Annenberg Learner
Course Guide

Neuroscience & the Classroom: *Making Connections*

A multimedia course for educators examining exciting developments in the field of neuroscience, and how new understandings about the brain and learning can transform classroom practice.

Produced by the Harvard-Smithsonian Center for Astrophysics

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Neuroscience & the Classroom:
Making Connections
Course Overview

Welcome to *Neuroscience & the Classroom: Making Connections*. This course provides insight into some of the current research from cognitive science and neuroscience about how the brain learns. The major themes include the deep connection among emotion, thinking, learning, and memory; the huge range of individual cognitive strengths and weaknesses that determine how we perceive and understand the world and solve the problems it presents us; and the dynamic process of building new skills and knowledge. The course invites you to examine the implications of these insights for schools and all aspects of the learning environments we create for our children—teaching, assessment, homework, student course loads, and graduation requirements. It is not a course that offers easy answers or proposes teaching methods that can be universally applied. Rather, it provides new lenses through which to view the teaching and learning challenges you face and invites you to discover your own answers to your own questions.

Course goals

- To foster an understanding of the unity of emotion and thinking and learning.
- To help educators connect brain research to classroom practice and school designs.
- To illustrate the benefits of collaboration between researchers and teachers so that research informs what happens in the classroom, and what happens in the classroom informs research.
- To recognize and strengthen two roles of the teacher:
    1. Teacher as designer who creates the context for learning (environment, lessons) and who is able to take the perspective of learners.
    2. Teacher as researcher who treats student responses as data that reveal the effectiveness of lessons and that provide information for the next step in the learning process.

The greatest benefit of this course is that, instead of providing simple answers, "tricks," or teacher-proof lesson plans, it treats you as a professional capable of finding your own answers to the specific teaching challenges you face in your particular circumstances. The course focuses on how learners learn and invites you to consider how teachers teach. As a result, you will become more skilled at inventing teaching

strategies to improve the learning of your students.

Along the way, the course offers you an important opportunity to revisit the experience of being a learner. It will remind you of the ways in which your students struggle with new material. In the language we use in this course, you will be "building new neural networks" for understanding and for applying ideas and principles that emerge from the research you study. To get the most from this experience (and from the course), we urge you to become conscious of your own learning—the struggles, the misunderstandings, the moments when ideas gel, the need to repeatedly revisit a new idea, your emotional responses, the conditions under which you do your best learning, the effort required—the whole messy, non-linear process. To this end, you may find it useful to keep a journal of your learning: thoughts, feelings, observations, and insights.

Thinking big, starting small

The course has two main goals:

- To provide new insights into learning based on research.
- To stimulate your thinking on how to connect your teaching and lessons learned to these insights.

Some of the ideas in the course may challenge your current beliefs about learning and teaching. Many of the ideas may reinforce your beliefs, especially by making you conscious of feelings you have had about learning as a result of your years of experience as both a learner and a teacher. Either way, you will be filled with ideas, and you may feel a desire to start changing and fixing things right away. You may even feel obligated to become an agent of change. We can offer only one bit of advice: relax.

Change takes time, and most teachers don't have a lot of that. The scope of what you can change also depends on how much authority or responsibility you have. An experienced division head may be able to implement new ideas more quickly and with wider impact than can a new teacher. You can only do what you can do. What's important is that you start somewhere.

Nick and Martha, the two teachers in Unit 6 (Sections 3, 5), didn't start as revolutionaries. Nick began with an idea that he wanted to give more choice to the students in his English class; he was looking for a way for his students to feel connected to literature. Martha started with an idea about how to reduce the fear of and focus on grades in her history classroom. Other teachers begin with even smaller changes, though they often feel very big to the them. One decides that he is going to stop lecturing and let his students talk more, and find out what they think before telling them what he thinks. Another decides to spend more time getting to know her students as people, creating emotional connections on a personal level. One thing leads to another, and slowly these teachers influence other teachers or, eventually, become leaders—

department chairs, division heads, principals—and these small changes spread. All that matters is that you continue to think, imagine, invent, and experiment.

The course guide

The guide provides exercises to stimulate your thinking and to help you build new neural networks for the ideas presented in the course. The exercises focus on the specific ideas contained in each unit, and run the gamut from a focus on personal exploration to classroom interventions to systemic change.You should find yourself going back and forth from the unit to the exercises, with excursions into some of the additional material available in the course. These include video illustration or explanation, sidebars of related information, and links to relevant articles that also contain bibliographies suggesting further possible readings.

Although you can certainly take this course alone, you might find value in going through it either with colleagues (at your school or online) or in a more formal class with a leader or facilitator. You or your facilitator can select exercises from those suggested in this Guide, and can invent some of your own based on questions, issues, or problems that affect your school or classroom. Combining written responses, discussions with colleagues, and personal reflection about what you are learning will be most helpful.

A note to facilitators and those taking the course for credit

You can take the course for credit in one of three ways: on your own, with a colleague (at your school or online), or as part of a larger group with a facilitator. The course can be taken for two graduate education credits through Colorado State University. For more information on receiving graduate credit for this course, go to learner.org/workshops/graduate_credit.html.

It is the facilitator's job to create the shape of the course by selecting the specific additional readings and the exercises—balancing the apparent needs of the group with the time requirements for earning the credits. If you are taking the course alone or with a partner for credit, your job will be to take on the facilitator's role—creating the shape of the course by selecting from the course materials to meet your educational goals and to meet the requirements for earning the credits.

Reading the text and sidebars in each unit, including the Introduction and Conclusion, should take about two hours per unit. This includes watching the videos and thinking about what you've read. Most of the supplemental articles will also take about an hour to read, and each one of the assignments for each section of the text can be done in some fashion in an hour, except where otherwise noted. However, as teachers you know that learning new material tends to demand more time and thought than an initial reading takes, and you know that everyone works differently and requires different amounts of time to work through problems or assimilate new ideas. So rather than

moving through the course and the exercises to the rhythm of a clock, we suggest that you move to the more irregular pace of your personal learning process, guided by its inevitable cycles of progress and regression. Ultimately, the most important outcome is that you learn the concepts sufficiently so that you can take them back to your schools and put them into practice. To achieve this goal, you will spend more than the minimum hours specified to receive credit.

A note on the approach to preparation between units

In courses like this, you get a lot of information, but assimilating that information—beginning to really understand and internalize it so that you can use it—tends to be very difficult. Information comes to you; some of it seems exciting and provocative and stimulates all sorts of ideas. But pursuing those ideas is like chasing rabbits through a field: a glimpse here, a feeling that you've almost caught one, and then they disappear.

As you go through each unit, it is essential to think about the ideas—to see if you can put them into your own words or apply them and discover where you still have questions. Each of us assimilates information differently, so between units we encourage you to design your own homework. (Those taking the course for credit will need to discuss this suggestion with the facilitator.) Decide what you need in order to begin the process of internalizing and applying the ideas around which the workshop is constructed. Ask yourself, "What would help me? What do I need now?"

Here are some possible homework avenues and some resources that are available to you:

- Review: Read an essay that develops some of the ideas from the unit that you just studied. In each unit, you will find supplemental articles for further reading. (For the complete bibliography, please go to the Resources section of the website.) View one or more of the videos in a unit and think about how it illustrates the principles in that unit, or simply reread the unit.
- Preview: Read an article that touches on ideas that will be presented in the next unit. Some people like to preview ideas, so you might select one of the supplemental articles contained in the upcoming unit. Or you can read the upcoming unit before it is assigned, watch the accompanying videos, and jot down some ideas. Then, reread the unit and think more deeply about the ideas you wrote down. In this method, the rereading is important.
- Discuss: Get together with one or two people to discuss the ideas from the unit just completed: "Here's what I think I understand; here are the questions I still have." If you are taking the course for credit, you can have these informal discussions before or after your full-group discussions.
- Record your thoughts: Sit alone and write about the ideas from a unit—put

them in your own words, look at their implications, see what questions still arise. Especially useful might be to explore how a new concept challenges, changes, or supports an idea or belief you already have. For example, you might productively examine your initial thinking about the connection between emotion and learning in light of new ideas presented in the course.

- Apply the ideas: Give yourself a practical exercise such as looking at the implications of a specific idea for some aspect of school (homework, a lesson plan, a teaching method, grading, memorization, etc.). Try to link a specific idea or quotation from the unit to the particular implication. (In the supplemental articles, you also will find some essays that are written by teachers that focus on practical implications.)
- Combine exercises: Any of these suggestions can be combined. For example, while writing in your journal, you might find yourself wanting to reread a section of a unit or replay a video, or you might want to read a related supplemental article or start a discussion with a colleague. Then, you might want to return to your writing.

For those who like more direction for homework possibilities between units, we offer some reading suggestions from the collection of supplemental articles. And, there are exercises later in this guide under the heading of each unit.

Getting started: Your first assignments for the course

Prior to studying the course text or viewing the videos, we ask you to read a short essay and do some writing assignments. These first assignments lay the foundation for the course, for you will return to this work both as you progress through some of the units and at the end of the course. While you can go through the course materials however you wish, the course is designed to take you through an introduction, six units, and a conclusion. Between each of these parts, there are suggested readings and exercises to help you build an understanding of the concepts over time.

Assignment 1: Write about the connection between emotion, thinking, and learning.

Send what you have written to the facilitator or share it with others who are taking the course with you. (The facilitator can revisit these periodically during discussions.)

Assignment 2: Read and discuss "Fostering Conceptual Change."

The purpose of this assignment is to begin to make you aware of your own cognitive and emotional processes. You should read the article to explore the extent to which it applies to you—the degree of difficulty you experience when making conceptual change.

This course may challenge some of your strongest beliefs about teaching and

learning, and the essay may help to sensitize you to signs of resistance to new ideas and may help to provide some strategies for overcoming this resistance.

As you proceed through the course, revisit the ideas in this essay and examine your reactions to challenges to your beliefs about education. In addition to discussing these thoughts with others who are taking the course with you, you might find it beneficial to begin your course journal with these reactions and thoughts.

Assignment 3: Write about a teaching or learning problem.

Think of a specific teaching or learning problem you have encountered.The problem should derive from something that you found difficult to help your students (if you are a teacher) or colleagues (if you are an administrator) to learn or understand. Focus on the essence of it, not a detailed retelling. Follow the models below to get an idea of the length expected.

1. Write a brief analysis of the problem: What do you think is the issue? What solutions might you try?
2. Send this assignment to the course facilitator or share it with your group or partner. (The facilitator can revisit these periodically during discussions, and you will be using this problem for the final assignment.)

Here are a few examples:

- A teacher was focusing on teaching ninth graders how to write a coherent paragraph—a topic sentence followed by an illustration and explanation and then a concluding sentence. In class the teacher provided examples of paragraphs, modeled the creation of a paragraph, and then led the class through the creation of a paragraph composed on the white board. This group paragraph was successful. For homework, he asked each student to write a paragraph, and he was puzzled to find that most of the paragraphs he received reflected no understanding of how to write a paragraph.
- A second grade math teacher worked to help students to articulate their mathematical reasoning. He wanted them to explain, “The problem said ‘two more came,’ so I knew I needed to add,” but he got, “I knew 2+4 was 6.” In a two-step problem, he was looking for, “I knew I needed to find the total before I could divide them all equally,” but he got, “I knew 13+3 was 16, and I knew 16 divided in half was 8.” Or in a problem involving permutations, he wanted, “I found 4 combinations starting with the yellow shirt, so I knew there would be 4 combinations with the green shirt and the orange shirt, and 3x4 is 12,” but he often got, “I tried all the different combinations I could think of and got 9.” Even after introducing the notion of organizing data and demonstrating various possibilities, he found that many students didn’t internalize the importance of

organizing the data and approached a similar problem, a few weeks later, as randomly as the first.

- A school administrator's greatest challenge was figuring out how to motivate her faculty to incorporate more research-based strategies into their instruction in order to develop higher-level thinking skills in the students. Despite all her efforts—explaining the benefits of these ideas, providing articles for her teachers to read, sending specific teachers to workshops and conferences, providing in-service workshops, offering financial incentives—she could not teach them to effect the changes she hoped to see.

Unit exercises for thinking, writing, and discussion

All assignments are meant to be done after you have read the unit text and watched the accompanying videos under which the assignments appear. For example, before doing the assignments listed under "Introduction," read the Introduction in the course text, including the sidebar, and watch the videos.

In approaching all exercises and discussions, it is important to be free from self-defeating mindsets of "can't," such as "we could never do that in my school," or "we tried that and it didn't work." These exercises are intended to be explorations inviting you to look at existing structures and practices through new lenses and imagining "What if?" and "Why not try?" Once you have a vision of what might be, there is always plenty of opportunity to explore the obstacles and imagine how to deal with them.

Introduction
The Art and Science of Teaching

Major principles

- Effective research about learning results from researchers and teachers working in a dynamic partnership.
- Researchers provide insight into learning.
- Effective learning is supported by teachers who are reflective about the relationship between their teaching and the students' learning.
- Teachers use research to discover answers to their own questions about how to foster meaningful learning. What teachers think is easy for learners may not be.
- Teachers must be wary of brain-based panaceas.

Assignment 1: Take some time to think or write about three roles of a teacher:

- Designer who creates the context for learning (environment, lessons) and who is able to take the perspective of learners.
- Researcher who treats student responses as data that reveal the effectiveness of lessons and that provide information for the next step in the learning process.
- Member of a professional community who interacts with researchers.

Discuss these roles by sharing illustrations of them from your own experiences or from ideas you have about how to put these roles into practice. For example, when and how have you, or might you, take on the perspective of learners in your classroom? Can you illustrate the benefits? How might you become a researcher in your classroom? What might you learn from viewing student responses as data (evidence of how students are approaching a problem or of the strategies they are using to solve it, as opposed to simple right or wrong answers)? How might you become more active in a community of educators?

Assignment 2: Write about and discuss the extent to which your school and your teaching are built on "knowing answers."

One important part of this course is the emphasis on moving away from a concept of learning that is limited to knowing the answers. In the introduction (Section 3), Jason redesigned his class so that his students would think of themselves as problem-designers (asking good questions) instead of problem-solvers (focusing on getting

answers). And Sam (Introduction, Section 7), the young theater teacher, discovered that creating his own answers to teaching problems made him a better teacher than when he simply used answers that other teachers provided.

Identify in your writing very specific evidence that illustrates your claims. What new insights are you discovering about this approach to learning?

Assignment 3: Write about and discuss the school-related topics that either reflect or conflict with the fundamental beliefs you have about learning.

Look at the final list of school-related topics at the end of the Introduction:

- Motivation, attention, engagement, and memory.
- How different students perceive and solve problems.
- Learning differences and disabilities.
- Policy and practice issues involving all aspects of school (such as homework, grading, course loads, graduation requirements, etc.).

Take some time to write about and discuss the ones that jump out at you, because the way they are manifested in your school seems either to reflect or to conflict with fundamental beliefs you have about learning. Be specific about both your beliefs and the reflection or conflict you see.

Suggested readings between the Introduction and Unit 1:

Possible review:

Ablin, J. “Learning as Problem Design Versus Problem Solving: Making the Connection Between Cognitive Neuroscience Research and Educational Practice.” *Mind, Brain, and Education* Vol. 2, Issue 2 (May, 2008): 52–54.

McDevitt, T.M. and J.E. Ormrod. “Fostering Conceptual Change About Child Development in Prospective Teachers and Other College Students,” *Child Development Perspectives*, Vol. 2, Issue 2 (August, 2008): 85–91.

Possible preview:

Immordino-Yang, M.H. “A Tale of Two Cases: Lessons for Education from the Study of Two Boys Living with Half Their Brains.” *Mind, Brain, and Education* Vol. 1, Issue 2 (June, 2007): 66–83.

Unit 1
Different Brains

Major principles

- All brains are different.
- One teaching style, one approach, and one design will not succeed with all learners.
- Brain function relies on interconnected systems rather than on separate modules or hemispheres.
- How we perceive the world and solve problems is determined by our profile of cognitive strengths and weaknesses, our experiences, our emotional needs, and the sociocultural context.
- What teachers think is easy for learners may not be.
- Young brains are more plastic but less efficient.

The major principles explored in Unit 1 suggest that schools and classrooms need to be as flexible as possible in working with the array of different perspectives and cognitive strengths students bring with them. For learners with various profiles to be successful, teachers must find flexible ways of presenting lessons or of being open to flexible ways in which students might demonstrate their understanding. Providing this flexibility allows students different entry points to the lesson. For example, Nico's approach to the problem of recognizing and producing tonal meaning in conversation was to treat the problem as pseudogrammatical, while Brooke's approach was heavily emotional. It is the same problem, but with different entry strategies—depending on the cognitive strengths of the two boys.

As you go through the suggested exercises below, keep the major principles of the unit in mind.

Assignment 1: Write about and discuss the various aspects of your classes and of your school that allow for flexibility.

Recall the story of Nico and Brooke (Unit 1, Section 4)—how their teachers needed to adapt to the boys rather than expect the boys to adapt to a preset curriculum. Although these teachers were confronted with an extreme demand for differentiated instruction, their experience suggests that teachers might profit from assuming that

everyone's brain is a bit different.

Look at various aspects of your classes and of your school (for example, grading, homework, graduation requirements, daily schedule, assessment, etc.). Which ones allow for flexibility? Which ones do not? How might the latter be made more flexible? Can you think of any students who might learn more as a result of this flexibility?

Assignment 2: Analyze a case study.

Recall the story of Brooke and the expectation that, given his neuropsychological profile, he would find it easy to reproduce tonal sounds using nonsense syllables ("na na") (Unit 1, Section 6).

Case study: *Stan is in Ms. J's English class and writes good essays about issues like teen drug use and democracy. He has an unusual knack for using good personal examples and organizing persuasive arguments. Many of his classmates struggle with organization, so Ms. J came up with the idea of simplifying the task by stripping it down to what she saw as its basics. She disassembled good paragraphs (taken from professional writers), listed the sentences out of order, and asked the students to reassemble the paragraphs. She assumed Stan would be the best in the class at this exercise and was surprised to find he was the worst.*

Write down the answers to the following questions:

1. What might explain Stan's poor performance?
2. In thinking about this case, what is required of a student to be able to do Ms. J's exercise?
3. How might different people approach this task?

Assignment 3: Select a piece of work from two different students doing the same assignment—a homework assignment, or a test, or a project. One piece should be from a student who did poorly (received a bad grade but appeared to try), and one should be from a student who did well on the same assignment.

Answer the following questions:

1. Looking at this work as a source of data, what do you think it reveals about how the students approached the problem?
2. What knowledge or understanding did each student possess?
3. What strategies were used?
4. Where did one student seem to move away from your expectations, and are there any clues as to why the student went in this direction?
5. Did this student seem to share your understanding of the problem or assignment? Why or why not? As you consider this problem, think about not just

the individual cognitive profiles students bring to problems, but also the plasticity and relative inefficiency of a child's brain.

6. Finally, can you imagine a way that the less successful approach to the assignment might lead to an interesting solution that you might not have considered? If you struggle with this exercise, try examining the selected students' work with a colleague or two.

Assignment 4: Interview students to gain additional insights.

As an additional layer to the previous exercise, try interviewing both students about their work to attempt to gain more insight into each one's thought process, knowledge, perception of the problem, and strategies for solving it.

Answer the following questions:

1. Were your analyses of the work reinforced by how the students talked about it?
2. Did you find anything surprising in the students' answers that might help you to see where each was coming from?

Suggested readings between Unit 1 and Unit 2:

Possible review:

Immordino-Yang, M.H. "A Tale of Two Cases: Lessons for Education from the Study of Two Boys Living with Half Their Brains." *Mind, Brain, and Education* Vol. 1, Issue 2 (June, 2007): 66–83.

Possible preview:

Immordino-Yang, M.H., and A. Damasio. "We Feel, Therefore We Learn: The Relevance of Affective and Social Neuroscience to Education." *Mind, Brain, and Education* Vol. 1, Issue 1 (March, 2007): 3–10.

Immordino-Yang, M.H., and F. Matthias. "Building Smart Students: A Neuroscience Perspective on the Role of Emotion and Skilled Intuition in Learning." In D. A. Sousa (Ed.), *The Future of Educational Neuroscience: Where We Are Now, and Where We're Going Next*. Bloomington: Solution Tree Press. 2010.

Unit 2
The Unity of Emotion, Thinking, and Learning

Major principles

- Emotion is the rudder for thinking, learning, and decision-making.
- Motivation is rooted in emotional relevance.
- Meaningful learning requires three other ingredients: factual knowledge, skilled intuition, and understanding of rules or principles.
- The purpose of education is to develop students' abilities to recognize the complexities of situations and to help them create increasingly nuanced and sophisticated strategies for acting and responding.
- Young people must learn to feel their emotions and understand them.

This unit suggests that the essential connection between emotion and cognition requires that we rethink how we look at students' motivation, their ability to solve problems, and the schools we have designed for them. Some of the behavior and learning problems that teachers confront in the classroom may take on new meaning when examined through the lens of this connection. As you go through these assignments, keep this connection and the principles from the unit in mind.

Assignment 1: Analyze a case study.

Case study: A high school math teacher wants his students to take more control of their learning and be more reflective about it. He wants them to develop the skills necessary to examine their learning strategies and change them if they are not effective. The students are satisfied with a superficial attempt at learning. They consider that, if they complete one or two problems, they have achieved mastery and are reluctant to practice further. Their concern is more about their grade than their learning.

Analyze this problem through the lens of the role of emotion in learning. Write down the answers to the following questions:

1. What possible solutions does your analysis suggest?
2. What might you do to implement a solution?
3. Are there obstacles to implementing your solution?
4. If so, how might you deal creatively with these?

Assignment 2: View and discuss the video "Depth of Field."

Pay attention to the ways in which Eric Baylin and his students talk about photographs. As a photographer, Eric talks like an expert. However, once they begin to understand depth of field, his student novices also start talking like photographers, an indication that they are beginning to think like artists. Look for these moments when you hear students beginning to think like artists.

Write down the answers to the following questions:

1. What does it mean to "think like" an expert in the subject that you teach—to think like an historian, a writer, a mathematician?
2. How might you begin to develop this ability in your students?
3. What might be the greatest impediment to your success?

Note: This is a two-hour assignment. If you view and discuss the video in your group with your facilitator, one hour will be part of your contact hours, and the other hour can be homework; or the entire assignment can be homework. If it is all done as homework, try to view the video and discuss it with a colleague; or, if you watch it alone, write about your observations in your journal.

Assignment 3: Analyze a case study.

Some of the most difficult classroom problems have complex emotional roots. The case study below is one of those. Because you won't have all the emotional and family information to do a definitive analysis, you should draw whatever inferences you can. Your assignment is to analyze the boy's behavior and the teacher's response and to suggest possible courses of action that you might take or what you might have done differently early on. As you read the case, keep in mind that we all have emotional triggers.

<u>Case study:</u> *"Last year, I had a new student who had moved to town in the middle of the year. During faculty meetings before his arrival, we were advised that he was a very troubled 12-year-old who had had a difficult time with authority, tended to become violent, and really struggled with school. His one redeeming quality, however, was that he was very artistic and loved to draw. I felt like the lucky one on our staff because I was going to be the one who could boost this student's self-esteem, make him realize his talents and potential, and ultimately save him from what seemed to be certain up-hill battles in every other area of his life.*

"Our first assignment together was a study of the style of Art Nouveau artist, Gustav Klimt. The students were to use colored pencils and, in the style of Klimt, draw from observation of a live model. They were asked to pay close attention to the face and hands, giving as much detail as possible, and the rest could be implied. The Klimt style

shows a lot of pattern and color, and students were asked to show these in their work, as well.

"My new student had a fabulous start, drawing the model in excellent proportion. He had really grasped the concept of foreshortening and was working quickly—much faster than the rest of the class. I made a point of complimenting specific elements of his drawing, and announced to the class how lucky we were to have had such a talented young artist move to our town. I showed his drawing to the class to point out some of his acute details in the face and hands.

"The next day, students went right to work on their drawings again. As I walked around conferencing with different students, I found that I didn't check in as much with my new student because he seemed to be working diligently and talking casually and cheerfully with other students at his table. As the class neared a close, I leaned in to check his progress and was shocked to see that he had very adeptly been adding many violent features to his drawing. For example, the feet were now bloody stumps with smoke rising from them; the hand was holding a cigarette; the model's face now had bloody scars on it; and there were dead animals on the floor of his drawing, most of them decapitated or missing limbs.

"It was extremely disturbing to me, so I approached the boy by asking, 'What happened here?' He replied, 'The guy killed all of these animals and wanted to burn them, but he accidentally burned off his foot when he was starting the fire.' I told him that this was disturbing, and there was no way I could display it on the walls with the rest of the class. He didn't care.

"I was saddened that he had taken such a fabulous drawing that I had made a point of praising, trying very consciously to build up his self-esteem, and had turned it into something that could never even be displayed in the school, nor could I hold it up again to show it off to the class. I brought the drawing to the principal after school, and we had a long discussion about him. This violence became a theme in all of his artwork. He moved again before the end of the year."

Write down the answer to the following question: How can teachers create supportive emotional environments and help students gain insights into and manage their emotions?

Assignment 4: Write about and discuss the teaching or learning problem you wrote about during the preliminary exercises for this course in light of the major principles listed above.

Write down the answer to the following question: Might the learning difficulty presented in the problem have emotional components that suggest possible solutions or approaches to try?

Suggested readings between Unit 2 and Unit 3:

Possible review:

Immordino-Yang, M.H., and A. Damasio. “We Feel, Therefore We Learn: The Relevance of Affective and Social Neuroscience to Education.” *Mind, Brain, and Education* Vol. 1, Issue 1 (March, 2007): 3–10.

Immordino-Yang, M.H., and F. Matthias. “Building Smart Students: A Neuroscience Perspective on the Role of Emotion and Skilled Intuition in Learning.” In D. A. Sousa (Ed.), *The Future of Educational Neuroscience: Where We Are Now, and Where We’re Going Next.* Bloomington: Solution Tree Press. 2010.

Possible preview:

Immordino-Yang, M.H. “The Smoke Around Mirror Neurons: Goals as Sociocultural and Emotional Organizers of Perception and Action in Learning.” *Mind, Brain, and Education* Vol. 2, Issue 2 (June, 2008): 67–73.

Immordino-Yang, M.H., and L. Sylvan. “Admiration For Virtue, Neuroscientific perspectives on a motivating emotion.” *Contemporary Educational Psychology* (2010).

Unit 3
Seeing Others from the Self

Major principles

- Schools must make room for the self of the students.
- Learning depends in part on mirror neurons and our ability to simulate.
- Teachers' and students' goals must be aligned.
- Motivation to take moral action may derive from engaging in meaningful reflection about others' situations in relation to one's own.

This unit suggests some of the reasons that involving the self of the learner in schools may be important. Although traditional ideas about schooling may be embedded in the monkey-see, monkey-do cliché, research reveals that monkey only does if it understands what it sees—recognizes it as familiar and desirable. The mechanism for this recognition is our ability to simulate experience as if it were real. We use our complex cognitive and emotional abilities to imagine actions or solutions to problems and let them play out on our most primitive brain parts, those responsible for our physical survival, in order to feel their rightness or wrongness in our gut. What happens in the classroom will either invite the participation of the "real me," the self, or it won't. If it doesn't, the intended learning may not occur: students may not notice the teacher's modeling or may notice but fail to engage in active, emotion-laden simulations. Modeling can be useful if the teacher and learners understand and share goals; even imitation can be useful, especially if used mindfully to induce simulation. Depending on how they are used, both techniques can succeed or fail at inviting the learner's self into the classroom.

As you move through these assignments, keep in mind the principles from this unit and remember Jill's voice (Unit 3, Section 6): "I just need a place where I can be myself."

Assignment 1: Compose a letter to your department chair or an administrator in which you explain in your own words what it means to involve the self of students in your school and in your class.

Recall Hallie Cohen's challenge of trying to teach violin to a group of reluctant seventh graders (Unit 3, Section 3). Her approach to the problem of drawing the students into her lesson was an effective solution because she essentially tapped

into something that mattered to those students. She involved the students' self in the lesson.

In your letter, describe the behavior or other evidence that signals the involvement of the self of students. Be specific and use examples.

Then continue your letter either by:

1. Writing an idea you have for a lesson plan or for a larger systemic change that you would like to implement or see implemented in order to achieve the goal of making your school or classroom more inclusive of the students' self; or
2. Writing a full description of something you or your school already does to include the self of the students, and explain and illustrate how it succeeds and how it might be improved or expanded.

Work on this assignment either alone or with a colleague (producing one letter that you both create). Although the primary goals of this exercise are to help you make sense of this notion of the self and to help you begin to think about its relevance to education, you may probably find it most useful to make this a real letter that you actually send, discuss, and implement. (Eventually, you might consider trying to transform the letter into an essay that you publish.)

Assignment 2: Help your students build "skilled intuition."

1. Read "Building smart students: A neuroscience perspective on the role of emotion and skilled intuition in learning," Immordino-Yang and Faeth (See Resources: http://www.learner.org/courses/neuroscience/resources/resources.html).
2. Modify your lesson plans for a particular unit to explore how you might help your students build "skilled intuition," or create a series of new lesson plans to achieve this goal.
3. Keep a log or journal of what you try and of the outcomes that most please you. If a particular lesson didn't work as you hoped, write about it: speculate on the reasons and see if you can redesign the idea. (This assignment will require a minimum of two hours to do the reading and planning. It will require unspecified additional hours to implement and document it in the classroom.)

Assignment 3: Imagine new school designs.

You'll notice that the essay "Building smart students" suggests some good strategies that have become fairly common—connecting material to student interests, solving open-ended problems, and creating a safe emotional environment. Try to think beyond these, and imagine fundamentally different school designs that might result from a different conception of how learning occurs (the ideas in this course). Let your

imagination roam to ideas about a new school system that supports new approaches to teaching. In other words, instead of limiting your thinking to what teachers can do in an imperfect system to motivate students, imagine the ingredients of a new system—one that nurtures student interest and curiosity and transforms it into deep motivation. If you find some ideas you like, identify some changes that would need to occur in order to convert your vision to reality. (Reminder: Don't let yourself become bogged down in what "will never work at my school.")

Write your thoughts and ideas in your journal.

Assignment 4: Analyze a case study.

Case study: A pre–K teacher struggled with a student whose problem was lack of motivation for an activity he didn't like. It was a constant fight to keep him on task. His academic skills blossomed, yet his desire to complete the given assignment did not increase. At first, the teacher thought it was a lack of confidence. Maybe the student recognized that his fine motor skill was not where he wanted it to be, so perhaps he felt his work was substandard and allowed his focus to wander. The teacher tried everything. She worked one-on-one with the boy, used encouraging words to build confidence, discussed responsibility, and so on. She involved the boy's parents, as well—discussions about giving more responsibility at home—but nothing seemed to work. If he didn't want to do something, there wasn't anything the adults could say or do to effect improvement. It was evident that if he was excited by the activity, he did it with pleasure; but if any part of that activity did not interest him, his focus was derailed.

Look at this problem through the lens of the ideas in this unit, including the idea of aligning emotional goals. What solutions might you try? Write your thoughts and ideas in your journal.

Assignment 5: Analyze the last paragraph of Unit 3, Section 6:

"Schools constantly claim that producing good citizens is their mission, yet so many of the motivators remain external—grades, college-readiness, pleasing parents, and the ubiquitous fear factor. And conditions in the classroom tend not to foster meaningful reflection. Perhaps our ends and our means are not aligned. What do we mean by "good citizens"? Is neuroscience offering insight that might be useful to achieving this goal? Could it be giving us a glimpse into the survival and self-related processes underlying social behavior and creativity?"

How might you answer the questions posed above—both in terms of the desire to develop moral citizens and in terms of developing creativity? Keep in mind Dr. Immordino-Yang's research into social emotions like admiration and compassion, and her discovery of the sort of inner-directed attention that preceded her volunteers' feeling that they should take some sort of action in their own lives. Recall John's description of his reaction in the study (Unit 3, Section 5).

Assignment 6: Revisit the teaching and learning problem you wrote about prior to the start of the course and analyze it from the perspective of what you have learned in the first three units about the role of emotion in learning.

Write down the answers to the following questions:

1. What new insight into the problem have you developed?
2. Can you imagine some specific solutions to try?

Suggested readings between Unit 3 and Unit 4:

Possible review:

Immordino-Yang, M.H. "The Smoke Around Mirror Neurons: Goals as Sociocultural and Emotional Organizers of Perception and Action in Learning." *Mind, Brain, and Education* Vol. 2, Issue 2 (June, 2008): 67–73.

Immordino-Yang, M.H., and L. Sylvan. "Admiration For Virtue, Neuroscientific perspectives on a motivating emotion." *Contemporary Educational Psychology* (2010).

Possible preview:

Immordino-Yang, M.H. "A Tale of Two Cases: Lessons for Education from the Study of Two Boys Living with Half Their Brains." *Mind, Brain, and Education* Vol. 1, Issue 2 (June, 2007): 66–83.

Immordino-Yang, M.H., and K.W. Fischer. "Neuroscience bases of learning." In V. G. Aukrust (Ed.), *International Encyclopedia of Education*, 3rd Edition, Section on Learning and Cognition. Oxford, England: Elsevier, 2009.

Unit 4
Different Learners, Different Minds

Major principles

- Our perception of problems and our approaches to solving them are influenced by our profiles of neurological, emotional, and cognitive strengths and weaknesses and by our experiences.
- People differ in their abilities for attention and working memory, and teachers can help all students learn.
- Because "normal" depends on context, it makes more sense for teachers to analyze the match between learner and context than to expect everyone to learn in some standardized fashion.
- Bringing school learning ("school science," for example) and actual practice ("real-world science") closer together might improve education.

In "A Tale of Two Cases," while discussing the remarkable success of Nico and Brooke, Immordino-Yang writes that "their families and teachers may have played a major role in their recoveries, through allowing these boys the freedom to actively engage in their own learning, without restricting them to preconceived notions about how they would function or recover after surgery." Faced with a completely new challenge, these teachers had to abandon their customary curriculum and approaches and take their lead from the boys. The teachers had to find out what the boys could and couldn't do under what circumstances (discover their strengths and weaknesses in specific contexts) and build lessons that facilitated learning. Unit 4 emphasizes the importance of truly meeting students where they are. As you work on the assignments, keep this goal and the major principles in mind.

The first two assignments for this unit are experiments for you to conduct in your classes. You are to study the results, draw conclusions about what the results suggest about specific students in your class and about your teaching, and discuss these conclusions with your colleagues. (It is not possible to provide an expectation for how much time these experiments might take. Keep track of the time in a log or journal.)

Assignment 1: Try new approaches to reduce stress and demands on attention in one or more of your classes.

The unit suggests many possible interventions for reducing the stress and demands on attention, interventions that are likely to help not only those who may have neurological difficulties, but all students as well. Try some of these approaches in one or more of your classes for at least a month, and invent others that seem particularly appropriate to your students (even individual students) and circumstances. Examples might include:

- If you tend to use pop quizzes, replace these with announced quizzes.
- Replace timed tasks with untimed tasks.
- Consider allowing students to work in pairs on some assessments and activities, rather than working alone.
- If you have some students who never seem to complete all the homework, reduce the amount for them—being mindful to keep only the most critical and engaging tasks, the tasks that support what you really need the students to understand.
- If memorization has been your primary focus, replace it with open-book or real-world exercises that ask students to apply the knowledge they usually memorize.

Assignment 2: Have your students identify the circumstances under which they focus as best as they possibly can.

1. Ask your students to think about and then to tell you the circumstances under which they seem to learn best and to demonstrate their best learning—when they feel they can really focus. It's important that they understand that their ability to focus is the central issue in this experiment. Have them consider every factor they can imagine—the environment, sitting or lying down or pacing, the presence of music or quiet, isolation or the presence of others, talking or typing or writing, and so on. The circumstances may differ for different tasks. And the ability to focus will vary from student to student: You are simply encouraging them to identify the circumstances under which they focus as best as they possibly can. (Be mindful that emotional relevance is likely to be a factor.)
2. Then, within the constraints you face (and explain these to your students), let your students work as much as possible under these circumstances. Let them study and demonstrate their understanding in contexts that are most conducive to their doing their best work with real focus. Finding ways to accomplish this goal will likely require you to think outside the boxes of classroom and daily schedule. Be creative.

Assignment 3: Write about and discuss ways to increase students' success in school.

Recall the distinction between "school science" and science as it is done in practice,

and recall the examples of successful people who had various learning difficulties.Try to imagine the specific practices and policies that you might change in your classroom or in the school as a whole to increase the likelihood that more students will succeed in school instead of having to wait until after they graduate. In other words, how might school work become more like world work?

Assignment 4: Analyze a case study.

Case study: *"I teach self-contained special education in a large city school to a group of students (grades 1 to 5) with developmental problems learning disabilities, and emotional disorders. One academic problem perplexes me as well as the speech language pathologist with whom I work. For the great majority of my students, whether or not they have language disorders, if you ask them to give the definition of a word, they give an example. I might ask Olivia what 'foot' means while teaching multiple meaning words, and, instead of answering that it's a unit of measurement or a part of the body, she'll say, 'I have a foot.' I've worked with them several times on how defining and giving examples are separate; but the next week when we read a text and I ask what a word means to check their understanding, I get examples again or examples for similar sounding words. I don't know how to better explain that I want an abstraction, not a concrete example—and the difficulty is compounded by the enormous difficulties some of my students have with all abstract concepts."*

Based on what you have studied in this unit, write down the answer to the following question: How might you help this teacher?

Assignment 5: Analyze a case study.

Case study: *"As the assistant head of an elementary school, I am constantly faced with the challenge of helping teachers understand the importance of thinking of alternative methods of teaching and of assessing and modifying expectations for children who have mild-to-moderate learning disabilities. It is sometimes difficult for teachers, especially of upper grades (4–6), to realize that modifying expectations does not mean they are lowering their standards. They are excellent teachers who have very high expectations of themselves and their students. It is difficult for them to accept when their students, regardless of whether they have a disability, slip in their expected performance. Their frustration with these students comes through when they write reports at the end of the year. I have had numerous conversations with them. They agree at that moment that they need to change their perceptions of these students, but they seem to find it difficult to change."*

Write down the answer to the following question: How might you advise this administrator to work with his teachers if he sought your help?

Suggested readings between Unit 4 and Unit 5:

Possible review:

Immordino-Yang, M.H. “A Tale of Two Cases: Lessons for Education from the Study of Two Boys Living with Half Their Brains.” *Mind, Brain, and Education* Vol. 1, Issue 2 (June, 2007): 66–83.

Immordino-Yang, M.H., and K.W. Fischer. “Neuroscience bases of learning.” In V. G. Aukrust (Ed.), *International Encyclopedia of Education*, 3rd Edition, Section on Learning and Cognition. Oxford, England: Elsevier, 2009.

Possible preview:

Fischer, K.W., and L.T. Rose. “Webs of Skill: How Students Learn.” *Educational Leadership* Vol. 69, No. 3 (November, 2001): 6-12.

Schwartz, M. “Cognitive Development and Learning: Analyzing the Building of skills in Classrooms.” *Mind, Brain, and Education* Vol. 3, Issue 4 (December, 2009): 198-208.

Unit 5
Building New Neural Networks

Major principles

- Teachers cannot transmit knowledge to learners.
- Learning is a dynamic process of building and rebuilding new neural networks.
- Performance depends on context.
- Students need to learn to create contexts to support their own learning.
- Skills tend not to be isolated abilities learned in a linear fashion, but rather webs of interrelated abilities.
- Learning new skills and concepts depends on coordinating more basic skills to form increasingly complex skills.
- Regression is essential to learning.

This unit can feel more like safe ground to teachers than the units on emotion and how we perceive and solve problems. Although we imagine that many of the ideas in this unit also challenge some of your bedrock beliefs about learning, teachers are often more comfortable with what seems familiar—in this case, the seemingly rational process of assimilating new knowledge and developing new skills. So it is important to remember that, though we are presenting cognition separately, emotion and cognition cannot be separated in learning or in any other typical brain function. It is, therefore, entirely appropriate to continue to discuss emotion as well as cognition as you proceed through these exercises.

In addition, this is a good time to become conscious of yourself as a learner. Teachers tend to teach as they have been taught, a tendency that can obscure the memory of how they actually learn. The first assignment is intended to remind you, so we suggest you become as fully aware as possible of yourself as a learner, and forget during this assignment that you are a teacher.

Assignment 1: Write about and discuss your experience of working to internalize, understand, remember, and use the new concepts introduced in this course.

You are working to learn many new concepts, and like any learner you are building new neural networks. Write down the answers to the following questions:

1. Do the course ideas about how we learn coincide with the process of learning that you are experiencing?
2. What specific steps have you had to take to understand these ideas and be able to put them into your own words to explain or discuss them with your colleagues?
3. What scaffolding has the course provided?
4. Have you had to create some of your own scaffolds?
5. How has the context (the conditions under which you are taking this course) affected your learning?
6. Can you articulate how you are putting the pieces of the unit (or course) together to build an increasingly complex understanding?
7. Have you been aware of periods of regression?
8. If so, what did you do during these times?
9. Have you discovered moments when you resisted or rejected new ideas?
10. If so, what happened in those moments?

In answering these questions, try to be as specific as possible by illustrating your responses using actual moments you recall. (The reflective, introspective nature of this assignment might require more than an hour's work. Keep track of the time it takes you to complete in your journal.)

Assignment 2: Explore the interplay between your experiences as a learner and as a teacher.

1. Does your teaching reflect what you now understand about learning?
2. Are your expectations for how your students learn aligned with what you know about how you learn?
3. Are there areas where your experience of learning conflicts with the research about learning as presented in this unit?
4. How will you resolve those conflicts?
5. Have you found students who don't learn the way you learn? How will you teach these students?
6. Have you discovered things you need to change in your teaching? What are they?
7. Why do they need changing?
8. How will you change them?

Try to look at these issues as specifically as you can by drawing on actual

experiences (in your learning process and from your classroom) to illustrate your thoughts. (Again, the nature of this assignment may require more than an hour of work. Keep track of the time it takes you to complete.)

Assignment 3: Think about how you might change your approach to teaching based on the ideas from this unit and create a lesson that embodies these changes.

1. Write down the changes you might make to your approach to teaching based from the ideas in this unit. Be very specific.
2. Create a lesson or series of lessons that embody these changes.
3. When you are able to implement your plan in the classroom, keep a journal of how it works and of your observations. Ideally, try to assess the students' skill or knowledge level both before and after the lesson(s).

(This assignment will require more than an hour. At a minimum, you will need an hour to think about the changes you might make to your teaching and another hour to create a plan. Keep track of the time you devote to writing about the actual implementation.)

Assignment 4: Analyze a lesson by breaking down into its component parts the concept or skill the lesson teaches.

Recall the example of the baby who was learning to fill a cylinder with blocks (See Unit 5, Section 6 video, "Johanna and Mother"). This process of building more complex new skills or of developing a greater understanding is the basic model for how we learn. Recall, too, that Judy and Bob were assigned the more complex task of writing an essay on the significance of Andrew Jackson's policies, but the process of developing the skills to write such an essay is the same as it was for baby Johanna.

Just as Johanna learned more basic skills on her way to mastering the simple skill of filling a cylinder, over their years in school, Judy and Bob constructed skills that they would need to coordinate in order to accomplish the more complex task of writing an essay on Andrew Jackson. They constructed the skills of reading documents, summarizing them, and developing a point of view about them. They learned to write essays about abstract ideas, use evidence, and organize an argument. They developed an understanding of cause and effect and how the past influences the future. At least, they ought to have done these things before tackling the assignment on Andrew Jackson. If, for example, they still struggle to read documents relevant to the task because their vocabulary is inadequate, the base on which they are constructing their new conceptual understanding of Jackson's policies (never mind their significance) will be weak, and the teacher will need to address this weakness.

Select a specific lesson or assignment that you have planned for one of your classes. Break down into its component parts the concept or skill that the lesson teaches—the smaller skills and bits of knowledge on which rests the more complex

skill or understanding, the intended outcome of the lesson. Also look at the connections among these components that must be made for the successful completion of the lesson. Write down the answers to the following questions:

1. Are the students ready for this lesson?
2. If not, what needs to be done before they should attempt it?
3. What parts might you still need to scaffold?

Assignment 5: Give the above assignment to your students. Those who did it well were probably ready.

Write down the answers to the following questions:

1. Can you analyze the work of one student who did poorly to determine what components or connections embedded in the more complex skill might be missing from that student's knowledge base?
2. Does this analysis provide insight into what this student might need to do in order to improve the base on which the assignment rests?
3. Might emotional factors be interfering with the successful completion of the assignment?
4. What might you do to help this student?

Assignment 6: Write about and discuss your approach to grading.

Although some schools have replaced grades with narrative assessments, most have not. So, teachers will likely continue to operate in a grade-based system. Write down the answer to the following question: What changes might you make in your approach to grading to take into account regression as a constructive and necessary part of learning?

Suggested readings between Unit 5 and Unit 6:

Possible review:

Fischer, K.W., and L.T. Rose. "Webs of Skill: How Students Learn." *Educational Leadership* Vol. 69, No. 3 (November, 2001): 6-12.

Schwartz, M. "Cognitive Development and Learning: Analyzing the Building of skills in Classrooms." *Mind, Brain, and Education* Vol. 3, Issue 4 (December, 2009): 198-208.

Possible preview:

Blodget, A. "Motivation: Making Room for the Self in School." *Independent School*, National Association of Independent Schools, Spring 2009 (online feature).

Unit 6
Implications for Schools

Major principles

- We think in the service of emotional goals.
- Performance depends on context.
- Regression is essential to learning.

Assignment 1: Complete Nick's exercise outlined below.

Nick's exercise: Nick led the curriculum committee (the department chairs and other academic leaders) through an exercise. "Forget you are teachers," he said, "and remember yourselves as learners. Think back to the time you did your best learning, whether in or outside of school. And write down the conditions that you believe were most responsible for your success as a learner." As people read their list, he wrote on the board the conditions that appeared more than once. Next, he had them look at the assumptions about learning that seem embedded in the practices and policies of their school.

The purpose of the exercise is to discover how close or far apart are the conditions under which you did your best learning and the conditions under which your students learn best in your school. Discuss these with a colleague and think about what you might do to align these two lists, if that is what is needed.

Assignment 2: Create new classroom practices.

Focus on a specific group of principles that you feel are related, and look at their implications for your classroom (your teaching) or for the school as a whole (the system of practices and policies that support your teaching). Transform the implications into specific classroom practices or changes in the school.

Look at the exercise below from Section 7 of Unit 6:

Make sense of the concepts about learning. Articulate the principles that resonate with your experiences not only as a teacher, but also as a learner. Look specifically at issues in areas that are important to you—those in your classroom and those systemic assumptions about learning that restrict what you want to do in your classroom. For example, take a belief you have developed about learning, and use it as a lens through which to look at one of these areas:

CLASSROOM:	SCHOOL:
Homework	Graduation requirements
Teaching methods	Schedule
Lesson plans	Student course loads
Memory issues	Departmental organization of schools
Tests and quizzes	Standardized testing
Expectations and rigor	Meeting “the standards”
Grades	Grades
Coverage	Coverage
AP courses	AP courses
Difficult students	Discipline

Write down the answers to the following questions:

1. How does the connection between performance and context affect the way you might approach homework assignments?
2. How might it affect your school’s policies about homework and what your parent body needs to know about homework?
3. Invent something. Try something new. Take a step, however small in a new direction.

Assignment 3: Write a letter to help your colleague solve their teaching or learning problem.

Partner with a colleague, and exchange the teaching problems you wrote prior to reading the text of the course. Imagine that your colleague has come to you with this problem for help.

Write a letter of **no more than 1,000 words** in which you help your colleague solve the problem:

1. Start by analyzing and pointing out the nature of the problem, in order to answer the question, “What is this problem really about?” To do this, choose one or more concepts from the course that you think relate to the teacher’s problem, and use them to explain the underlying cause of the problem to your colleague. Examples of concepts might include:
   - consideration of the learning context
   - the students’ background knowledge
   - individual differences in approach or perception of the problem

- complexity or content of the material to be learned
- the students' emotional response to the material
- the design or presentation of the learning experience or materials

2. Decide whether the problem is primarily social, affective, or cognitive, or some combination of these factors.
3. Next, explain in your own words a little bit about the concepts that you have chosen, and show your colleague how applying these concepts to the problem leads to a new way of understanding it and to a new insight about what to do. In this section, argue for your perspective; try to prove to your colleague how your view is substantiated by evidence. (To do this, draw on evidence from the course materials.) Be sure that you explain how the evidence that you give relates to the concepts you invoked in the first part of the letter, as well as how it relates to the aspect of the problem that you are focusing on. (In this section of the letter, you aim to answer your colleague's question, "Why should I believe you?")
4. Finally, propose a plan of action that answers the question, "Now that I understand the problem, what should I do to fix it?" Here, describe one or a few instructional tools or methods that best address the problem. Explain how these tools relate to the concepts you used earlier and how they will serve to ameliorate the problem. (Be specific. Your colleague is in trouble and needs practical strategies with clear explanations as to why they may help.)

Note: This assignment should take a minimum of two hours.

Suggested readings between Unit 6 and the Conclusion:

Possible review:

Blodget, A. "Motivation: Making Room for the Self in School." *Independent School*, National Association of Independent Schools, Spring 2009 (online feature).

Blodget, A. "When School Makes Us Sick." *Independent School*, National Association of Independent Schools, Spring 2010.

Keene, E. O. "New Horizons in Comprehension." *Educational Leadership* Vol. 67, No. 6 (2010): 69-73.

Stein, Z.; T.L. Dawson, and K.W. Fischer. "Redesigning Testing: Operationalizing the New Science of Learning." *The New Science of Learning: Computers, Cognition, and Collaboration in Education*, Springer Press, 2010.

Possible preview:

Fischer, K. "Mind, Brain, and Education: Building a Scientific Groundwork for Learning and Teaching." *Mind, Brain, and Education* Vol. 3, Issue 1 (2009): 3–16.

Conclusion
A Community of Educators

The conclusion asks you to think about yourself in a larger community of professionals—teachers, researchers, school administrators, and teacher trainers. Everyone brings something to this partnership to improve the learning experiences for our children. Researchers bring insight into brain function; educators bring knowledge of students functioning in actual classrooms. Creating working relationships within this community is the key to improving our schools.

Assignment 1: Write about and discuss what the impact of this course has had on your ideas about learning.

Recall Martha in Unit 6. Her reading about regression reinforced her almost forgotten animosity to grades and motivated her to change her approach to grading students. Write down the answers to the following questions:

1. Did any of the concepts in this course reinforce ideas you had already developed based on your experience in the classroom?
2. Look at these specifically by identifying the research idea and talking about the actual experiences that led you to the same conclusion about learning.
3. How has the scientific corroboration of your own discoveries about learning affected you?

Assignment 2: Identify areas of research.

Write down the answer to the following question: As a result of your work and thinking during this course, what questions emerge as important for researchers to explore?

Assignment 3: Identify obstacles to change.

Write down the answers to the following questions:

1. What are some of the obstacles to making the sorts of changes to schools that you would like to make?
2. How might you work with other professionals in order to deal with these?

Final assignments

This is an opportunity for you to bring together the strands of this course by applying the ideas to the problem you identified as you began the course, and by reflecting about yourself—what you have learned and your openness to learning.

Assignment 1: Develop a presentation of a solution to your problem. For possible help, read "Depth of Field/Depth of Understanding: Finding the Emotional Connection," by Eric Baylin (see Resources: http://www.learner.org/courses/neuroscience/resources/resources.html). Ideally, this will be a formal presentation to your group.

Present the problem you described as you started the course:

1. Briefly state the problem.
2. Explain your original understanding or analysis of the problem (the lens provided by your conceptual framework or beliefs about learning). Connect the original specific belief about learning or teaching with your original understanding or analysis of the problem.
3. Explain your new insight into or understanding of the problem (in relation to ideas from the course, changes to your beliefs, and your new lens). Specifically connect the course ideas with your new analysis, making the relationship between them clear. How do you understand the nature of the problem differently now?
4. Present some specific strategies you might now try in order to resolve the problem; connect these to specific ideas from the course.

Assignment 2: Explore changes in your understanding about learning.

Revisit your original statement about the connection between emotion and learning. If you found that you had to change (or are in the process of changing) some of your initial concepts about teaching and learning, examine the process of conceptual change.

Perhaps revisit the essay "Fostering Conceptual Change About Child Development in Prospective Teachers and Other College Students."

Write down the answers to the following questions:

1. How resistant or open to new ideas were you?
2. Has your experience as a learner given you any new insights into your students, insights that will affect your teaching? Be specific.

Final note: For those who want to think about the classroom and school implications of the research, here are some additional articles (see Resources: http://www.learner.org/courses/neuroscience/resources/resources.html):

Ablin, J. “Learning as Problem Design Versus Problem Solving: Making the Connection Between Cognitive Neuroscience Research and Educational Practice.” *Mind, Brain, and Education* Vol. 2, Issue 2 (May, 2008): 52-54.

Baylin, E. “Depth of Field/Depth of Understanding: Finding the Emotional Connection.” *Schools: Studies in Education* Vol. 7, No. 1 (2010).

Blodget, A. “A More Perfect Union: Marrying Standardized and Formative Testing,” *ASCDExpress*, vol 5, 503.

Blodget, A. “Motivation: Making Room for the Self in School.” Independent School, National Association of Independent Schools, Spring 2009 (online feature).

Blodget, A. “When School Makes Us Sick.” *Independent School*, National Association of Independent Schools, Spring 2010.

Collins, K. “Beauty in the Beast: Falling 4 Math.” *ASCD Express*.

Dweck, C.S. “Brainology: Transforming Students’ Motivation to Learn.” *Independent School*, National Association of Independent Schools, Winter 2008.

Keene, E.O. “New Horizons in Comprehension.” *Educational Leadership* Vol. 67, No. 6 (2010): 69-73.

Moore, L.R. “On the Same Page: How to Teach Students to Love Reading—and Why It Matters.” *Independent School*, Winter 2008.

Volkman, J. “Inspiration, action and peace,” *Public School Montessorian*, Winter 2011, Issue 90.