

# Chapter 6

## Memory

### Outline

- I. Memory As Information Processing
  - A. **Memory** is a set of systems involved in the acquisition, storage, and retrieval of information.
  - B. Using one's memory involves three interrelated processes.
    1. **Encoding** is the active process of putting information into memory—a matter of forming cognitive representations of information.
    2. **Storage** is the process of holding encoded information in memory.
    3. **Retrieval** involves the process of locating, removing, and using information stored in memory.
- II. Sensory Memory
  - A. **Sensory memory** stores large amount of information for a few seconds or less.
  - B. There are sensory memory systems for each sense, but two are usually considered.
    1. Visual sensory memory, or **iconic memory**, is the sensory store associated with vision.
    2. **Echoic memory** is the sensory storage system associated with the sense of hearing.
  - C. Information is not encoded in sensory memory; it is stored just as it is received.
- III. Short-Term Memory (STM)
  - A. Information from sensory memory can be processed more fully by moving it into short-term memory.
  - B. **Short-term memory (STM)** is a level, or store, in human memory with limited capacity and, without the benefit of rehearsal, a brief duration.
  - C. This STM is often called *working memory*.
    1. Information from sensory memory or from long-term memory can be moved into STM, where we can work with it.
    2. Getting information into STM requires that one attend to it
- IV. The Duration of STM
  - A. **Maintenance rehearsal** is the simple repetition of information already in STM.
  - B. STM can hold information for approximately 15 to 20 seconds.
- V. The Capacity of STM
  - A. George Miller suggested that STM had a capacity of seven, plus or minus two, chunks of information.
  - B. A **chunk** is the representation in memory of a meaningful unit of information.
- VI. Long-Term Memory (LTM)
  - A. **Long-term memory (LTM)** refers to memory for large amounts of information that is held for long periods of time.
  - B. It is not known how long information remains stored in LTM.
  - C. It is possible that memory is reconstructed from recollections of past experiences.
  - D. Simple repetition of information is seldom sufficient to process it into long-term memory.

- E. **Elaborative rehearsal** refers to thinking about, organizing, and forming images of information to make it meaningful; or relating information to something already in LTM.
  1. This term was proposed by Craik and Lockhart in 1972.
  2. It is not an either-or process; information can be elaborated to greater or lesser degrees.

#### VII. Are There Different Types of Long-Term Memories?

- A. **Declarative memory** includes semantic memory and episodic memory from which information can be intentionally recalled.
  1. Vocabulary, concepts, language rules, and facts are stored in **semantic memory**.
    - a. **Clustering** refers to the process of recalling related items of information together on the basis of shared associations.
    - b. Subjective organization refers to the process of imposing personal organization if there is a list of unrelated words to recall.
    - c. Hierarchical network models propose that concepts or propositions are stored in interrelated, predictable ways.
  2. In **episodic memory**, life events and personal experiences are stored.
    - a. It is time-related, and experiences are stored in chronological order.
    - b. A separate category is *autobiographical memory*, which contains events (episodes) that are particularly significant.
- B. **Nondeclarative memory** (procedural memory) involves the acquisition, retention, and retrieval of performance skills such as a tennis stroke or golf swing.

#### VIII. On the Accuracy of Long-term Memories

- A. Determining the accuracy of past experiences is difficult.
- B. According to Bartlett, people tend to form features of what is experienced.
  1. Through a process called **reconstructive memory**, features are retrieved and reconstructed to form a report of what was encoded and stored.
  2. Recent research and theory support Bartlett's general idea.
    - a. Features are scattered widely over different parts of the brain.
    - b. Therefore, no single part of the brain houses a complete memory.
- C. Sometimes, the reconstruction process results in inaccurate reports of what is in memory.
  1. Inadequate connections among the features associated with an event stored in memory can lead to inaccurate reconstruction.
  2. At encoding, inadequate separation of episodes from other similar episodes may cause a person not to remember a feature specific to a given episode.
- D. Retrieval cues may match more than one set of features representing more than one episode.
- E. A **repressed memory** is one that is so disturbing that a person has pushed it into the unconscious where it is no longer readily available for retrieval.
  1. There is controversy as to whether memories recovered during therapy are actual or false memories.
  2. There is ample research showing that memories can be implanted.
  3. This is an important issue for psychology, as well as the legal system.
- F. Eyewitness testimony is another area in which the accuracy of long-term memory is of critical importance.
  1. **Compromise memory** involves the blending of conflicting information in memory so that an "averaged" version of information will be recalled.
  2. There is much debate about whether eyewitness testimony is accurate.

#### IX. SPOTLIGHT: Does Gender Affect Memory?

- A. There seem to be no gender differences in semantic memory, or in the type of memory tasks usually associated with general intelligence.
- B. There are significant and stable gender differences in both encoding and retrieval for episodic and/or autobiographical memory.
  1. Women generally recall more life events, both positive and negative in emotional flavor.

2. Women produce episodic memories more quickly than men and with more emotional intensity.
  3. These differences are also found in children, with girls having richer episodic retrievals.
  4. Women also outperform men in eyewitness memory for a violent murder.
- C. At both encoding and retrieval the amygdala of women shows more activity when episodic memories are being formed or remembered.
- X. Where and How are Memories Formed in the Brain?
- A. Scientists assume that most human memories are stored in the cerebral cortex, but recognize that other, lower structures are involved.
    1. The hippocampus seems most necessary for memory formation.
    2. **Retrograde amnesia** refers to the loss of memory for events that occurred before the onset of amnesia.
    3. **Anterograde amnesia** occurs when one is unable to remember events occurring after the onset of amnesia.
  - B. Memories are formed when changes occur in the cerebral cortex that are, in part, influenced by the action of the hippocampus.
  - C. Memory formation can be influenced by changes at the synapse.
    1. With repetition or experience, the flow of impulses across synapses becomes easier.
    2. The neurotransmitter, glutamate, causes a change in the ion balance on the postsynaptic membrane, so that the neuron may be stimulated more readily.
    3. Other research claims that what matters are changes (increases in the number of receptor sites) in the postsynaptic membrane.
- XI. How We Measure Retrieval
- A. Direct, Explicit Measures of Memory
    1. **Recall** asks someone to produce information to which he or she has been previously exposed.
      - a. In free recall, a person can recall information in any order, but is given the fewest retrieval cues.
      - b. In serial recall, a person is required to recall information in the order presented.
      - c. In cued recall, retrieval cues are provided.
    2. In **recognition**, a person is asked to identify previously experienced material.
      - a. First, the person must retrieve information stored in memory.
      - b. Second, the person must match that memory with material to be recognized and decide whether the material was seen before.
  - B. Indirect, Implicit Measures of Memory
    1. **Relearning** is the change in performance that occurs when one is required to learn material for a second time and almost always requires fewer trials than did the original learning.
    2. Procedural memory (knowing how to do things) is another example of an indirect measure of memory.
- XII. How We Encode Information
- A. The Power of Context
    1. The **encoding specificity principle** asserts that how we retrieve information depends on how it was encoded in the first place.
    2. **State-dependent memory** refers to the idea that retrieval depends on the extent to which a person's state of mind at retrieval matches the person's state of mind at encoding.
    3. **Flash-bulb memories** refer to memories that are unusually clear and vivid.
  - B. The Usefulness of Meaningfulness
    1. **Meaningfulness** refers to the extent to which new information evokes associations with information already in LTM.

2. Meaningfulness resides in the learner, not in the material to be learned.
- C. The Value of Mnemonic Devices
  1. Mnemonic devices are encoding techniques that can aid retrieval of information
    - a. Narrative chaining occurs when unorganized material is woven into a meaningful story.
    - b. **Imagery** at encoding can improve retrieval, such as the key word method of study.
    - c. **The method of loci** involves taking a well-known location and visually placing material to be recalled in various places.
- D. The Role of Schemas
  1. A **schema** is an organized mental representation of the world that is adaptive and formed by experience.
    - a. A person scheme helps to organize information about the characteristics of people.
    - b. A role scheme includes information and expectations about how people in certain roles should behave.
    - c. Event schemes house ideas about how events should occur.
  2. Retrieval is enhanced when information to be remembered is consistent with prior, existing information.

### XIII. How We Schedule Practice

- A. Overlearning
  1. **Overlearning** is the process of practicing or rehearsing material over and above what is needed to learn it.
  2. Overlearning improves retrieval, but a diminishing returns phenomenon occurs.
- B. Scheduling, or Spacing, Practice
  1. In massed-practice conditions, there is no break between learning trials.
  2. In distributed-practice, rest intervals are interspersed among the learning trials.
  3. Short and meaningful study periods are more efficient than study periods massed together.

### XIV. How We Overcome Interference

- A. **Retroactive interference** occurs when interfering activities come after the learning that is to be remembered or retrieved.
- B. **Proactive interference** occurs when previously learned material interferes with the retrieval of material learned later.

# Practice Test Questions

## Multiple Choice

- Psychologists talk about passing information through three levels or compartments of memory called, in order,  
 a. encoding, storage, and retrieval.       c. central, peripheral, and somatic.  
 b. primary, secondary, and tertiary.       d. sensory, short-term, and long-term.
- For approximately what length of time is information typically held in one's sensory memory?  
 a. less than a second  
 b. a few minutes  
 c. a day or two  
 d. At least some information is held there permanently.
- The minimal requirement for keeping information in short-term memory with maintenance rehearsal is that we  
 a. elaborate it in some way.       c. organize it.  
 b. make it meaningful.       d. re-attend to it.
- The amount of information held in STM (i.e., its capacity) can be extended (at least a little bit) if we can \_\_\_\_\_ that information.  
 a. rehearse       c. chunk  
 b. attend to       d. elaborate
- The best way to encode information into long-term memory is  
 a. rote repetition.       c. maintenance rehearsal.  
 b. taking extensive notes.       d. by elaborating it.
- Elaboratively rehearsing information is largely a matter of organizing it and  
 a. making it meaningful.       c. retrieving it.  
 b. re-attending to it.       d. repeating it.
- Imagine a 42-year-old man who has not ice-skated since he was 12 years old. Even though it has been 30 years, he finds that can still skate quite well. His ability to ice skate has been stored in his \_\_\_\_\_ long-term memory.  
 a. physical       c. episodic  
 b. procedural       d. semantic
- The answer to which question is most likely to be found in episodic memory?  
 a. When and where did you learn to ride a bicycle?  
 b. When and where did Wundt open his laboratory?  
 c. What sorts of information are stored in episodic memory?  
 d. What is the result of dividing 134 by 12?
- If any sort of memory is to be repressed, what sort of memory is it likely to be?  
 a. nearly anything in STM       c. facts stored in semantic LTM  
 b. events stored in episodic LTM       d. habits stored in procedural LTM
- When psychologists suggest that an aspect of memory is well organized (into categories or networks, for example) to which aspect of memory are they referring?  
 a. episodic       c. meta-memory  
 b. short-term       d. semantic

11. Referring to memory as “reconstructive”
- a. is a notion that goes back to the early 1930s.
  - b. implies that all of our memories are stored just as we experienced them.
  - c. is virtually the same as Freud’s concept of repression.
  - d. reflects the fact that specific memories are stored in specific areas of the cerebral cortex.
12. A diagnosis of anterograde amnesia implies that short-term memories cannot be made into long-term memories. This unfortunate situation is most likely to result from lesions or damage to the
- a. occipital lobe.
  - b. hypothalamus.
  - c. hippocampus.
  - d. corpus callosum.
13. When memories are formed, what is the LEAST likely change to occur in the brain?
- a. The number of synapses increases.
  - b. Neural thresholds become lower.
  - c. The amounts of neurotransmitters change.
  - d. New neurons are formed by experience.
14. When psychologists talk about “retrieval failure,” what assumption do they make?
- a. We are dealing with short-term memory.
  - b. Information is available, even if it is not accessible.
  - c. There must be some sort of brain damage involved.
  - d. The material was never stored in the first place.
15. Information is most difficult to retrieve when retrieval is requested by asking for
- a. recognition.
  - b. relearning.
  - c. recall.
  - d. some implicit measure.
16. Research that involves \_\_\_\_\_ is dealing with implicit measures of learning.
- a. recognition
  - b. schema
  - c. serial recall
  - d. relearning
17. Implicit measures of memory are most appropriate for information stored in
- a. semantic memory.
  - b. procedural memory.
  - c. reconstructed memory.
  - d. episodic memory.
18. Most people cannot remember all of the features on a one-dollar bill. Which of the following phrases best describes the basic problem in such instances?
- a. lack of availability
  - b. poorly worded questions
  - c. improper encoding
  - d. proactive interference
19. What does the “encoding specificity hypothesis” tell us?
- a. Retrieval is enhanced to the extent that retrieval cues match encoding cues.
  - b. We tend to remember pleasant things more readily than we remember unpleasant ones.
  - c. Retrieval is enhanced to the extent that we use explicit measures rather than implicit ones.
  - d. The effects of retroactive interference are greater than the effects of proactive interference.
20. Studies of “state dependent” memory provide support for
- a. recognition being superior to recall.
  - b. retrograde amnesia.
  - c. the encoding specificity hypothesis.
  - d. the value of mnemonic techniques.
21. Mnemonic techniques enhance or improve retrieval because they
- a. involve the continued repetition of information.
  - b. make material more meaningful.
  - c. involve the right side of the brain as well as the left.
  - d. lengthen the storage of LTM.

22. Making up a story that contains all of the words on a list to be learned is a mnemonic device called  
 a. the peg word method.  c. mental imagery.  
 b. the method of loci.  d. narrative chaining.
23. Organized, but general, representations of knowledge stored in one's LTM are  
 a. mnemonic devices.  c. episodes.  
 b. schemas.  d. retrieval strategies.
24. After a list of words is presented to Bob 8 times, we have evidence that he has learned the list. If we want Bob to engage in 200% overlearning of this list, how many ADDITIONAL presentations would be required?  
 a. 0  c. 16  
 b. 8  d. 20
25. Which is true most often?  
 a. Retroactive interference is less disruptive than is proactive interference.  
 b. Overlearning increases the capacity and the duration of STM.  
 c. Overwhelming anxiety explains most retrieval failures on classroom exams.  
 d. Distributed practice is superior to massed practice.
26. If, during the course of a semester, you have nine classroom exams, for which exam will PROACTIVE interference be the greatest?  
 a. the first  
 b. the fifth (the one in the middle)  
 c. the ninth  
 d. Proactive interference effects would be the same for all nine exams.
27. You are in an experiment to demonstrate the retroactive interference that may occur between two learning tasks, A and B. You are assigned to the Experimental Group. The first thing that you will be asked to do is  
 a. take a test on your retrieval of A.  
 b. learn Task A.  
 c. learn Task B.  
 d. rest while the Control Group learns Task A.

### True/False

1. \_\_\_ True \_\_\_ False For information to be processed into memory, the very first thing that we do to or with that information is to learn it.
2. \_\_\_ True \_\_\_ False The type of memory, or level of processing, with the largest capacity is our sensory memory.
3. \_\_\_ True \_\_\_ False Of the three levels or types of memory, perceptual attention influences short-term memory the most.
4. \_\_\_ True \_\_\_ False The most efficient strategy for encoding information in semantic long-term memory is to use elaborative rehearsal.
5. \_\_\_ True \_\_\_ False Information in semantic long-term memory is probably stored in chronological order, that is, is stored in the order in which it was received.
6. \_\_\_ True \_\_\_ False Psychologists have concluded that there are simply no significant differences in the memory processing of females and males.
7. \_\_\_ True \_\_\_ False At least on classroom exams, retrieval measured by recall is superior to retrieval measured by recognition.
8. \_\_\_ True \_\_\_ False We may think of explicit memory retrieval as an unconscious process.
9. \_\_\_ True \_\_\_ False Flashbulb memories are stored in procedural long-term memory.
10. \_\_\_ True \_\_\_ False Mnemonic devices have an impact on retrieval, but not on encoding.
11. \_\_\_ True \_\_\_ False Retrieval is a skill that can be enhanced with practice.

## Key Terms and Concepts

**memory**\_\_\_\_\_

\_\_\_\_\_

**encoding**\_\_\_\_\_

\_\_\_\_\_

**storage**\_\_\_\_\_

\_\_\_\_\_

**retrieval**\_\_\_\_\_

\_\_\_\_\_

**sensory memory**\_\_\_\_\_

\_\_\_\_\_

**short-term memory (STM)**\_\_\_\_\_

\_\_\_\_\_

**maintenance rehearsal**\_\_\_\_\_

\_\_\_\_\_

**chunk**\_\_\_\_\_

\_\_\_\_\_

**long-term memory**\_\_\_\_\_

\_\_\_\_\_

**elaborative rehearsal**\_\_\_\_\_

\_\_\_\_\_

**declarative memory**\_\_\_\_\_

\_\_\_\_\_

**nondeclarative memory**\_\_\_\_\_

\_\_\_\_\_

**semantic memory**\_\_\_\_\_

\_\_\_\_\_

**category clustering**\_\_\_\_\_

\_\_\_\_\_

**episodic memory** \_\_\_\_\_

\_\_\_\_\_

**reconstructive memory** \_\_\_\_\_

\_\_\_\_\_

**repressed memory** \_\_\_\_\_

\_\_\_\_\_

**retrograde amnesia** \_\_\_\_\_

\_\_\_\_\_

**anterograde amnesia** \_\_\_\_\_

\_\_\_\_\_

**recall** \_\_\_\_\_

\_\_\_\_\_

**recognition** \_\_\_\_\_

\_\_\_\_\_

**relearning** \_\_\_\_\_

\_\_\_\_\_

**encoding specificity principle** \_\_\_\_\_

\_\_\_\_\_

**meaningfulness** \_\_\_\_\_

\_\_\_\_\_

**mnemonic devices** \_\_\_\_\_

\_\_\_\_\_

**narrative chaining** \_\_\_\_\_

\_\_\_\_\_

**method of loci** \_\_\_\_\_

\_\_\_\_\_

**schema** \_\_\_\_\_

\_\_\_\_\_

**overlearning** \_\_\_\_\_

\_\_\_\_\_

**retroactive interference** \_\_\_\_\_

\_\_\_\_\_  
**proactive interference** \_\_\_\_\_

\_\_\_\_\_

# Answers to Practice Test Questions

## Multiple Choice

1. **d** The key to this item is that we're talking about "levels" or "compartments," otherwise, alternative **a** would look pretty good. The best alternative here is the last one.
2. **a** Of all of our different varieties of memory, the duration of sensory memory is, by far, the shortest. Some folks say less than one second, some say about a second, but even an alternative that says "a few minutes" is way too long.
3. **d** You have to be careful on this one. The word "minimal" is very important here. Any one of these alternatives will do the job, but the minimum necessary is simply paying attention to it again.
4. **c** The best term (although arguments could be made for some of the other alternatives) is the technical term "chunk," largely because the others are more related to duration than to capacity.
5. **d** The best way is to "work with it," using elaborative rehearsal.
6. **a** We say that elaborative rehearsal gets information into LTM, so "retrieving it" won't do. Alternatives **b** and **d** say the same thing and are related to STM, so the answer is that it involves making the material (more) meaningful.
7. **b** These abilities are most likely in procedural memory.
8. **a** Mostly because it is personal and autobiographical, the answer to the question about learning to ride a bicycle is probably in episodic memory. Note that actually remembering how to do so would be in procedural memory.
9. **b** Long-term memories of traumatic, anxiety-producing experiences—of the sort usually found in one's episodic memory—are the sorts that are typically repressed.
10. **d** There is little doubt that all of our memory processes are organized in some fashion, but issues of organization are mostly related to semantic memory.
11. **a** That our recall of experience is reconstructed from bits and pieces of stored information is a point of view that goes back to Barlett in 1932. The other three alternatives are just simple false.
12. **c** Because the hippocampus is involved in "moving" experiences from STM to LTM, and because a difficulty in doing so is what anterograde amnesia is, the quality answer is the third one.
13. **d** It's difficult to say, of course, exactly what changes take place in the brain when memories are formed, but we know for sure that new neurons are not formed or created. Remember from Chapter 2 that we are born with more neurons than we'll ever have again.
14. **b** When we talk about retrieval failure, we are probably going to assume that the information that cannot be remembered is in memory, but cannot be gotten out for some reason, which is essentially what the second alternative is saying.
15. **c** In virtually every case (although do note that there are exceptions) recall is more difficult than any other measure.
16. **d** When we ask someone to relearn previously learned—and perhaps forgotten—material, we are really testing to see if any of that material is still there—implicitly.
17. **b** In truth, material in procedural memory seems to actively resist explicit measures of retrieval.
18. **c** The simple thing to say is that we cannot remember these features because we have never really tried to learn them, which is to say that they have never been properly encoded.
19. **a** I think that **a** is a fairly good, concise statement of the encoding specificity hypothesis. Note that although alternatives **b** and **d** are essentially true statements, they are not related to the question.
20. **c** State-dependent memory studies have to do with the person's "state of mind" at encoding and at retrieval, and verify what we predict with the encoding specificity hypothesis.
21. **b** More than anything else they may do, mnemonic devices enhance the meaningfulness of what we are encoding.
22. **d** This item provides a good description of what is involved in narrative chaining.
23. **b** This item provides a good definition of schemas.
24. **c** If Bob engages in no more trials, overlearning = 0%; 8 trials = 100%; 16 trials = 200%, and 20 trials = 250% overlearning.
25. **d** Answer **a** is virtually never true. Answer **b** incorrectly talks about STM instead of LTM. Answer **c** sounds good, perhaps, but it is untrue, while answer **d** is nearly always true.

26. **c** The very last test will always provide the most proactive interference—interference from materials learned earlier.
27. **b** You may want to go back and review the design for both the retroactive and proactive interference experiments. The correct choice here is that as an experimental subject, you will begin by learning Task A.

### **True/False**

1. **F** No, actually, before we learn it we must attend to and perceive it, but before that we must sense that information.
2. **F** Whereas LTM seems to be virtually without limit in terms of capacity, sensory memory is going to be limited by our sensory ability. Sensory memory capacity is large, but not as large as that of LTM.
3. **T** Indeed, because paying attention is so central to STM, we find its capacity limited.
4. **T** This statement is simple in that it does not bother to tell us just what elaborative rehearsal is, but in its simplicity, it is true.
5. **F** Information in semantic memory is no doubt well organized, and one of the ways in which it may be organized is chronologically. Having said that, I still am going to claim that the answer here is false because there are so many other, better, more common ways of organizing material in semantic memory—and because chronological organization better fits episodic memory.
6. **F** Women seem to have richer, more complete, and more emotionally-intense episodic or autobiographical memories than do men.
7. **F** No, in fact, quite the opposite is true.
8. **F** No. Explicit measures are necessarily conscious processes, such as recognition and recall.
9. **F** This is terribly unlikely—so much so that I'd call it false. What we call flashbulb memories are more likely to be stored in episodic memory.
10. **F** If you think about this one for a minute, you will see how silly it is. Yes, mnemonic devices impact on retrieval, but they do so by having their real impact at the time of encoding, putting information into memory in a more meaningful way.
11. **F** In fact, practicing the retrieval of learned information is exactly what you are doing right now. I hope it helps. It should.

# EXPERIENCING PSYCHOLOGY

## Tapping Into Flashbulb Memories

We have defined *flashbulb memories* as experiences stored in long-term memory that are particularly clear and vivid, and easy to retrieve. Most likely, these memories are stored in episodic memory, and although their recollection may be easy and vivid, they may not all be accurate.

By and large, one's personal collection of flashbulb memories varies from one generation to another.

To explore flashbulb memories in more detail, you might try a few things. First, ask someone in his or her twenties, someone in his or her forties, and someone in his or her sixties for two or three flashbulb memories that most easily come to mind.

Did you notice how easy it is to have people understand the basic notion of flashbulb memories? To what extent was there any overlap in the sorts of events that constitute flashbulb memories for people of different ages? Can you assess the extent to which the flashbulb memories you noted were accurate representations of the events recalled? Did you note any distortions? Did you note any consistent ways in which these memories were recalled? Were there any differences in the *kinds of events* that people recalled? Even though they may have recalled different events, were there any similarities in the details of their recollections, that is did they tend to mention what they were doing at the time, or who was with them, or how they felt when the event occurred?

## *Using the Internet to Expand Your Appreciation of Psychology*

### **1. SENSORY MEMORY (pp. 199-200); SHORT-TERM MEMORY (pp. 200-203); and LONG-TERM MEMORY (pp. 203-206)**

Few of the websites devoted to human memory focus on the nature of memory or memory systems. Most websites focus on ways and means of improving memory. This is not a bad thing. After all, forgetting less and remembering more is a goal we all share. When I began searching sites for this chapter, I was not prepared to find that nearly one-third of all the sites dealing with “memory” address computer memory, RAM and ROM and other technological uses of the term.

<http://www.exploratorium.edu/memory>

(The Exploratorium is an online version of a hands-on science museum, and they have a section devoted to memory. Most of the activities at this site are directed toward assessing memory function and offering ideas and games for improving memory. But there are other good features as well.

<http://chiron.valdosta.edu/whuitt/col/cogsys/infoproc.html>

(an excellent interactive essay on the information-processing approach to memory)

<http://faculty.washington.edu/chudler/chmemory.html>

(“Neuroscience for Kids” devoted to memory. You will find articles, games, and experiments.)

<http://www.bbsonline.org/documents/a/00/00/04/46/bbs00000446-00/bbs.cowan.html>

(an extraordinary article on the capacity of short-term memory)

<http://psychclassics.yorku.ca/Miller>

(the short, original paper by George Miller, “The Magical Number Seven, Plus or Minus Two)

## 2. ON THE ACCURACY OF LONG-TERM MEMORIES (pp. 206-210)

Perhaps the most important insight about memory that has emerged over the past decade is that memories are fluid, changing, and uncertain. Even those memories of events that we each believe are so clear, so accurate, so vivid, may be wrong—they may represent events that never happened. Memory is plastic and malleable.

<http://plato.stanford.edu/entries/memory>

(an excellent summary on memory in general, but click on “3.1 Constructive Remembering” if nothing else)

<http://www.fmsfonline.org>

(the website the “False Memory Syndrome Foundation,” and the folks supporting this website have an agenda. Please begin by reading the link “About the FMS Foundation.” It is devoted to debunking the notion of “repressed memories.” Point-of-view notwithstanding, it is a rich site, and there is a good section called “Focus on Science” (which also has to be considered in the context in which it appears).

<http://www.jimhopper.com/memory>

(If the previous website carries the view “there is no such thing as repressed memories”), here is the opposite point of view. A skeptical mind is a good thing in science, and I would caution not to take either site seriously without considering the other. If nothing else, this is a site with many links.)

<http://faculty.washington.edu/eloftus>

(If you get into the issue of repressed/false memories, you need to stop by here. There are direct links to several of her papers)

<http://eyewitnessconsortium.utep.edu>

(in 1998, then U.S. Attorney General, Janet Reno convened a panel of experts “to improve the accuracy of eyewitness testimony.” This website carries on the task. The validity (and reliability) of eyewitness testimony is directly linked to issues of memory. There are many very good links at this site to explore.)

### **3. WHERE AND HOW ARE MEMORIES FORMED IN THE BRAIN? (pp. 211-212)**

Neuroscientists seem to be getting closer every day to an understanding of how the brain encodes, stores, and retrieves memories. The relatively recent insight that memories are often reconstructions, based on several factors, both past and present, has made it even more difficult to account for the physiological underpinnings of the human memory system. Mindful of the fact that we are here dealing with a beginning psychology class—and not a graduate-level neuroscience class—we offer the following.

<http://www.hhmi.org/research/investigators/kandel.html>

(a short, simple piece on “Cell and Molecular Studies of Memory”)

<http://faculty.washington.edu/chudler/bvc.html>

(a clever site on the brain vs. the computer)

<http://faculty.washington.edu/chudler/plast.html>

(a most excellent piece on brain plasticity, learning, and memory)

<http://skepdic.com/memory.html>

(a lot of information on memory, a good bit of it with a neuroscience base)

<http://science.howstuffworks.com/question672.htm>

(a good summary on amnesia)

## Factors That Affect Forgetting (pp. 213-226)

One of the joys of the science of psychology is that so much of it is relevant to our everyday lives. I see nothing at all wrong with the notion that science can have application to problems in our experience. We have seen that remembering is a dynamic, constructive process. Forgetting is essentially what happens when remembering fails. It, too, is a dynamic process, and it is better understood than ever before. And the upshot is that there is some truly practical advice that psychologists can offer on steps to take to improve memory; or reduce forgetfulness. **Although the second half of Chapter Six is nicely organized into four major sections on measuring retrieval, encoding information, scheduling practice, and avoiding interference, the Internet is not so well organized.** The bottom line, in any case, is the same: What can be done to improve one's ability to retrieve information stored in memory? On this question, there are many websites:

<http://www.mindtools.com/memory.html>

(a “semi-commercial” website with lots of ads for all sorts of things—some related to memory, some not. But the basic focus of the homepage is “Tools for Improving Your Memory” a rather long piece, available in pdf format for easy downloading and printing)

<http://eudesign.com/mnems>

(There may be a single website in cyberspace which lists more mnemonic techniques, but somehow I doubt it.)

<http://www.thememorypage.net>

(it is, after all, called “The Memory Page”)

<http://www.mindtools.com/memory.html>

(lots of things here, but the memory/mnemonics section is particularly good)