

Measure What Matters. Evidence-Informed Tactics for
Better and More Relevant Multiple-Choice Questions

Write Better

MULTIPLE-CHOICE

QUESTIONS

To Assess

LEARNING



PATTI SHANK, PHD

Author of *Write and Organize for Deeper Learning*

Write Better Multiple-Choice Questions to Assess Learning

**Measure What Matters—
Evidence-Informed Tactics for
Multiple-Choice Questions**

Patti Shank, PhD

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Praise for *Write Better Multiple-Choice Questions*

When I want an easily comprehensible way to create tests and, specifically, multiple choice questions, I go to Patti Shank. She has succinctly offered her question creation wisdom in an uber-useful book, *Write Better Multiple-Choice Questions*. There are a few great books I like to give to clients and colleagues. This is now among those. Thanks, Patti, for filling a much-needed void.

Matthew Richter

President of the Thiagi Group, Facilitator, Game Designer, Instructional Designer, And Management Consultant

Patti Shank has become known as a reliable resource for carefully researched, thoughtfully documented advice on key instructional design challenges. This latest addition to Patti's series of guidebooks is yet another example of everything we've come to expect from her. Patti has filled this book with practical step-by-step guidance, useful examples and thought-provoking tools to help readers better understand multiple-choice logic and improve their ability to put that logic to work in the real world.

John Leh

CEO, Lead Analyst, Talented Learning

This book will become a "must-have" for anyone writing learning activities. It helps instructional designers, trainers, and anyone responsible for creating usable training, craft relevant activities, and post-course assessments. Armed with the tactics in the book, readers can create assessments that genuinely test someone's ability to perform a task or apply knowledge to a job context. I think it's a hugely valuable addition to the field of L&D/T&D. Thank you for putting it together.

Sharon Boller

Author and Speaker, Affiliate Consultant for Tier1 Performance

I found what I was looking for in this book. My first language is not English, so the easy-to-understand writing and advice was very helpful. The full bibliography was extremely valuable.

Aude Caussarieu

Didactic Sciences

In the L&D industry, there are several dozen important authors you should be reading. Patti is even rarer. She combines practical application with research-supported content. She is a stellar example of the singular handful of individuals in this category. Anything she writes should not only be on your to-read list. It must be on your to-read-right-now list. *Write Better Multiple-Choice Questions* is another worthy addition to the must-read and must-reference-often list.

Bill Sawyer

Oracle Corporation

I now understand the science behind writing these questions and a clear process to follow—one that starts at the beginning with identifying what needs to be learned and what needs to be demonstrated. One of the key benefits for me is now being able to offer constructive suggestions to those writing multiple-choice questions that will add value to their work.

Kath Cherrie

National Vice President, New Zealand Association for Training and Development

Multiple-choice questions are one of the most readily available tools for people who design learning experiences, and MCQs are one of the most frequently misused learning tools. Patti has created the best resource on the when, why, and how of creating effective multiple-choice questions.

Julie Dirksen

Author of *Design for How People Learn*

This is a very worthy addition to the library of every instructional developer, designer, and even every analyst. Patti provides much more than just how to create valid multiple-choice questions and does so in an easy-to-read and very actionable manner.

Guy W. Wallace

President, EPPIC Inc.

Patti Shank does it again! By doing exhaustive research and translating it with a practitioner's wisdom, Patti gives us clear, energizing, and practical advice so we can create powerfully effective multiple-choice questions on our own!

Will Thalheimer

Author, *Performance-Focused Smile Sheets*, Work-Learning Research, Inc.

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Chapter 1:

What Are We Doing?

Léo works in contract management and helps others use the contract management application. He recently got a call from legal about contract omissions and inaccuracies. Lily works directly with customers who use her company's cloud-based integrated application. Leaders want to certify people to reduce problems that occur when people don't use the application properly. Leilani created a unique stretching method based on body mechanics research and wants to make sure her instructors know how to appropriately teach her method.

Léo, Lilly, and Leilani have similar concerns, even though they have very different jobs. All of them have a critical and important need to make sure people can perform as needed and achieve needed results. Each needs to identify what people must be able to do. And they need a way to determine whether those results are achieved.

If your work involves helping people perform, it is critical for you, too, to identify the required skills and determine if needed results are achieved. The process described in this book is meant to help Léo, Lilly, Leilani, and *you* to create effective multiple-choice questions (Chapters 3-7) that assess whether participants have achieved what they need to learn (Chapter 2).

Why Multiple-Choice

People use multiple-choice questions because they're efficient to deliver and score. Well-written multiple-choice questions allow us to:

- Efficiently measure a wide range of knowledge and skills,
- Easily and objectively score assessments,
- Assess understanding and use of knowledge and skills, and
- Reduce costs and time for assessment (Gierl et al., 2017).

To be valid, assessments must assess a representative sample of knowledge and skills from the area tested. Assessing a representative sample of knowledge and

skills can be time consuming. The efficiency of multiple-choice questions makes this possible (Haladyna, 1997).

Multiple-choice questions can't adequately assess all learning objectives, so I include information about performance assessments in this chapter. Still, multiple-choice questions are regarded as one of the most widely applicable testing methods.

Multiple-Choice Challenges

While delivering and scoring multiple-choice questions is *efficient*, there are some challenges to overcome to also make them *effective*. I'll describe two main challenges we need to overcome to create effective multiple-choice assessments.

Challenge 1. There are so many ways to write bad questions.

Consider the poorly-written multiple-choice question below. How many problems can you find?

What is the correct way to rotate fresh produce in the produce department?
(Select the correct answer.)

- a) Lift the display and rotate it 90 degrees.
- b) Swap fruit or vegetables from one end of the store to the other end.
- c) Move the oldest produce to the top of the display and add fresher produce from stock to the bottom of the display.
- d) None of the above.

This question has serious problems! The incorrect answers a and b are not plausible, making it easy to eliminate them as the correct answer. Answer c is the longest and has the most depth, which is an obvious clue that it is the correct answer. The last answer choice, d, is an answer choice we shouldn't use (discussed in Chapter 3). People often make these mistakes, as well as others.

Guessing the correct answer when the question is poorly written is often easy, as seen in the example. This is *absolutely not what we want*.

Consider this “fixed” example, created with the evidence-informed writing guidelines described in this book.

What is the correct way to rotate fresh produce in the produce department?
(Select the correct answer.)

- a) Discard older produce and restock with fresh produce from stock.
- b) Restock fresh produce and then stack good older product on top.
- c) Put older produce on sales racks and restock with fresh produce.

In this rewrite, all incorrect answers are plausible. There are no clues as to the correct answer. I removed “None of the above” as an answer choice. It is no longer easy to guess the correct answer. And it has three answer choices, because research shows this is often the best number of answer choices (discussed in Chapter 3).

Challenge 2. There’s a lot to know to write effective multiple-choice questions.

Writing good multiple-choice questions involves some challenging skills. They include:

- Writing good learning objectives so we know what to assess with our questions.
- Writing multiple-choice questions that assess important knowledge and skills in the learning objectives so assessments measure the right things.
- Following evidence-informed question writing guidelines, which make questions easier to understand and harder to guess, so information gained from assessments is accurate and valuable.

Using these skills to write good questions prevents a host of problems, including morale problems from confusing or unfair assessments, unusable assessment results, and legal problems due to unfair and invalid assessments. And we cannot forget the credibility damage caused by poorly-written assessments.

While it takes effort to learn to write good multiple-choice questions, it is certainly worth the effort considering the problems prevented. Like most skills, we get better over time with practice, so this challenge becomes easier.

One of my clients develops technical training; their question writers are content experts. When we started working together, I wrote their questions and we edited them together. After three weeks they could write decent questions that I edited to better follow evidence-based guidelines. After a few more weeks, their questions required few edits. Now? They check in from time to time.

What Should We Assess?

Assessment means measuring learning outcomes to find out whether needed outcomes were achieved. My colleague, Will Thalheimer (2018), created the *Learning Transfer Evaluation Model* (LTEM) in response to the shortcomings he saw in the Kirkpatrick model (1959). Below is a concise overview of the model.

	<i>Tier</i>	<i>Description</i>
8	Effects of Transfer	Instructional outcomes which affect learners, coworkers/family/friends, the organization, the community, society, and the environs.
7	Transfer	Learner uses what was learned to perform work tasks successfully, as demonstrated through objective measures.
6	Task Competence	Learner performs relevant realistic actions and decision making.
5	Decision Making Competence	Learner makes decisions given relevant realistic scenarios.
4	Knowledge	Learner answers questions about facts/terminology.
3	Learner Perceptions	Learner answers questions about course satisfaction, course reputation, etc.
2	Activity	Learner engages in learning activities.
1	Attendance	Learner signs up, starts, attends, or completes a learning experience.

LTEM Model, used with Will Thalheimer's permission, <https://www.worklearning.com>

Because it often is difficult to assess what we really want to know (Tiers 7 and 8), we settle for proxies. Proxies are stand-ins for something or someone else. For example, someone named to make healthcare decisions for you when you cannot do so is acting as your proxy.

Many learning practitioners and instructors construe attendance or completing activities (Tiers 1 and 2) as proxies for achieving needed outcomes. The problem is they aren't good proxies. People easily attend and engage in activities without achieving needed learning outcomes.

To assess whether people can do what we teach them, we must aim higher. Tiers 5 and 6 on the LTEM chart are what we should primarily assess with multiple-choice questions.

Research is clear that well-written multiple-choice questions can measure a wide range of important learning outcomes, including analysis, decision making,

and problem solving (Haladyna, 1997, 2004). Fortunately, research also shows that well-written, higher-level multiple-choice assessments can be an effective proxy for higher levels of measurement (Drake Prometric, 1995).

Why Assessment Matters

There are many reasons to assess learning. The primary reason discussed in this book is to find out whether participants achieved needed learning outcomes. Assessment also supplies critical information we need to improve instruction.

Those who train others may mistakenly believe the needed outcome is that the content they created is used. The use of content is not our primary job, however. Our primary job is to facilitate needed knowledge and skills and needed outcomes. When we don't build needed knowledge and skills, the needed outcomes are not likely met, and our work is far less valuable.

To build needed knowledge and skills, we need to analyze whether our instruction, as created, builds the skills it is supposed to build. That's what this book is about: to analyze the skills people need, and then to write multiple-choice questions to see if participants achieved those skills.

There are other benefits of good assessments, including memory gains. Because this book deals primarily with summative assessment, the focus is on written assessments to assess whether the desired learning objectives were achieved. Performance assessments and formative assessments are briefly discussed.

Formative and Summative Assessment

Formative (during instruction) and summative (after instruction) assessments help us analyze whether participants are gaining or have gained the needed knowledge and skills.

Formative assessment includes activities that occur during instruction. It identifies the misunderstandings and missing understandings participants have so we can fix them while instruction is in progress. Examples of common formative assessments include open questions, quiz questions, and activities.

For example, a course for people newly diagnosed with diabetes might use formative assessment to determine whether participants know the symptoms of low and high blood sugar. The following image shows what this kind of formative assessment activity might look like.

Symptoms of low and high blood sugar

Instructions: Sort each symptom by dragging it into one of two categories: *Symptom of low blood sugar* or *Symptom of high blood sugar*. You will see if your answer is correct while you sort.

Sweating

Symptom of low blood sugar

Symptom of high blood sugar

Formative learning activity built in Articulate Rise, © Articulate Global, Inc., all rights reserved.

Based on the results, the course could offer feedback, suggest additional content, or progress to new content.

Formative assessment informs next steps by designers, instructors, and participants (Black & Wiliam, 2007). The primary goal is to examine what participants struggle with and what does not work well, then to fix those issues.

Summative assessment evaluates achievement of the learning objectives—typically at the end of an instructional unit. Some examples of common summative assessments are tests, simulations, and skill demonstrations.

For example, a course for people newly diagnosed with diabetes might have a summative assessment at the end of each module. The module on analyzing blood sugar results might include the following multiple-choice question.

Question 5 of 15

Two hours after eating lunch, you check your blood sugar. The reading: 384 mg/dL. This reading indicates that your blood sugar is: (Select the correct answer.)

- Too low
- Normal
- Too high

SUBMIT 

Summative test question built in Articulate Rise, © Articulate Global, Inc., all rights reserved.

Chapter 2:

The Right Learning Objectives

Many people design and deliver instruction as a series of topics. They decide what they are going to teach, then decide how to teach those topics, then teach them. This approach has flaws, including delivering instruction that is less relevant or valuable. I'll describe what we need to do instead.

Outcomes Are Objectives

To design instruction with a list of topics is common, and often far less effective. To be effective, we should start with the outcomes needed from instruction (Gosling & Moon, 2001). When we use a topic approach, we tend to design content (information) rather than instruction designed to produce specific skills. We need to design for needed learning outcomes or what participants are expected to know, understand, and be able to do (Kennedy, Hyland, & Ryan, 2007). This is where learning objectives come in. They must describe exactly that.

Learning objectives are navigation tools, much like GPS. With GPS, we enter a destination, then GPS guides us there. Learning objectives guide us to activities and assessments to achieve the needed outcomes (Mahajan & Singh, 2017).

Well-written learning objectives have many benefits, including helping participants and other stakeholders analyze:

- Whether given instruction is relevant to their needs,
- What participants will be able to do, and
- The effort needed to achieve the specified outcomes (Kennedy, Hyland, & Ryan, 2007).

And well-written learning objectives help those who design and facilitate instruction to:

- Design instruction specifically to produce needed outcomes,
- Select needed content and activities to produce needed outcomes,
- Analyze what needs to be assessed,
- Design assessments specifically to measure needed outcomes, and
- Analyze whether instruction produces the needed outcomes.

Taylor's (2005) meta-analysis found that presenting learning outcomes as "rule codes" had a positive effect on knowledge used when performing a task. Rule codes are phrases that specifically describe what to do and why. For example, a rule code for adding new patients to the system might be, "Assure that patients are not already in the system to avoid duplicate entries." Rules codes are more impactful than less-specific statements such as, "Don't create duplicates."

We assume that "all objectives are at the use level (i.e., "performance" objectives) and that learners will practice or be assessed on the particular performance" (Sugrue, 2002). Sugrue explains that terminal and enabling objectives should always be written as performance objectives.

Terminal objectives describe what participants should be able to do as a result of instruction. Enabling objectives describe the sub-tasks for the task described in the terminal objective. For example, let's consider this terminal objective:

Accurately identify the meaning of medical terms used to describe a medical diagnosis.

Medical terminology is made up of roots, prefixes, and suffixes, so identifying their meaning depends on identifying the meaning of roots, prefixes, and suffixes and then putting them together. As a result, three enabling objectives for this terminal objective are:

Accurately identify the meaning of medical terminology roots used to describe a medical diagnosis.

Accurately identify the meaning of medical terminology prefixes used to describe a medical diagnosis.

Accurately identify the meaning of medical terminology suffixes used to describe a medical diagnosis.

The terminology “terminal objectives” and “enabling objectives” may be unfamiliar to you. Take the four learning objectives I just described. They tell us that participants need to be able to accurately identify the meanings of word parts (enabling objectives) and words made of those parts (terminal objective).

In some places in this book, I use “LO” to stand in for “learning objective.”

Well-Written Learning Objectives

Learning objectives describe the specific real-life or job behaviors or actions needed from instruction and tell us how to measure them. For example, here’s a well-written learning objective.

Content writers will write appropriate alternative text, which includes all needed elements, for each digital image.

This learning objective is well written because it:

- Specifically describes what people must be able to do: Write alt text for a given digital image, AND
- Describes how to measure performance: Alt text is appropriate and includes all needed elements.

This learning objective points out what should be measured. Here are the two obvious things to measure:

- Do participants know the elements they need to include in alt text?
- Can participants write appropriate alt text for a given image that includes the needed elements?

Before you develop well-written assessments, you must have well-written learning objectives. Otherwise, it’s hard to know what to assess.

Sometimes someone gives you learning objectives that are poorly written (not real-life or job tasks, specific, or measurable). Poorly-written learning objectives provide little help in analyzing what assessments are needed and/or how to measure them.

If someone gives you poorly-written learning objectives, how can you write quality assessments to measure them? My advice? Rewrite them.

I totally get that you cannot simply change someone's learning objectives. But you do need to understand what their learning objectives should be to know what assessments are needed. For example, here is a learning objective a human resources manager gave me: "Understand how to manage staff tardiness."

Because this learning objective is not specific or measurable, here's the conversation we had that helped me rewrite it. At the end, you'll see the revised learning objective I used to write good multiple-choice questions.

Me: What do you want people to be able to do when you say in your learning objective that people should understand how to manage staff tardiness?

HR Manager: I want them to know what to do.

Who needs to know what to do?

Supervisors.

You want supervisors to know what to do in which circumstances?

I want them to know what to do when a staff member is tardy.

You want supervisors to know what to do when a staff member comes to work after the time they were scheduled to arrive?

Chapter 3:

Write Multiple-Choice Questions

In this chapter, we'll discuss the parts of a multiple-choice question and how to write them correctly.

Parts of a Multiple-Choice Question

Multiple-choice questions include a **stem** and **answer choices**. The stem asks the question, and answer choices include the correct answer (key) and incorrect but plausible answers (distractors). The most common multiple-choice question type includes a stem, one key, and two or more distractors. Here is the typical format for a multiple-choice question and an example of a multiple-choice question in this typical format.

Stem

- a) Answer choice
- b) Answer choice
- c) Answer choice

Which of the following image formats is best to use for digital images that require frequent resizing?

- a) JPG - Joint Photographic Experts Group
- b) EPS - Encapsulated Postscript *
- c) PNG - Portable Network Graphics

Multiple-choice question writers often use an asterisk (*) to indicate the correct answer for each question.

Other multiple-choice question formats are discussed in Chapter 5. Multiple-choice questions may include media, such as images, audio, or video, which are used to offer information needed to select the correct answer(s). Media use is discussed in Chapter 3.

Stem

Good stems ask about relevant and important knowledge or skills in the learning objective. Consider what important knowledge and skill is most relevant to assess for the following learning objective.

Within 15 days of returning to home base, staff who travel will complete their expense reports in the corporate travel application without errors.

In Chapter 2, I discussed analyzing the most important questions a participant should be able to answer for each learning objective. Here are important questions I think participants should be able to answer for this learning objective.

- When must I complete an expense report?
- What if I don't complete my expense report within the specified time?
- How do I complete an expense report?
- How can I tell if the expense report has any errors?
- What if I receive an error code while completing the report?

To review the process for using these questions to create relevant multiple-choice question stems, I'll show how I would use some of these questions to write stems. For example, I could use this question to assess whether test takers understand when they must complete an expense report.

If you return from a trip on the 10th of the month, which of these dates is the last date you can file your expense report?

I could use this question to assess whether test takers know what will happen if the expense report isn't completed within the specified time.

Which of the following is a consequence of submitting your expense report after the allotted time period?

I could use variations of the following stem to assess whether participants can tell if the expense report has any errors.

[expense report image] **What error is shown on this expense report screen?**

Good Stems

Below are two stems. The top stem is incomplete and doesn't communicate what we are assessing. The bottom stem is complete and does communicate what we are assessing. Stems *must* clearly communicate what we are assessing.

Workplace fires: (Doesn't communicate what is being tested.)

If you encounter a workplace fire, what is the first thing you should do?
(Communicates what is being tested.)

The two best formats for a stem are a **question** and an **incomplete sentence**. The following is the same stem written as a question and as an incomplete sentence.

There is a small fire in the wastebasket next to a desk. When should you clear the building? (Question)

There is a small fire in the wastebasket next to a desk. You should clear the building when: (Incomplete sentence)

A good stem has the following characteristics.

Concise	Phrase the stem in as few words as possible using easy-to-understand words and sentences.
Positively stated	Avoid words such as NOT, ISN'T, and DON'T because they make the stem harder to understand and answer. State the stem positively instead.
Includes only relevant details	Include enough details in the stem to understand what is being tested. Leave out irrelevant information. If the learning objective requires finding irrelevant information, use a situation-based question.

- Uses “should” instead of “could” When the stem uses “could,” participants are more likely to select partly correct answer choices. Use of “should” helps people select the correct or best answer and not a partially or sometimes correct answer.
- Offers no clues We should not offer any clues or hints as to the correct answer in the stem.
- Doesn’t retell The stem should not repeat instructional content. It should prompt people to use previous content.

TRY THIS!

Exercise 3-1. For the two learning objectives shown (left column), write a stem that assesses important knowledge and skills.

I completed the first item to show you how to do the exercise.

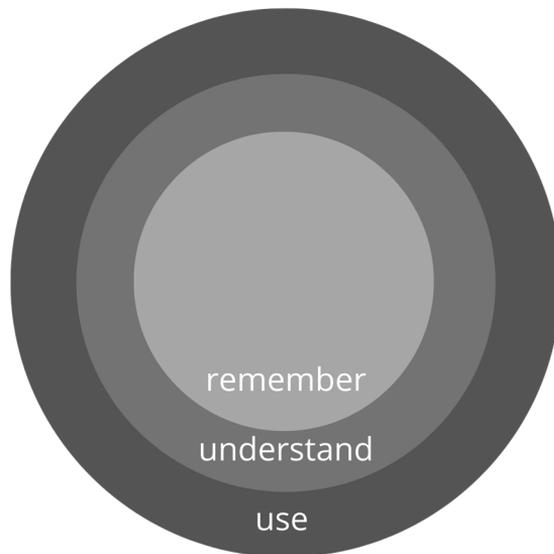
Exercise answers are at the end of this chapter. You will learn more if you do the exercise *before* you review the answers.

<i>Learning Objective</i>	<i>Stem</i>
Students will calculate the mean score from a series of test scores.	Calculate the mean score from the following test scores.
Technicians will select the appropriate personal protective equipment for a given pesticide application situation.	

Chapter 4:

Higher-Level Questions

In this chapter, I discuss how to better assess *important* knowledge and skills in learning objectives. The image below shows three levels of thinking. The two outer circles align with many of the thought processes we want to assess with multiple-choice questions (Sugrue, 2002; Haladyna, 1997; Haladyna & Rodriguez, 2013). It is the sweet spot for the most relevant multiple-choice questions.



These levels represent:

- **Remember:** What we recall or recognize
- **Understand:** What we understand
- **Use:** The ability to use what we remember and understand to perform complex real-life and job tasks

The single most important way to improve assessments is to test above the remember level (Shrock & Coscarelli, 2007). The thought processes we want to prompt during assessment are the same thought processes that participants use when they are doing the task in real life or on the job (Berk, 1997). In other words, what people need to be able to do is what we should assess.

If, in real life or on the job, people must be able to:	<i>then</i>	During assessment, we should assess whether they can:
Make sense of data.		Make sense of data.
Analyze which rules apply.		Analyze which rules apply.
Evaluate what could go wrong.		Evaluate what could go wrong.
Decide which step to take next.		Decide which step to take next.

TRY THIS!

Exercise 4-1. For the two learning objectives shown (left column), describe what we should assess (right column).

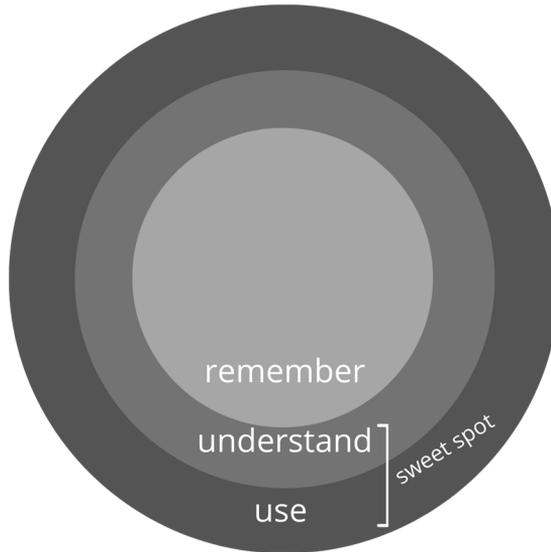
I completed the first item to show you how to do the exercise.

Exercise answers are at the end of this chapter. You will learn more if you do the exercise *before* you review the answers.

<i>Task</i>	<i>What should we assess?</i>
Students will calculate the mean from a series of numbers.	Calculate the mean score from the following test scores.
Homeowners will select the appropriate personal protective equipment before applying pesticides and other pest treatments.	
Couples will make good decisions about using credit in a variety of situations.	

Thought Processes

Recall that we primarily want to assess the understand and use levels, as shown in the image below.



Assessing **understanding** typically asks test takers to select correct definitions, examples, and characteristics. Here are three examples of multiple-choice questions that assess understanding.

Example 1

What is Samina assessing when she reconciles her cash drawer at the end of each shift? (Select the best answer.)

Example 2

What does the code in the example show?

```
<ul>
  <li>Hot coffee</li>
  <li>Hot tea</li>
  <li>Iced coffee</li>

  <li>Iced tea</li>
</ul>
```

Example 3

You're working in the produce department and a customer asks if this pepper is organic. The following PLU code sticker is on the fruit. What do you tell the customer?



4688

When we write questions about definitions and characteristics, we should ideally paraphrase the instructional content. Asking test takers to select the exact definition or characteristic from the content is a remember task. Likewise, examples used in questions should be new examples, as asking people to select the examples from the content is a remember task.

Assessing **use** typically asks test takers to apply what they remember and understand to perform complex real life and job tasks. Haladyna (1997) discusses these common types of use: evaluating, problem solving, and predicting.

Evaluating means judging and making choices based on those judgments. Many work tasks require this thought process. For example, there are many times at work when we evaluate which approach will work best.

Here are three examples of multiple-choice questions that assess evaluating.

Example 1

[Diagram] Which of the cables shown will connect this monitor to this laptop computer?

Example 2

Marcus has been on staff for two months and arrived 20 minutes late for work today. This is the first time he has been late for work, and he was late because his car wouldn't start. Based on the tardiness policy, what should you do?