quickly produce many offspring that are genetically identical to their parents.	Literal
3	A	Tissue culture allows the horticulturalist to reproduce the exact genetics of the prize plant.	Extension
4	B	II and III only. Tissue culture uses science to remedy plant diseases and shortcomings, which would not be possible with natural reproductive means. Tissue culture uses science to create new varieties of plants to appeal to consumers.	Inferential
5	C	To reduce disease contamination during fragile plant tissue transfers.	Inferential
6	A	A laboratory.	Extension
7	B	Androgenesis.	Literal
8	D	Plant hormones, vitamins, and a nutrient source.	Literal
9	B	Tissue culture is labor intensive.	Inferential
10	C	Embryo rescue and androgenesis.	Literal

Agricultural Science Reading and Comprehension Set 4

Travis Park, Cornell University

Agricultural Business Management. Budgeting in Agricultural Operations.

1 A budget is a plan for how expenses and income are managed
over a period of time. Budgeting is an important, but sometimes
overlooked, aspect in managing agricultural accounts and operations.
When budgets are properly prepared, alternatives can be more
5 effectively compared, resources can be allocated, and better decisions
can be made. As with other aspects of agricultural business
management, accurate recordkeeping is important. Budgets help
define long-term business goals and eliminate wasteful spending
habits.

10 The budgeting process establishes goals for how money will be
spent and earned over a period of time. A total budget estimates total
income and expenditures for the fiscal or calendar year. It combines
all activities that either earn or spend money. A calendar year runs
from January 1 to December 31 on a given year. A fiscal year follows
15 a different calendar period, such as from July 1 through June 30 of
the following calendar year. Businesses follow a fiscal year to aid in
budgeting, because factors of production or services rendered may
not closely align with the calendar.

20 A partial budget compares the effects of alternative solutions to
a single decision. Often these budgets consider only the variable
expenses and income related to the decision. The fixed expenses and
income are constant regardless of the two options. An example of
such a decision can be deciding between purchasing a push
25 lawnmower and a riding lawnmower in a lawn maintenance business.
In making the decision, variable expenses would include the initial
investment in the lawn mower, fuel, and labor. Variable income could
include the income from the estimated number of lawns mowed in a
week with the push lawnmower versus the number mowed with a
riding lawnmower.

30 A unit budget estimates income and expenditures for the fiscal
or calendar year at the unit level, such as per square foot of
greenhouse bench space for example. This is a way for the managers
of the business to know exactly how much a unit will produce, as
well as how much the unit will cost to produce products.

35 A cash flow budget estimates income and expenses that are
allocated for short period of time. The period of time may be as short
as a month, a quarter, or a period that is appropriate for the business.

40 This budget is useful in determining when the income is sufficient to cover debts and expenses. A cash flow budget also informs the owner as to when outside financing may be necessary. For example, during June and July, many farmers lack income from farming operations, yet they incur expenses for fertilizer, labor, and pesticides. Budgeting ensures that sufficient funds are available to provide for these expenses during times of low income.

45 Before a business begins, owners must determine the initial, or start-up, costs the business will require. Start-up costs are expenses that the company necessary in order to begin operations. These can include tangible expenses. Tangible expenses are those expenses which can be quantified, or measured. Tangible expenses include
50 equipment, labor, insurance, rent, and inventory needed for production. Initial costs may also include services, such as a consultant or labor contracted through another individual or company.

Expenses can be either fixed or variable. Fixed expenses are those expenses which remain at a constant level, regardless of how
55 many units are produced. For example, a fixed expense might be cash rent for an 80-acre field. The rent does not change if the corn yield is 210 bushels or if it is 130 bushels. These expenses may include taxes, rent, insurance, utilities, and education.

60 Variable expenses are those expenses which vary depending upon the units produced. An example of a variable expense is feed costs. The feed costs required to raise one thousand feeder pigs is significantly less than the feed costs required to feed ten thousand feeder pigs. Thus, the feed costs depend upon the number of units, pigs, produced. Variable expenses may include feed, uniforms, and
65 veterinary medical costs.

Budgeting begins with estimating the kinds of items that require financial expenditures. Using previous records, efficiency tables, estimated costs of inputs, and price quotes from suppliers, the expenses of production amounts can be estimated. Similarly, the
70 amount of income from products or services can be estimated from previous records, efficiency tables, and estimates in income from each product produced. Estimated expenses are subtracted from estimated income.

75 Budgeting is difficult when the costs of production and/or the forecasted income are variable and volatile. For example, when fuel prices rise dramatically, budgets are often not aligned with actual expenses. Or, when the demand for agricultural products and services exceeds the supply, then the price per bushel of corn or other

80 commodity increases. In these instances, the budget may be reevaluated based upon changing market conditions. As always, the budget developed at the beginning of the year or production cycle must be compared to the actual statement of cash flows, which reflects the actual expenses and income of the operation.

Please select the *best* answer from the choices provided for each question.

1. Why are budgets important for agricultural business owners?
 - a. So that the business manager can measure where scarce financial resources are spent.
 - b. To determine which enterprises are most profitable, to determine how much money to spend on new equipment, and to track employee productivity.
 - c. To develop a statement of cash flows, an inventory, and a financial balance sheet at the end of each year.
 - d. So that alternatives can be more effectively compared, resources can be allocated, and better decisions can be made.
2. If a swine producer wants to know whether s/he can profit more from raising feeder pigs or from raising replacement gilts, which of the following budgets should s/he develop?
 - a. Unit budget.
 - b. Cash flow budget.
 - c. Partial budget.
 - d. Total budget.
3. When should does a business owner construct an overall budget?
 - a. At the beginning of the year.
 - b. In the middle of the year.
 - c. At the end of the year.
 - d. Once per decade.
4. Before developing a total budget, which of the following pieces of information are necessary?
 - a. Previous records.
 - b. Price quotes.
 - c. Detailed financial plans about the enterprise.
 - d. All of the above.
 - e. None of the above.
5. Why is budgeting difficult when expenses or incomes are volatile?
 - a. Because budgeting occurs months or even a year before income or expenses, those expenses and income that fluctuate are difficult to predict.
 - b. Sometimes expenses and income can blow up as a result of extreme volatility.
 - c. Volatile expenses and incomes may change suddenly, causing cash flows to exceed the budget.
 - d. None of the above.
6. In order to create an accurate budget, what basic management task must be conducted?
 - a. Profiting from sales.
 - b. Hiring the right employees.
 - c. Keeping accurate records.
 - d. Working with an honest accountant.

7. Which of the following would be categorized as a variable expense for a beef enterprise?
- Insurance premiums.
 - Feed expenses.
 - Mortgage payments on the farm.
 - None of the above.
8. Which of the following enterprises might consider following a fiscal year that coincides with the production year?
- Christmas tree farm with a fiscal year of April 1 through March 31.
 - U-pick strawberry farm with a fiscal year of July 1 through June 30.
 - Beef production with a fiscal year of January 1 through December 31.
- I only.
 - II only.
 - I and III only.
 - I, II, and III.
9. With which of the following statements would the author of this passage agree?
- Budgeting is an optional process when considering which of two financial decisions to make.
 - Budgets are useful for only part of the fiscal year.
 - Budgets ensure that the farm, business, or organization will make a profit.
 - Budgeting is a critical process relating to profit and business planning.
10. If a farmer wants to maximize profit per acre, which of the following budgets would be appropriate?
- Unit budget.
 - Cash flow budget.
 - Partial budget.
 - Total budget.

Agricultural Business Management. Budgeting in Agricultural Operations.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	D	So that alternatives can be more effectively compared, resources can be allocated, and better decisions can be made.	Literal
2	C	Partial budget.	Extension
3	A	At the beginning of the year.	Literal
4	D	All of the above. Previous records, price quotes, and detailed financial plans about the enterprise.	Inferential
5	A	Because budgeting occurs months or even a year before income or expenses, those expenses and income that fluctuate are difficult to predict.	Inferential
6	C	Keeping accurate records	Literal
7	B	Feed expenses.	Extension
8	B	II only. U-pick strawberry farm with a fiscal year of July 1 through June 30.	Extension
9	D	Budgeting is a critical process relating to profit and business planning.	Inferential
10	A	Unit budget.	Extension

Agricultural Science Reading and Comprehension Set 5

Travis Park, Cornell University

Horticulture. Hydroponic Plant Production.

1 Plants normally grow in soil. Sometimes soil is not available or
is not the first choice for a growing medium. Hydroponics is a means
of growing plants using a liquid nutrient solution instead of soil. The
5 area of hydroponics also includes aeroponics, which growers mist the
plants' roots with a nutrient solution. The field of hydroponics also
includes aquaponics, where both plants and fish are raised in the same
space.

 Although only recently gaining popularity, people have been
using hydroponics to grow plants for hundreds of years by many
10 different civilizations. For example, the Aztec civilization that
colonized areas of what is now Mexico used floating rafts on which
to grow food crops. The ancient Babylon civilization had developed a
system of "hanging gardens". Egyptian hieroglyphic records include
descriptions of growing plants in water. So, the concept of
15 hydroponics is not new.

 Modern hydroponics systems can be as simple as a homeowner
using an inexpensive manual system indoors to grow vegetables and
herbs. Or it can be as complicated and expensive as a commercial hot
20 house business using automatic systems to grow vegetables for a
larger market. The basic ideas behind growing plants without the use
of soil are the same, regardless of size or level of system
sophistication.

 One of the factors driving the development of modern
hydroponics systems is the potential use of these systems to grow
25 fresh produce in areas of the world that are not otherwise arable.
Some parts of the world lack sufficient precipitation or soil fertility to
grow crops outdoors. Growing plants using liquid nutrient solutions
and sand or glass wool as a support medium are common in urban
areas. Here undeveloped land for crops is scarce. Hydroponics has
30 even been tested by NASA for the potential use of growing plants in
space.

 There are several advantages to using hydroponics to grow food
crops. For example, higher yields can be produced. The devastating
effects of soil-borne pathogens and competitive weedy plants can be
35 eliminated. Fewer amounts of water and fertilizers are also used in
hydroponics. Some people also say that hydroponic vegetables are of
higher quality and appear more uniform.

Several disadvantages of hydroponic systems do exist.
Hydroponic systems are costly during setup and maintenance costs.
40 Diseases move quickly through shared nutrient solutions and can
infect many plants quickly. Of course, conventional growing systems
in fields use the sun's solar energy. Hydroponic use petroleum-based
energy, thus the energy costs are high.

All plants require light, water, oxygen, nutrients, and carbon
45 dioxide in order to grow and reproduce successfully. When plants are
grown naturally in soil, water percolates up through the soil from
groundwater sources to the plants' roots by a process known as
capillary action. Water also leaches down through the soil by
infiltration during precipitation. Nutrients, oxygen, and carbon
50 dioxide must all be dissolved in a water solution in order to be used
by the plants. This is true whether plants are grown in the soil or
hydroponically. Hydroponics is similar to growing plants in soil
because liquid nutrients are added to the root zone. Here the nutrients
can be absorbed by the roots. Aeration supplies oxygen and carbon
55 dioxide to the roots mechanically using an electric aerator.

The main difference between hydroponics and growing plants
in soil is that soil provides plants with a place to anchor the roots.
Roots anchored in the soil help the plant withstand environmental
conditions such as wind and precipitation. In hydroponics, roots
60 either grow freely in the liquid nutrient solution or are anchored to a
nutrient-free medium source. Inert media sources can include coir
(coconut fiber), gravel, and mineral wool (artificially spun metal or
mineral fibers).

Gardeners may choose from several different hydroponic
65 systems. The most common system in North America is the ebb and
flow system. It uses a tray filled with inert media that is flooded and
drained four to five times a day. This system works well for plants
that have a long life span and is used for growing plants in the
bedding plant industry.

70 Rafting is a simple system where a large volume of nutrient
solution is circulated below plants that are grown in floating
Styrofoam rafts. This system is commonly used for commercial
lettuce production.

The wick system consists of plants growing in a fine expanded
75 clay medium in pots. A wick is used in the bottom of the pot to bring
water to the plants roots from a reservoir, which is filled as needed.

80 The nutrient film technique is one of the newest systems to be developed. It uses a nutrient system that flows using gravity to move water down the roots of a plant using a series of tubes. The nutrient solution is collected in a reservoir to be used again. Only a very thin film of solution is ever in contact with the plants' roots. This allows the roots to absorb oxygen as well.

Please select the *best* answer from the choices provided for each question.

1. What is the term used to describe when plants are grown simultaneously with aquatic animals, such as fish and shrimp?
 - a. Aeroponics.
 - b. Aquaponics.
 - c. Hydroponics.
 - d. Plantiponics.
2. How can oxygen be added to the water used for hydroponics?
 - a. With a bubbler similar to those used in aquariums.
 - b. With falling water, as in the return to a main holding tank.
 - c. With injections of air into the system.
 - d. All of the above.
 - e. None of the above.
3. Hydroponic systems may take several different forms. Which of the following term is correctly matched with its respective system?
 - I. Rafting places plants within Styrofoam squares floating in water.
 - II. Wick systems grow plants on large rope wicks that contain nutrient solutions.
 - III. Ebb and flow systems fill and drain nutrient solutions from plant roots several times a day.
 - a. I only.
 - b. II and III only.
 - c. I and III only.
 - d. I, II, and III.
4. Why has interest in hydroponics increased?
 - a. Hydroponic systems are energy-efficient.
 - b. Hydroponics offers the ability to raise food where the soil and/or climate are unsuitable.
 - c. Hydroponics can reduce greenhouse gases, since plants consumer carbon dioxide in the greenhouse.
 - d. Hydroponics is relatively easy to understand, so many people can use these systems to raise food.
5. As a hydroponic producer, what could devastate your entire crop within the system?
 - a. Hard water.
 - b. Low humidity.
 - c. Disease.
 - d. Rock wool.
6. Because hydroponically grown plants lack soil in which to anchor roots, which of the following is true?
 - a. Plants must be grown indoors away from extreme winds.
 - b. Root diseases are less common in hydroponic systems.
 - c. Hydroponic systems cannot support tall plants.
 - d. None of the above.

- 7.** Hydroponics is not new. Which civilizations used hydroponic systems to raise crops?
 - a.** Apaches and English.
 - b.** Incas and Mayas.
 - c.** Eskimos and Australians.
 - d.** Aztecs and Egyptians.

- 8.** With the state of our global environment, what is one concern with hydroponic systems?
 - a.** It contributes to greenhouse gas accumulation in the atmosphere.
 - b.** It requires Styrofoam.
 - c.** It uses a lot of water.
 - d.** It uses a lot of fertilizer.

- 9.** In all hydroponic systems, what atmospheric gas must be available to plant roots?
 - a.** Argon.
 - b.** Carbon dioxide.
 - c.** Nitrogen.
 - d.** Oxygen.

- 10.** Which of the following hydroponic systems would be most effective with limited water supplies?
 - a.** Ebb and flow.
 - b.** Rafting.
 - c.** Nutrient film.
 - d.** Wick.

Horticulture. Hydroponic Plant Production.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	B	Aquaponics.	Literal
2	D	All of the above. With a bubbler similar to those used in aquariums. With falling water, as in the return to a main holding tank. With injections of air into the system.	Extension
3	C	I and III only. Rafting places plants within Styrofoam squares floating in water. Ebb and flow systems fill and drain nutrient solutions from plant roots several times a day.	Literal
4	B	Hydroponics offers the ability to raise food where the soil and/or climate are unsuitable.	Literal
5	C	Disease.	Inferential
6	A	Plants must be grown indoors away from extreme winds.	Extension
7	D	Aztecs and Egyptians.	Literal
8	C	It uses a lot of water.	Inferential
9	D	Oxygen.	Literal
10	C	Nutrient film.	Inferential

Agricultural Science Reading and Comprehension Set 6
Travis Park, Cornell University

Agricultural Mechanics & Technology. MIG Welding.

1 Welding is the process of fusing two metals together is a
process. It has been around for thousands of years, yet the specific
methods that are used have been perfected in the past century.
Welding is anything but ordinary. Today's welders are highly skilled
5 professionals who essentially build the world. Many welders have
mastered the several techniques involved in fusing metals together.

 In the most basic sense, welding involves a source of
electricity, an electrode, and two pieces of metal. The electricity
source basically short circuits, which provides a high temperature
10 open flame that melts parts of the two pieces of metal. The open
flame melts the electrode and neighboring areas of the base metals.
The electrode directs the energy and provides molten metal to fill any
cracks between the two pieces of metal. The resulting weld is called a
bead.

15 One such welding technique is the Metal Inert Gas (MIG)
welding (also called Gas Metal Arc Welding or wire-feed welding). It
is an automatic or semi-automatic arc welding process that uses a
wire electrode made of aluminum alloy. The wire electrode is fed
through a nozzle toward the joint between the two pieces of metal. An
20 inert shielding gas protects the weld area from atmospheric gas
contamination and oxidation during cooling.

 This shielding gas is used because it does not react with oxygen
in the atmosphere in a process called oxidation. Oxidation is
undesirable because it reduces the quality and durability of the
25 finished weld. If only carbon dioxide is used as an inert gas, the
welded bead's profile might not be as flat. Also, more spatter may
happen when using pure argon. Argon does not react at all with
welded metal, whereas carbon dioxide can react to a limited extent.
Thus, a combination of the two gases is often used. The main
30 difference is that carbon dioxide costs less than argon, and the ratio of
argon to carbon dioxide depends on what is being welded.

 MIG welding is widely used in industrial manufacturing,
particularly furniture and automobile manufacturing. It uses a current
of electricity that can either be direct or alternating to create an arc
35 between the electrode and the plate metal to be welded.

 Semiautomatic MIG welding occurs when a person operates the

welding nozzle and can manipulate the actual welding process. Automatic MIG welding systems do not involve people operating the actual welding process as it happens. This usually means that robotic welding arms are often used, such as in car assembly plants. People may set up and supervise the automatic welding machines, but they do not actively participate unless settings need to be changed or mechanical problems arise.

The two main MIG welding types are the conventional or the pulsed, depending on the type of power source used. Conventional MIG systems use a direct-current power source that supplies a constant voltage. It is not useful for welding metal sheets that are very thin and without a backing because it uses a higher heat input current. Pulsed MIG systems use a direct current power source like the conventional MIG system. This current is not consistent. Low current levels are punctuated with high current pulses, allowing a lower overall current compared to the conventional MIG system. Because it uses a lower overall current, this system can be used to weld thin sheets.

MIG welding is used because it is relatively easy to learn and master. It is a relatively clean and quiet welding technique that can be used in all positions, including overhead, vertical, and horizontal. It can also be used with stainless steel, mild steels, and aluminum. There are several potential disadvantages. MIG welding requires a large amount of shielding gas, which can be expensive. The cost of tips and nozzles is higher than with other welding techniques. It cannot be used to weld thick steel or for welding on surfaces that are dirty, painted, or that have a lot of corrosion.

Safety is an important aspect of any kind of welding technique. As with other arc welding techniques, the arc produced during MIG welding can reach temperatures of 3600 degrees. This is well beyond the temperature hot enough for fires to start. A carbon dioxide fire extinguisher should always be present when welding. Welders can prevent burns and other injuries by wearing welding gloves, protective clothing such as coveralls, and safety glasses at all time. Adequate ventilation is also important because inhaling shielding gas can cause sickness. The different metal vapors that are produced during the MIG welding technique are poisonous and can cause heavy metal poisoning. Permanent lung damage is also possible over time. Using eye protection is important during arc welding processes because the bright light that is generated can cause “arc eye”, which can cause eye pain and insomnia. The ultraviolet light can cause sunburns which can lead to skin cancers, and can also reduce a person’s night vision, or ability to see at night.

Please select the *best* answer from the choices provided for each question.

1. Why can pulsed MIG systems be used to weld thinner sheet metals?
 - a. Pulsing the electrode creates a flatter bead than conventional current.
 - b. Pulsing electrons keeps the electrons aligned in a strait line, making it easier to direct the flow of the weld.
 - c. The pulsing electron flow generates less heat that a conventional flow, which prevents burning through thin sheets of metal.
 - d. Pulsed electron flow uses less weld filler from the electrode, thus keeping the weld approximately the same thickness as thin sheet metal.
2. Why is oxidation undesirable in welding processes?
 - a. Oxidation changes the color of the weld, so that it is noticeable to the naked eye.
 - b. Oxidation creates a poor quality weld that is not durability.
 - c. Oxidation adds too much oxygen to the weld, creating a weld that is too hot.
 - d. Oxidation creates welds with too much splatter.
3. Which of the following are reasons for the popularity of MIG welding?
 - I. MIG welding is easy to learn.
 - II. MIG welding can be used in all positions.
 - III. MIG welding is clean.
 - IV. MIG welding is low temperature.
 - a. I only.
 - b. II and III only.
 - c. I and IV only.
 - d. I, II, and III.
4. Basic welding requires which of the following materials?
 - a. An electrode, two pieces of metal, and a power source.
 - b. Electricity, a circuit, and two pieces of metal.
 - c. An electrode, two pieces of metal, and a short circuit.
 - d. A short circuit, a power source, and two pieces of metal.
5. Based upon what you know about aluminum, why do you think that aluminum alloys are used in MIG welding for electrodes?
 - a. Aluminum has similar chemical properties to most base metals.
 - b. Aluminum is soft and melts at low temperatures, thus enabling molten metal to flow into the joint to be welded.
 - c. Aluminum is also inert, so it contributes to the shielding process and high quality welds.
 - d. Aluminum electrodes conduct electricity with greater efficiency, thus reducing the need for a lot of energy during welding.
6. What is a common name for a welded joint?
 - a. Molt.
 - b. Base metal.
 - c. Electrode.
 - d. Bead.
7. Welding uses inert gases to protect the weld. What is this gas called?
 - a. Welding gas.
 - b. Metal inert gas.
 - c. Oxidation gas.
 - d. Shielding gas.

- 8.** Welding can be dangerous, especially with high heat and fire potential. Why should the fire extinguisher be a carbon dioxide fire extinguisher and not a water fire extinguisher?
- Water fire extinguishers would not cool the metal quickly enough to put out the fire, whereas carbon dioxide will.
 - Carbon dioxide fire extinguishers are desirable for putting out all types of fires.
 - If water were used, it would contact the electricity, raising the possibility of shock and electrocution.
 - Carbon dioxide is a shielding gas, which protects the weld, in addition to extinguishing the fire.
- 9.** What is the purpose of the final paragraph of the passage?
- To persuade the reader to learn MIG welding.
 - To persuade the reader to use caution when MIG welding.
 - To inform the reader about the high temperatures involved with welding.
 - To compare MIG welding with various other kinds of welding.
- 10.** MIG welding uses inert gases. What do you think is a definition of inert gas?
- A gas that heats quickly to create a high temperature weld.
 - A gas that does not react with other gases or chemicals.
 - A gas that burns to add temperature to the welding process.
 - All of the above.

Agricultural Mechanics & Technology. MIG Welding.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	C	The pulsing electron flow generates less heat than a conventional flow, which prevents burning through thin sheets of metal.	Inferential
2	B	Oxidation creates a poor quality weld that is not durable.	Literal
3	D	I, II, and III. MIG welding is easy to learn. MIG welding can be used in all positions. MIG welding is clean.	Inferential
4	A	An electrode, two pieces of metal, and a power source.	Literal
5	B	Aluminum is soft and melts at low temperatures, thus enabling molten metal to flow into the joint to be welded.	Extension
6	D	Bead	Literal
7	D	Shielding gas.	Literal
8	C	If water were used, it would contact the electricity, raising the possibility of shock and electrocution.	Extension
9	B	To persuade the reader to use caution when MIG welding.	Inferential
10	B	A gas that does not react with other gases or chemicals.	Extension

Agricultural Science Reading and Comprehension Set 7

Travis Park, Cornell University

Soil Science. Vermiculture.

1 Earthworms are wonderful consumers of organic matter in the
soil. They are also quite efficient at producing a product that is fertile
and useful for many plants. Vermiculture is the use of worms to break
organic matter by some species of earthworms into vermicompost.
5 Vermicompost is also called worm castings or humus. It is the desired
product during the vermiculture process. Vermicompost is high in
nutrients that are used by plants. It is also used in improving the
texture and density of some soils. Vermiculture systems can be used
outdoors in compost piles for the rapid decomposition of lawn,
10 garden, and food wastes. Vermiculture can also be used indoors, most
often in kitchens, in order to break down household food waste.
Newspapers and other paper without chemicals can also be broken
down in a compost bin.

 Indoor vermicomposting systems consist of covered plastic,
15 wood, or Styrofoam bins and a closeable tap at the bottom that allows
liquids to be removed. This container is filled with a layer of gravel
and stones on the bottom of the container. The stones are covered by
a fine mesh to prevent worms from falling into the liquid produced
during the decomposition process. Damp, shredded newspaper
20 provides the worm habitat, while common kitchen waste serves as
worm food. Newspaper is the best and easiest bedding material to
find and should be damp when placed into the container.

 Many large-scale outdoor composting systems use earthworms
as decomposers. Decomposers are organism that break down dead
25 plants and animals. These outdoor systems can consist of windrows,
which are long piles of bedding materials that are laid on top of the
ground or concrete surface to prevent predators from feeding on the
worms. Outdoor systems may also use raised beds. In the raised bed
system, the worms are fed at the top of the bed. The vermicompost is
30 harvested from below the beds by using a breaker bar that is pulled
across a mesh screen at the base of the bed.

 The containers can be designed for different indoor purposes.
For the purpose of continuous harvesting of the vermicompost, a
series of trays that are aligned horizontally should be used. Since
35 earthworms will migrate towards their food source, a piece of mesh
that has holes large enough for the worms to migrate through divides
the bin vertically into two separate compartments. When one

40 compartment is full of vermicompost and is ready to be harvested, the
food wastes are placed in the other compartment in order to
encourage the worms to migrate to the new compartment. Then, the
vermicompost can be collected from the old compartment without
worms being harvested in the process.

45 Another system that can be used indoors consists of a series of
trays that are stacked vertically. The tray on the bottom is filled first
with the newspaper bedding and food waste. When the tray is full of
vermicompost, second tray is placed on top of the first one and is
filled with newspaper and food waste. When the worms have
migrated from the bottom tray to the top tray, the bottom tray can be
removed and cleaned.

50 Yet another system for vermicomposting involves an undivided
container. All of the newspaper, food material, and worms are mixed
together in the same container. This system is easy to build, but it is
difficult to harvest the vermicompost because the worms and the
compost must be emptied at the same time.

55 There are many species of earthworms, molds, bacteria, as well
as other decomposing organisms in nature that naturally break down
organic matter and litter. Vermiculture uses two main earthworm
species: *Eisenia foetida*, the Common Red Wiggler and *Lumbricus*
rubellus, the Red Earthworm. (Nightcrawlers are not recommended
60 because they tend to crawl out of and away from the vermicompost.)
These species are preferred because of their ability to break down
vegetation and animal manure efficiently. Individuals of these species
eat and digest approximately their entire body weight in food waste
every day. Thus, they produce vermicompost more quickly than other
65 earthworm species. The worms can break down meat food wastes, but
cannot digest bones. Also, composters will want to minimize the
amount of food wastes containing high amounts of chemical pesticide
residues, such as banana peels. These chemicals can harm the worms.

70 When the vermicompost has been digested properly, it is a rich,
dark brown or black color. It can be used to amend, or improve, soils
that are used for food crops. It should be mixed into soil, and not used
alone, because it is very concentrated. When used alone, it can cause
poor plant growth. It can also be used indoors with houseplants by
sprinkling a small amount around the base of the plant, avoiding
75 contact with the leaves. When the plants are watered, the nutrients
from the vermicompost are washed down into the root zone of the
plant.

Please select the *best* answer from the choices provided for each question.

1. In lines 2-3, the author states that earthworms produce a product that is fertile and useful for plants. What is that product?
 - a. Organic matter.
 - b. Humidity.
 - c. Nitrogen.
 - d. Vermicompost.
2. Why should nightcrawlers be avoided in the compost bin?
 - a. Nightcrawlers do not decompose household waste.
 - b. Nightcrawlers tend to crawl out of compost bins.
 - c. Compost is poisonous to nightcrawlers.
 - d. None of the above.
3. If you did use nightcrawlers in vermiculture, and they escaped into your house, based upon the passage, what would be one method to get them out of your house without harm?
 - a. Create a trail of vermicompost from the room where they escaped leading outside the house.
 - b. Use Red Wigglers as natural predators of the nightcrawlers.
 - c. Create a trail of moist newspapers leading from the room where they escaped to the outside of the house.
 - d. Create a trail of food, household waste, leading from the room where they escaped to the outside of the house.
4. What conditions of a worm's habitat should be recreated in a compost bin?
 - a. Cool, damp, dark conditions.
 - b. Warm, damp, dark conditions.
 - c. Cool, dry, dark conditions.
 - d. Warm, damp, light conditions.
5. In lines 50-54, the author presents ideas about a single-compartment compost bin. S/he states that these present difficulty in harvesting compost because it is difficult to separate the worms from the compost. What might be viable solutions to this challenge?
 - I. Pick the worms out by hand.
 - II. Use a screen to sort the worms from the compost.
 - III. Not worry about losing a few worms, as the ones left behind will likely reproduce.
 - a. I only.
 - b. II and III only.
 - c. I, II, and III.
 - d. None of the above.
6. What household materials are easily composted in vermiculture?
 - a. Food scraps and newspapers.
 - b. Non-meat food scraps and newspapers.
 - c. Non-vegetable food scraps and newspapers.
 - d. Newspapers and magazines.
7. What is the name given to organisms that break down dead plants and animals?
 - a. Producers.
 - b. Consumers.
 - c. Decomposers.
 - d. Predators.

- 8.** Compost bins use a couple of types of worms. Which are recommended?
- a.** Common Red Wiggler and Red Earthworm.
 - b.** Common Red Wiggler and Nightcrawlers
 - c.** Red Earthworm and Nightcrawlers.
 - d.** Redworms and Hookworms.
- 9.** Based upon information in the passage, if your home produced 12 pounds of food waste each day, how many worms would you need in your compost bin?
- a.** 4 pounds.
 - b.** 6 pounds.
 - c.** 12 pounds.
 - d.** 24 pounds.
- 10.** What could be a reason for the author writing this passage about vermicompost?
- a.** To inform readers about the basics of creating a vermiculture system.
 - b.** To persuade readers to create a vermiculture system at home in order to reduce waste going to landfills.
 - c.** To encourage readers to consider composting as a means of creating a useful plant product.
 - d.** All of the above.
 - e.** Two of the above.
 - f.** None of the above.

Soil Science. Vermiculture.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	D	Vermicompost.	Literal
2	B	Nightcrawlers tend to crawl out of compost bins.	Literal
3	D	Create a trail of food, household waste, leading from the room where they escaped to the outside of the house.	Extension
4	A	Cool, damp, dark conditions.	Inferential
5	C	I, II, and III. Pick the worms out by hand. Use a screen to sort the worms from the compost. Not worry about losing a few worms, as the ones left behind will likely reproduce.	Extension
6	B	Non-meat food scraps and newspapers.	Inferential
7	C	Decomposers.	Literal
8	A	Common Red Wiggler and Red Earthworm.	Literal
9	C	12 pounds.	Extension
10	D	All of the above. To inform readers about the basics of creating a vermiculture system. To persuade readers to create a vermiculture system at home in order to reduce waste going to landfills. To encourage readers to consider composting as a means of creating a useful plant product.	Inferential

Agricultural Science Reading and Comprehension Set 8
Travis Park, Cornell University

Biological Science Applications in Agriculture. Eutrophication.

1 Eutrophication is caused by an increase of nutrients in soil,
water, or even an entire ecosystem. This process in water is especially
detrimental to aquatic plants and animals. The accumulation of
5 nutrients in bodies of water from nutrient runoff from sewage and
fertilizers causes eutrophication. Most often, it causes excessive plant
growth in aquatic ecosystems. The excess plant growth occurs in
aquatic plant species that are unwanted. Aquatic ecosystems are those
ecosystems that are located in or directly adjacent to streams, rivers,
and lakes bodies of water.

10 Eutrophication increases the amount of plant and algal growth
in bodies of water. Excess growth of algae is called an algae bloom.
Algae blooms occur because the algae receive a sudden surge in
nutrients and grow rapidly. When the algae grows rapidly, it uses up
oxygen in the water. It also chokes out other plants that would
15 normally grow in the stream or lake. Some algae blooms may even
cause human illness.

 Eutrophication also accelerates the decay of these organisms in
water. This increased decay of organic matter results in hypoxia.
Hypoxia is a condition marked by a lack of oxygen in the water
20 available for fish and other animals. Oxygen is usually present in
water as dissolved oxygen. The lack of dissolved oxygen in water
leads to stress and even death of much aquatic life. Hypoxic water
supports only anaerobic bacteria species, those which do not need
oxygen to survive.

25 Eutrophication in water is a natural aging process of water
bodies. Rain and decaying plants and animals in the water cause
changes in the chemical make-up of the water. However, human
activities can accelerate this aging process. The process is accelerated
by the presence of phosphorus.

30 Fertilizers and sewage water contain large amounts of
phosphorus. Phosphorus is a major component in agronomic and
horticultural fertilizers. It is used for crop plants, gardens, and lawns
and is an important nutrient even in aquatic ecosystems. Phosphorus
runoff from sewers and septic systems can also speed the process of
35 eutrophication. Sewage treatment detergents designed to neutralize
calcium also contain large amounts of phosphorus.

Eutrophication also occurs in dry land, or terrestrial ecosystems. In these ecosystems, the build-up of fertilizers causes eutrophication. The increased amounts of nutrients in soils can lead to changes in the types of vegetation in an area. New plant species move into the area to take advantage of soil fertility. These new plants displace native species. Eutrophication can result in certain plant species becoming threatened or endangered. Plants, unlike animals, cannot move to more favorable locations.

Eutrophication can be both reduced and prevented. By creating buffer zones between the source of nutrients and the body of water, nutrients can be intercepted and filtered out in the buffer zone instead of by the lake or stream. Buffer zones contain plants, especially grasses and trees, that use excess phosphorous from fields and lawns. These buffer zones can be placed between bodies of water and roads, housing developments, and agricultural fields. These buffer zones are sometimes called riparian zones. Riparian zones or buffer zones minimize the amount of pollution that the body of water receives.

Another way to prevent eutrophication can be to change the policies that control how sewage, animal waste, and fertilizers are disposed of. By better managing nutrients and how we use them, we can prevent their misuse and better control where they ultimately travel in the ecosystem. Subdivisions are a primary source of fertilizer pollution. Homeowners can reduce the amount of fertilizer spread on lawns at one time. Or, homeowners can spread the timing of fertilizers in smaller amounts throughout the growing season.

Routine testing of local water supplies can also help farmers and homeowners optimize the usefulness of fertilizers that are added to the land. Using global positioning systems and precision farming methods, farmers use fertilizers in the precise amount needed by the crops. By encouraging homeowners to test their soil before adding fertilizers to lawns and gardens, money, time, and fertilizers can both be saved.

Bodies of water where eutrophication exists are difficult to remedy. Reversing eutrophication may take a long time. The main means of reversing eutrophication is by reducing the amount of phosphorus in the water. This means stopping the flow of sewage into bodies of water, decreasing the amount of phosphorus fertilizers used on lawns and fields near water, and creating buffer zones around bodies of water. Reducing eutrophication lowers the plant nutrients in water and increases the oxygen available for aquatic animals and plants.

Please select the *best* answer from the choices provided for each question.

1. The purpose of the first paragraph of the passage is to...
 - a. persuade readers to eliminate eutrophication.
 - b. define eutrophication and explain method of remedying the situation.
 - c. persuade readers to encourage eutrophication.
 - d. explain eutrophication and what causes it.
2. What are the problems caused by algae blooms in bodies of water?
 - a. Depletion of oxygen and competition with other plant life.
 - b. Addition of carbon dioxide and sedimentation.
 - c. Depletion of oxygen and sedimentation.
 - d. Sedimentation and introduction of microbes that cause human illness.
3. The last three paragraphs of the passage indicate groups of people who might be responsible for eutrophication. What can each group do to lessen the impact of eutrophication?
 - I. Farmers can use precision farming to maximize the nutrients used by plants and minimize the nutrients in field run-off.
 - II. Homeowners can use high volumes of fertilizer during dry times of the year.
 - III. Sewage treatment engineers can find other uses of sewage and not dump it into rivers and streams.
 - a. I only.
 - b. II and III only.
 - c. I and III only.
 - d. I, II, and III.
4. Line 7 describes aquatic plants that are unwanted. What would be another name for these plants?
 - a. Legumes.
 - b. Weeds.
 - c. Invasive species.
 - d. Algae blooms.
5. What is another name for a buffer zone?
 - a. Eutrophic zone.
 - b. Grassed waterway.
 - c. Riparian zone.
 - d. Atrophic zone.
6. Water lacking in oxygen as a result of eutrophication is called...
 - a. algal.
 - b. hypoxic.
 - c. eutrophic.
 - d. oxygenated.
7. Why are plants especially susceptible to eutrophication?
 - a. Plants cannot move from a nutrient-rich area to one more suitable for growth.
 - b. They are all rooted in soil, which contains elevated levels of nutrients.
 - c. Plants require carbon dioxide for photosynthesis, and eutrophication reduces the amount of carbon dioxide in water and land.
 - d. Eutrophication favors plant species that can make use of low levels of nutrients in water and soil.

- 8.** Which plant nutrient is a major contributor to the problem of eutrophication?
- Nitrogen.
 - Phosphorous.
 - Potassium.
 - Calcium.
- 9.** Lines 54-61 explain how to minimize the effects of eutrophication. Which if the following would be the best summary of the paragraph?
- Eutrophication cannot be prevented.
 - Eutrophication can be prevented by applying fertilizers in large volume at only one point in the growing season.
 - Eutrophication can be eliminated if homeowners applied anti-algal chemicals when they fertilize their lawns.
 - Eutrophication can be prevented by moderating the use of fertilizers.
- 10.** Lines 26-27 state that eutrophication is a naturally occurring condition in bodies of water. If this is so, why should we be concerned about eutrophication?
- We should be concerned because all eutrophication is detrimental and should be stopped.
 - Natural eutrophication allows organisms, especially plants, to uproot themselves and migrate to areas without excessive nutrients in the water.
 - While eutrophication is naturally occurring, this process is usually slow and seasonal. Rapid eutrophication causes the algal blooms and other detrimental effects.
 - None of the above.

Biological Science Applications in Agriculture. Eutrophication.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	D	...explain eutrophication and what causes it.	Inferential
2	A	Depletion of oxygen and competition with other plant life.	Literal
3	C	I and III only. Farmers can use precision farming to maximize the nutrients used by plants and minimize the nutrients in field run-off. Sewage treatment engineers can find other uses of sewage and not dump it into rivers and streams.	Inferential
4	B	Weeds.	Inferential
5	C	Riparian zone.	Literal
6	B	Hypoxic.	Literal
7	A	Plants cannot move from a nutrient-rich area to one more suitable for growth.	Extension
8	B	Phosphorus.	Literal
9	D	Eutrophication can be prevented by moderating the use of fertilizers.	Inferential
10	C	While eutrophication is naturally occurring, this process is usually slow and seasonal. Rapid eutrophication causes the algal blooms and other detrimental effects.	Extension

Agricultural Science Reading and Comprehension Set 9

Travis Park, Cornell University

Physical Science Applications in Agriculture. Alternative Energy Sources from Agriculture.

1 As our world population increases, we need new sources of
energy. Non-renewable energy sources are those which, when used,
cannot be replenished. Examples include coal, oil, and other fossil
5 fuels. Non-renewable sources of energy are becoming increasingly
expensive *and* scarce. Humans have developed alternative energy
sources through innovative technology. These help meet the energy
demands for transportation, electricity, and food production.

 Many kinds of alternative energy sources exist and are available
for use by humans. Many people think that these are having no
10 impact on the environment. However, even alternative energies
frequently use some energy sources that are not non-renewable in
their production. The two main goals of developing new alternative
energy sources are that they are renewable and that they are
sustainable. Four technologies that are being developed today as
15 alternatives to non-renewable fossil fuels are biofuels, wind energy,
solar energy, and geothermal energy.

 Biofuels are mostly liquids that are produced from plants that
are harvested in ways similar to how they would be harvested if they
were meant for human or animal consumption. There are two main
20 ways to convert plants into energy for human use. The first involves
growing crops that are high in sugars or starches, such as corn and
sugar cane. Processers then use yeast to ferment the harvested crops
and produce ethanol, a form of fuel, as the end product. The second
way that plants can be used to produce energy is to grow crops that
25 are high in oils, like algae and canola, which can be processed into
fuels called biodiesels.

 A major controversial issue of biofuels is using crops for fuel.
Instead of raising crops for food, farmers sell crops to make fuel. This
may cause an increase in food costs for many people. This practice
30 may also decrease the amount of food that can be exported for
humanitarian purposes to other parts of the globe. Some people
contend that the process of making ethanol is inefficient, meaning
that the production of ethanol consumes nearly as much non-
renewable fuel as is produced.

35 Wind energy technology is another alternative to non-
renewable fuels. The idea of using windmills for generating energy is
not new. They have been used for many centuries to mill grains into

40 flour and pump water from farmland. Current issues with wind
technology include the variability and unpredictability of wind. It is
difficult to predict when wind speeds would be adequate for energy
generation. While the windmills do not produce carbon dioxide and
use small amounts of lubricating fuels when they operate, the
manufacturing process is energy-intensive.

45 Solar energy is produced using heat and light from the sun. The
idea of using the sun to produce energy to meet the needs of humans
is not new, either. Many cultures warm homes by building them
oriented toward the sun. Today, using solar energy to produce
electricity is most commonly accomplished with photovoltaics, or
solar panels. While solar energy is increasing in popularity, the cost
50 of installation and materials is initially high. Further, producing solar
panels requires much energy.

Geothermal energy is produced when energy that is generated
by heat stored in the Earth's core is collected and used for human
purposes. It is more reliable than solar and wind energy because the
55 heat energy produced by the Earth's core is constant, Geothermal
energy is not affected by atmospheric weather conditions. The main
issue with geothermal power plants is that they can have detrimental
effects on land stability near geothermal production facilities. Some
production practices require the injection of water into dry bedrock.
60 Also, some production facilities emit greenhouse gases that were
trapped below the earth's surface.

Today, energy is commonly stored using batteries which
contain chemicals that react in a closed system. With alternative
energy sources, scientists are also trying to find better ways to store
65 the energy that is produced. One main way that is currently being
developed is the fuel cell. Fuel cells are different from batteries
because they exhaust the chemical reactants used to produce the
electricity. These reactants must then be replenished in order for the
fuel cell to be used again. Scientists are currently working to see if
70 hydrogen, chlorine, oxygen, and other alcohols can be used in fuel
cell technology. This technology is not used widely because the cost
is high and the efficiency is low.

Please select the *best* answer from the choices provided for each question.

- The passage gives examples of non-renewable fossil fuels. They are
 - biofuels, wind energy, solar energy, and geothermal energy.
 - light energy and kinetic energy.
 - electrical energy, chemical energy and heat energy.
 - coal and oil.
- Why is the production of crops for biofuels a controversial topic?
 - Farmers produce biofuels instead of food.
 - It raises the prices of crops.
 - Producing biofuels decreases the amount of crops to be exported.
 - All of the above.
- Which of the renewable energy sources is the most reliable?
 - Solar energy.
 - Geothermal energy.
 - Wind energy.
 - They are equally reliable.
- Fuel cells differ from batteries because
 - They exhaust the geothermal reactants used to produce the electricity.
 - They exhaust the electrical reactants used to produce the electricity.
 - They exhaust the chemical reactants used to produce the electricity.
 - They do not differ.
- When producing ethanol, processors will use crops which are high in
 - vitamins and minerals.
 - sugar and starches.
 - oil and water.
 - salt.
- Using solar energy in private homes is increasing in popularity. There is one major drawback, what is it?
 - Energy is wasted because the sun is so hot.
 - The materials are initially quite expensive.
 - Government holds many restrictions on building solar panels.
 - Very few workers can install solar panels.
- Why should we study or continue to embark on producing new sustainable energy resources?
 - Sources of energy are decreasing, and the population is increasing.
 - Crops such as corn and soybeans are in abundance for human consumption, so we need to find other uses.
 - Non-renewable energy is becoming expensive.
 - A and C.
- Which of the following are possible solutions to the contention that food grown for fuel allows hunger to persist?
 - Scientists can identify plants that yield higher quantities of biofuels.
 - Scientists can identify plants that grow in areas not currently used for food crops.
 - Scientists can identify plants that have properties useful for biofuels and food.
 - I only
 - II and III
 - All of the above
 - None of the above

- 9.** The author of this passage would likely agree with which of the following statements?
- a.** Biofuels offer a rich opportunity to address our global energy needs.
 - b.** Alternative energy sources may eventually be limited in volume.
 - c.** Non-renewable energy sources are not in limited supply.
 - d.** Use of solar energy is in jeopardy because of the greenhouse effect.
- 10.** Even if scientists found new crops to use for biofuels, why might some people continue to argue that biofuels are not a viable option for energy?
- a.** New crops used to produce biofuels still require productive farmland, which means food crops cannot be produced and hunger persists.
 - b.** Biofuels, because they are food crops, can also be used for food.
 - c.** Because new crops might be the product of science, they might harm the environment.
 - d.** Biofuels likely contribute to global warming because production of these crops involves greenhouse gases.

Physical Science Applications in Agriculture. Alternative Energy Sources from Agriculture.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	D	Coal and oil.	Literal
2	D	All of the above. Farmers produce biofuels instead of food. It raises the prices of crops. Producing biofuels decreases the amount of crops to be exported.	Inferential
3	A	Solar energy.	Literal
4	C	They exhaust the chemical reactants used to produce the electricity.	Literal
5	B	Sugar and starches.	Literal
6	B	The materials are initially quite expensive.	Inferential
7	D	A and C. Sources of energy are decreasing, and the population is increasing. Non-renewable energy is becoming expensive.	Extension
8	C	All of the above. Scientists can identify plants that yield higher quantities of biofuels. Scientists can identify plants that grow in areas not currently used for food crops. Scientists can identify plants that have properties useful for biofuels and food.	Extension
9	A	Biofuels offer a rich opportunity to address our global energy needs.	Inferential
10	A	New crops used to produce biofuels still require productive farmland, which means food crops cannot be produced and hunger persists.	Extension

Agricultural Science Reading and Comprehension Set 10

Travis Park, Cornell University

Central Core (Agriscience). Invasive Plant Species.

1 Plants grow in a certain geographic area, called a range. Each
species is uniquely adapted to the climatic and environmental
conditions of that range. Over the course of many years, plants have
adapted features that allow them to survive extremes of temperature,
5 moisture, and soil conditions. Additionally they have adapted to
survive specific disease, insect, and animal pressures. A plant that has
adapted to its original range is called native species.

 Humans have occasionally carried unique plant species back
home from their travels around the globe. Not all of these foreign
10 species have survived the environmental or climatic conditions found
in our country. However, some plant species have proven more
adaptable to their new living conditions and have survived. These
species, which not only survive, but thrive in areas beyond their
native range, may become invasive species. According to the United
15 States Department of Agriculture, an invasive species is one whose
“introduction causes or is likely to cause economic or environmental
harm or harm to human health” (USDA, 2008). They thrive beyond
their natural range of dispersal. Invasive species thrive to the extent
that they often become weeds, or nuisance plants.

20 Why do these invasive species thrive in their new range? Often
the environmental and climatic conditions of the new range are
similar to that of their native habitat, allowing the invasive species to
survive. As the invasive species continues to survive, it frequently
finds that no competitive or predatory species exist in the new range.
25 Competitive species are those organisms that compete for food,
water, light, or space with the plant. Predatory species are those
organisms which eat the leaves, stems, roots, or flowers of another
plant species. These are often insects or animals. Lacking competitive
or predatory species, the invasive plant species not only survives, but
30 thrives, because no other organisms, aside from humans, are available
to contain them.

 While eventually becoming weeds, invasive plant species have
been collected and introduced for specific and honorable reasons.
People import invasive species for reasons such as landscaping
35 around homes, controlling the erosion as ground cover, feeding
livestock, and providing living fences and natural barriers. Even
though intentions were honorable, invasive plant species seemingly
outwitted humans and many have become weeds.

40 An example of an invasive plant species is kudzu. Kudzu is a
climbing perennial, semi-woody vine. Kudzu's original range was
Japan and China. It was introduced to the United States in the late
1800s as a means of ground cover for erosion control in the
southeastern part of the United States. Finding no natural predators or
competitors, kudzu spread quickly, growing up to one foot per day.
45 The main detrimental impact of kudzu is that it grows so rapidly and
with such dense foliage that it crowds out and smothers other plant
species. When driving in the South, it is not uncommon to see the
carpet-like kudzu plants completely covering roadsides, hillsides, and
even large trees. Kudzu is listed as an invasive species in states
50 ranging from Missouri and Illinois to Florida and Connecticut to parts
of eastern Texas.

Another invasive plant species that was imported to the United
States from Asia is multiflora rose. Multiflora rose is a thorny,
perennial shrub that grows to 15 feet tall. It was introduced to the
55 United States as a living fence for livestock and for ornamental
purposes in the 1860s. It is currently listed as an invasive species in all
of North America with the exception of the arid regions of the
western parts of America and Canada. Multiflora rose grows to form
dense, nearly impenetrable thickets of plants that out-compete native
60 plant species.

A final example of an invasive plant species is johnsongrass.
Johnsongrass is a tall perennial grass that grows in clumps reaching
heights of eight feet. It was introduced in the early 1800s from the
65 Mediterranean area. Johnsongrass is listed as an invasive plant
species in all 50 states, except Alaska, Maine, and Minnesota.
Johnsongrass possesses a tremendous power to reproduce quickly
through many prolific seeds and through its rhizomes, horizontal
stems that grow underground and produce roots and shoots.
70 Johnsongrass is listed as one of the 10 worst weeds in the world. It
displaces native vegetations and prohibits tree seedlings from
growing.

Control of invasive species is difficult primarily because they
reproduce so quickly and prolifically. They also out-compete native
75 plant species for light and water. While chemical controls usually
work effectively, they also kill native species. Biological controls
work as well, but biological controls often involve introducing a
second invasive species of animal, insect, or disease. Thus, the most
effective, but most expensive means of control is often human and
80 mechanical means.

Please select the *best* answer from the choices provided for each question.

1. What is a plant that is uniquely adapted to a specific habitat and geographic area called?
 - a. Range
 - b. Native species
 - c. Invasive species
 - d. Extinct species.
2. Which of the following resources do invasive species compete with existing plant species?
 - a. Space, light, and water.
 - b. Space, nutrients, and oxygen.
 - c. Light, nutrients, and oxygen.
 - d. Humidity, carbon dioxide, and predators.
3. Why would some people have thought that multiflora rose would have made a good living fence?
 - I. It is thorny.
 - II. It grows to a tall height of 15 feet.
 - III. It grows in rows.
 - a. I only.
 - b. II and III only.
 - c. I and II only.
 - d. I, II, and III.
4. In line 48, the term “carpet-like” refers to what growth habit of kudzu?
 - a. Growth of up to one foot per day.
 - b. Green, shaggy appearance.
 - c. Wide, flat main stems.
 - d. Dense, smothering foliage.
5. Many invasive species tend to be perennials. What does *perennial* mean?
 - a. A plant whose life cycle lasts only one year.
 - b. A plant whose life cycle lasts for two years, but with different forms each year.
 - c. A plant whose life cycle lasts year after year.
 - d. A plant that does not produce seeds.
6. What makes johnsongrass especially difficult to control?
 - a. It is tall.
 - b. It produces many seeds.
 - c. It reproduces via rhizomes.
 - d. It produces many seeds *and* via rhizomes.
7. Lines 32-38 describe some of the “honorable” reasons for introducing invasive species. What should be done in the future before introducing new species of plants outside of their natural range?
 - a. At the same time, introduce a competing species of insect or animal to limit the growth of the invasive species.
 - b. Examine the species limiting factors, such as climate, consumers, and soil conditions.
 - c. Introduce invasive species regularly because the strongest plants will survive and improve the ecosystem.
 - d. None of the above.
 - e. All of the above.

- 8.** What factors about the United States make it ideal for invasive species to grow?
- a.** Fertile soils.
 - b.** Temperate climate.
 - c.** Plentiful rainfall.
 - d.** All of the above.
- 9.** Not all species of plants introduced to our country from other countries are necessarily bad. What is the defining characteristic to determine whether a plant is invasive or not?
- a.** The plant grows rapidly.
 - b.** The plant competes for resources, such as light, water, and space.
 - c.** The plant is a nuisance.
 - d.** The plant does not produce a beneficial seed or fruit.
- 10.** Which of the following would be the best title for this passage?
- a.** Invasive species provide real benefits for humans.
 - b.** Invasive species: Weaker than native species.
 - c.** Invasive species: Opportunities for new technologies.
 - d.** Invasive species: Plants gone bad.

Central Core (Agriscience). Invasive Plant Species.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	B	Native species	Literal
2	A	Space, light, and water.	Literal
3	C	I and II only. It is thorny. It grows to a tall height of 15 feet.	Literal
4	D	Dense, smothering foliage.	Inferential
5	C	A plant whose life cycle lasts year after year.	Inferential
6	D	It produces many seeds <i>and</i> via rhizomes.	Literal
7	B	Examine the species limiting factors, such as climate, consumers, and soil conditions.	Extension
8	D	All of the above. Fertile soils. Temperate climate. Plentiful rainfall.	Extension
9	C	The plant is a nuisance.	Inferential
10	D	Invasive species: Plants gone bad.	Inferential

Agricultural Science Reading and Comprehension Set 11

Travis Park, Cornell University

Food Science. Maple Syrup Production.

1 Maple sugar is a sweetener that is made from the sap of maple
trees. It can be used as an ingredient in baking, boiled into syrup,
whipped into a cream, or concentrated into a hard candy. Today, the
most common form of maple sugar is maple syrup. Many imitation
forms of maple syrup exist for purchase at grocery stores. As a
5 natural food, maple sugar has many uses.

 The maple sugaring process was originally discovered by
Native Americans who would cut the bark of a maple tree. They
collected the sap in hollowed logs as it dripped out of the tree. Hot
10 stones would be added to the sap in order to boil the water, leaving
thick sugar crystals that would not spoil during storage. These Native
Americans shared their process of producing maple syrup with the
European colonists, who used tin buckets to collect the sap from the
plentiful maple trees.

15 While all trees produce sugary sap, only a few species have a
high enough sugar concentration to be used efficiently for syrup.
While the Sugar Maple, *Acer Saccharum*, is the most widely used tree
species used for making syrup, black maples, silver maples, red
maples, box elders, hickories, and birch trees can also be used. Only
about five percent of the tree's total sap is used for making syrup, so
20 there is plenty left for the tree to use during its growing process.

 Maple sap contains mostly water. Sucrose is the major sugar
component that is produced by the plant through the process of
photosynthesis. In the fall, the sugars that are produced from
25 photosynthesis are transported by the tree into the roots as starches,
where they help the plant survive the cold winter. In early spring
between February and April, the starches are converted to sugar and
are transported to the twigs and leaf buds where they help the plant
produce new growth. Sap flows throughout the tree during the entire
30 growing season, but only the sap that is present during the early
spring is used for syrup production. The sugars in the sap help keep
the tree from freezing during the winter.

 The sap from many maple trees is required to make maple
syrup. It takes about forty gallons of sap to make one gallon of maple
35 syrup. One gallon of syrup weighs about eleven pounds. When first
collected, sap is nearly colorless, almost tasteless, and low in sugar
content. The best days for sap collection are days that are warm

during the day and cold during the night.

40 The process of making maple syrup begins with a tree that is at
least 10 inches in diameter. A small hole that is about two inches
deep and about a half inch in diameter is drilled into the tree. A spile
is a hollow spout that is inserted into the hole. A galvanized
collection bucket is hung from the spile. It is important to collect the
45 sap within a day of being collected in order to prevent it from
fermenting. The sap is collected in a big storage tank where an
evaporator is used to boil the water out of the syrup. The syrup can be
boiled down further to remove additional water, making maple candy.

The evaporator uses a heat source, most often a wood furnace,
50 to heat the sap. Heavy cast iron grates are used to hold the fire out of
the ashes. The sap holding tank is above the fire. The sap flows by
gravity down to the flue pan where the amount of sap that enters is
controlled by a float valve. When the sap flows through the flue pan,
it enters the syrup pan, which has a flat bottom. This is where the
maple syrup is boiled to the proper sugar concentration. It is
55 important to keep the syrup moving in the evaporator in order to
prevent burning. The evaporator heats the sap to 185 degrees
Fahrenheit.

Today, plastic tubes can be used for transporting the tree sap to
60 collection tanks in a sugar house. A sugar house is the term used to
name the building where sap is boiled and maple syrup is produced.
Usually gravity and the internal pressure of the tree force the sap into
the collection buckets, but a system that uses a vacuum pump can also
be used.

Pure maple syrup is a relative delicacy, and it is good for your
65 health. Pure maple syrup contains more minerals than honey. It also
contains fewer calories than honey. Pure maple syrup is an excellent
source of manganese and a good source of zinc. Manganese is an
antioxidant, which contributes to cancer prevention. Zinc slows the
progression of arteriosclerosis, a disease affecting arterial blood
70 vessels. Both zinc and manganese help the body's immune system
fight illness and disease.

Please select the *best* answer from the choices provided for each question.

1. According to the passage, who is credited with discovering maple syrup?
 - a. *Acer Saccharum*.
 - b. Europeans.
 - c. Vikings.
 - d. Native Americans.
2. Which species of maple tree is the most widely used for maple syrup production?
 - a. Red maple.
 - b. Black maple.
 - c. Sugar maple.
 - d. Norway maple.
3. How many gallons of sap are required to produce one gallon of pure maple syrup?
 - a. 10.
 - b. 11.
 - c. 40.
 - d. 185.
4. What is the major sugar produced during photosynthesis?
 - a. Fructose.
 - b. Glucose.
 - c. Maltose.
 - d. Sucrose.
5. When processing sap to make pure maple syrup, what is the waste product?
 - a. Carbon dioxide.
 - b. Water.
 - c. Fire.
 - d. Stiles.
6. Sap collected in tubes uses gravity and the tree's internal pressure. What is causing this internal pressure?
 - a. Gravity.
 - b. Trees moving sugars from roots to limbs for leaf production.
 - c. Moon cycles, similar to what produces ocean waves.
 - d. The thawing of soils in spring.
7. What percentage of the tree's sap is collected to be used for maple syrup production?
 - a. 5%.
 - b. 10%.
 - c. 25%.
 - d. 50%.
8. What is the purpose of sap in trees?
 - I. It carries pure maple syrup from the leaves to the roots.
 - II. It carries the chlorophyll from roots to the leaves of plants, like our skin pigments.
 - III. It carries water and nutrients throughout the tree, similar to our blood.
 - a. I only.
 - b. II and III only.
 - c. I and II only.
 - d. III only.

- 9.** Although the first paragraph indicates that imitation versions of maple syrup exist, what is the purpose of the final paragraph?
- a.** To explain the process of maple syrup production.
 - b.** To provide evidence to persuade the reader to purchase pure maple syrup.
 - c.** To argue against tapping trees for maple syrup production.
 - d.** To demonstrate the value of maple syrup to forest ecosystems.
- 10.** What is the major sugar produced during the process of making pure maple syrup?
- a.** Fructose.
 - b.** Glucose.
 - c.** Maltose.
 - d.** Sucrose.

Food Science. Maple Syrup Production.

Answer key.

#	Answer: letter	Answer: description	Type of Question
1	D	Native Americans.	Literal
2	C	Sugar maple.	Literal
3	C	40.	Literal
4	D	Sucrose.	Literal
5	B	Water.	Inferential
6	B	Trees moving sugars from roots to limbs for leaf production.	Inferential
7	A	5%.	Literal
8	D	III only. It carries water and nutrients throughout the tree, similar to our blood.	Extension
9	B	To provide evidence to persuade the reader to purchase pure maple syrup.	Inferential
10	D	Sucrose.	Extension
