NEUROSCIENCE AND SOCIETY
Curriculum for High School Teachers

Unit 5: Education, Development, & the Brain

Center for Neuroscience & Society, University of Pennsylvania

The Franklin Institute
Acknowledgments

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From sensing to moving to thinking to feeling, neuroscience explains how we perceive and interact with the world around us. This field provides a rich opportunity for high school students to explore fundamental science, framed within the context of everyday decisions and new challenges they will face as they enter adulthood.

Information about the intersection between neuroscience and society abounds online and in the media, yet many sources are unreliable. Meanwhile, there are few textbooks on neuroscience and its societal applications that are designed intentionally for high school students. This curriculum, therefore, is a curated collection of resources—reviewed by experts and tested by teachers—to help you bring this fascinating content into your classroom.

The curriculum is intentionally modular to provide flexibility. Each unit can stand alone, ready to be incorporated into an existing biology, psychology, or other course. Alternatively, multiple units can be linked together to create a semester-long elective course.

You can adapt the content to meet the readiness and capabilities of your class as needed. You can select certain topics and activities to match your students’ interest and skip others depending on time constraints.

The goal of the curriculum is to inspire excitement about and increase knowledge of neuroscience. The suggested activities include a variety of instructional approaches, and we encourage you to ask open-ended questions and guide conversations so students are interacting instead of being passive listeners. Students often find personal relevance in these topics, so feel free to extend activities and discussions.

If you feel you have reached the limit of your knowledge about a particular subject, don’t worry! Even scientists may not know the answer. Neuroscience is still a developing field and you can create opportunities for you and your students to think critically and learn together. Use the provided links and documents as a gateway to finding additional sources and evaluating their quality.

Your feedback is also welcomed, of course. Please contact the program administrator at neuroscience@fi.edu with comments and suggestions. Thank you for all your hard work!
Alignment with Next Generation Science Standards
The “Neuroscience and Society” curriculum supports Next Generation Science Standards in the following areas.

High School – Life Science

**HS-LS1 From Molecules to Organisms: Structures and Processes**

Disciplinary Core Ideas
- LS1.A: Structure and Function
- LS1.B: Growth and Development of Organisms

Science & Engineering Practices
- Developing and Using Models

Crosscutting Concepts
- Structure and Function
- Stability and Change

**HS-LS3 Heredity: Inheritance and Variation of Traits**

Disciplinary Core Ideas
- LS3.A: Inheritance of Traits
- LS3.B: Variation of Traits

Science & Engineering Practices
- Asking Questions and Defining Problems
- Analyzing and Interpreting Data
- Engaging in Argument from Evidence

Crosscutting Concepts
- Cause and Effect
- Systems and System Models
- Science is a Human Endeavor
There are a whole multitude of factors that go into healthy brain development and learning. The needs of our bodies and brain during childhood and adolescence are different than those of adults because we as humans must learn and adapt to whatever environment we are born into—for example, we must be able to quickly pick up whatever language the people around us speak! Even though the brain changes throughout the course of our lives, these unique needs in our early years mean that certain factors (such as sleep) are particularly important!

This section will look at a range of issues related to learning and development, including sleep, memory, and sensitive periods. [Note that the Well-Being Unit contains additional topics about factors that contribute to learning and memory (exercise, meditation, etc.).]

**LEARNING OBJECTIVES:**
Students will be able to ...

- Explain the basics of genetics and how genetics relates to the nature/nurture debate.
- Describe how learning a second language is influenced by developmental sensitive periods.
- Give examples of different types of memory and identify associated brain regions.
- List some of the positive benefits of sleep and how adolescents differ in their sleep needs as compared to adults.
- Identify some of the symptoms of ADHD and dyslexia, and describe the basics of what we know about brain correlates and treatment.

**TABLE OF CONTENTS:**
A. [Terms and Definitions](#)
B. Topics:
   1. [Genetics and the Brain](#)
   2. [Sensitive Periods & Plasticity](#)
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   4. [Learning Disorders](#)
   5. [Sleep](#)
C. [Annotated Articles by Topic (for further reading)](#)
**TERMS AND DEFINITIONS**

(Genetics-related terms are also found in the mental illness unit)

**Trait** – A characteristic feature of a person. There are physical traits (e.g. eye or hair color) and behavioral traits (e.g. impulsivity). Another kind of trait is a predisposition to a medical condition (e.g. risk for heart disease).

**DNA** – The material found in the cell nucleus which holds instructions for making proteins in our body. This “blueprint” for our body is the source of heredity because some of this information from each parent is passed on to the child.

**Genes** – A section of DNA that acts like a “recipe”: specific instructions to make proteins. It is thought that humans have around 20,000 – 25,000 genes.

**Chromosomes** – DNA is compactly stored in thread-like structures called chromosomes. Each human has 23 pairs of chromosomes in each cell.

**Critical/Sensitive Periods** – Periods of development where certain cognitive and physical characteristics are most quickly acquired, or when the brain is most adaptable to certain changes.

**Neural Plasticity** – The ability of the brain to change its neural pathways and/or synapses.

**Declarative Memory** – Declarative memories are those memories that can be consciously recalled and stated, such as facts, directions, or lists.

**Non-Declarative Memory** – Non-declarative memories describe a range of memory types such as skills (e.g. riding a bike) and classical conditioning (e.g. salivating in response to a bell-ring).

**Episodic Memory** – Memories about specific events in the past (e.g. my 10th birthday party). This is a type of declarative memory.

**Semantic Memory** – Facts that are “abstracted” from any specific experience, such as names of animals, country flags, etc. This is a type of declarative memory.

**Circadian Rhythms** – Physiological, behavioral, or cognitive changes that are aligned to a roughly 24-hour cycle. These fluctuations are primarily driven by an “internal clock” that is in turn affected by environmental cues.

**REM Sleep** – Rapid Eye-Movement (REM) sleep is the phase in which we dream. It is the last phase of the sleep cycle, and while our eyes move and heart rate increases, our muscles are paralyzed.
Is our brain hard-wired in certain ways from birth? What about the brain can change over time, and what seems to be fixed?

**Key Points:**
- Genes are essentially the “blueprints” within our body that influence which traits are expressed and how cells function.
- Genes and environment interact to influence how the brain develops: both “nature” and “nurture” matter.

**Resources and Discussion Questions:**

Genetics (also see genetics section in the Mental Illness Unit)

The Learn.Genetics website from the University of Utah has a lot of great resources for teaching basic genetics:
- This is an introduction to traits that discusses the relationship between genes and environment on physical/behavioral traits, trait inheritance, and complex traits.
- This website gives a description of what it means to talk about genetic “risk” factors.

This lesson plan from Baylor College of Medicine explains genetics and heredity by having students look at the differences between X and Y chromosomes and how they relate to sex determination.

An overview from the Dana Foundation of genetics and the brain, and how researchers are attempting to study the relationship between genetics, other biological processes, and environment.

**Classroom Activities:**

**Activity #1 - Discussion of Heredity**
Ask students if they have ever heard of “nature vs. nurture.” Have students name some traits that they think are more influenced by “nature” or genes (e.g. eye color), traits that are more influenced by “nurture,” or experiences in the world (e.g. what language you speak), and traits that seem to be influenced by both (e.g. height or weight). Alternatively, have a pre-made list of traits and ask students to discuss or vote on/discuss which traits they think are genetic, which are environmental, and which are both. See a list of some common traits here at the Learn.Genetics page mentioned above, and be aware of these common myths about human traits.

**Activity #2 - An Inventory of My Traits**
Students take an inventory of their own easily-observable genetic traits and compare those inventories with other students in the groups. See this and other PDFs with activities on inherited traits at the Learn.Genetics page.
Is brain plasticity constant over the course of our lives? No—the brain is more receptive to changing and learning from the environment early in life, particularly for certain kinds of skills. Two skills we’ll discuss in detail below are vision and language.

These periods when we are most predisposed to learn from environmental input are called “sensitive periods” (or, equivalently, “critical periods”). Sensitive periods have been studied in most detail in animals, because scientists can have complete control over the animals’ environments. This gives them the possibility of varying when the brain is exposed to different kinds of inputs, to find out when it is most plastic. This would be unethical to do on purpose to humans. But there is also fascinating evidence from humans who, by accident or misfortune, were deprived of certain input at certain times of life and show that humans, too, have sensitive periods.

**Key Points:**
- The human visual system develops quickly over the first few years of life, and disruption to vision during this time may be later irreversible.
- There are many critical periods in language perception and speech. This critical period relates both to the first language we learn as well as our ability to learn a second language.
- Critical periods are thought to relate to increased periods of brain plasticity.
- While brain plasticity is related to critical periods, plasticity in increasingly shown to be important for learning even into adulthood.

**Resources and Discussion Questions:**
This [short video](#) discusses idea of critical periods and sensitive periods for development.

**Critical Periods in Vision**
- This [interactive site](#) demonstrates how different regions of the brain process different types of information along the visual pathway.
- The American Optometric Association has a [website](#) with brief descriptions related to the basic development milestones in vision.
- BrainFacts.org gives a [good overview](#) of the research conducted on vision critical periods.

**Critical Periods in Language**
- In the Japanese language, there is no difference between “r” and “l”, which is why they often confused English words such as “rice” and “lice.” While all babies are born with the ability to distinguish all phonemes, over time, children no longer hear distinctions between phonemes when that distinction is not important to their own language. This is one reason why it is hard to hear and speak a language well when we learn it as an adult. Here is an older [video](#) showing this phenomenon.
- There are arguments over whether the learning of a first language itself must take place during a critical period. See Activity #1 below for videos that discuss a case about this question.

**Plasticity**
- Brain plasticity is defined as the ability for the brain to change its physical structure (not just pattern of firing), often in response to something in the environment.
Neuroscience for Kids has a good overview of plasticity.

An article from Nature on the relationship between brain plasticity and critical periods, and how new research may be changing the way we think about (and can manipulate) plasticity in the brain.

A famous study on London taxi drivers showed that the size of a taxi driver’s hippocampus is related to how long they have been driving the streets of London (see video here).

Learn about how environment and social factors, such as stress and poverty, can impact brain development in this Dana Foundation article.

Adolescence is a time of big changes and plasticity in the brain. This article by the Dana Foundation reviews the science of the teenage brain.

This video discusses brain development with an emphasis on adolescence, with advice for effective learning and positive decision-making.

Classroom Activities:

Activity #1 – The Case of “Genie”
Are there cases where a child was raised without language? What happens? Watch segments of the “Genie” videos below and discuss: Does Genie’s inability to fully learn English suggest that critical periods exist for language? (Note the pitfalls of drawing conclusions from single case studies—it’s possible that Genie had pre-existing disabilities that would have interfered with her ability to learn language even if she had been raised normally.) These videos contain emotional content that may be difficult for students.

- Video (55 minutes): PBS NOVA “Genie: Secret of the Wild Child”
- Video (6 minutes): “Genie: Feral Child”

Activity #2 – Second-Language Accent
Make a list of celebrities from other countries with accents and find out how old they were when they first learned English. Do you find a pattern? Are there celebrities from whom English is their second language but they speak flawlessly?

Assignment Ideas:

Assignment #1 – Design a Toy
Students work in teams to research critical periods for different skills during early childhood, and then design a developmentally appropriate educational toy for a child of a particular age. Components of the project can be adapted for in-class activities or shorter projects. This assignment is a project-based learning approach to childhood brain development; see project guide here.

Learning and Memory

Key points:

- There are many different types of memory, each dependent on a unique (though sometimes overlapping) set of brain structures.
- The hippocampus is a key brain region involved in the encoding of long-term memory.
- Over time, memories are “consolidated” (stored) in the cortex.
- There are many study techniques that make use of what we know about memory to help us better retain information.
Resources and Discussion Questions:

Memory and the Brain

Much of what we know about different kinds of memory comes from studies of patients who have had memory deficits (amnesia). The most famous case example of a person with significant long-term memory deficits is H.M.

- A surgery to reduce epileptic seizures removed much of H.M.’s bilateral hippocampi. (See a brief summary about H.M. from Psychology Today; see also this transcript of a PBS interview with Suzanne Corkin, one of the scientists who worked with him closely).
- Even though H.M. could no longer retain new declarative memories (“explicit” memory), it was discovered that he could still learn procedural skills and form other kinds of “implicit” memory. This was the first suggestion that different kinds of memory were stored in different areas of the brain.
- This video is an extremely well done reenactment of H.M.’s story and discussion of how researchers learned about memory through his deficits and retained abilities. (14 min)

Clive Wearing is another famous (and the most severe) case of a man with no long-term memory because of damage to his hippocampus during a viral infection. His case is unique in that he constantly feels like he is “waking up” for the first time. Whenever he sees his wife, he also feels like he hasn’t seen her in long time, and greets her with extreme excitement.

- A short video showing Clive interacting with his wife. (3 min)
- Another older video with a more detailed story of Clive’s illness and subsequent life. (13 min)

An article in Scientific American summarizes research suggesting that, while the hippocampus is initially responsible for creating long-term memories, these memories are moved to the cortex over time, making them less dependent on the hippocampus (which is why H.M. could remember who his family was and remember his youth, even though his hippocampus had been destroyed).

Studying and Learning/Memory

The serial position effect is a very well-studied phenomenon in which people remember items in the beginning and end of a list better than items in the middle.

It is thought that the primacy effect (items at the beginning are remembered better) is due to those items having the chance to be stored in long-term memory. The recency effect is due to those last items being retained in short-term memory. One reason we think this is because people with long-term memory disorders do not show the primacy effect, but they do show the recency effect.
We have also known for a long time that we forget things quickly that we have only studied once, but that spaced repetition (rather than cramming), helps us to best retain information.

Finally, we also know that active recall (testing ourselves), rather than passively reading information, is a much better way to learn (this is called the testing effect). This is why flashcards, for example, are a much more effective means of studying than repeatedly reading over notes. Even better, repeatedly write out the answers to the flashcards instead of just saying them out loud—engage more of your brain!

**Classroom Activities:**

**Activity #1 – Primacy and Recency Effects**

One very well studied phenomenon in the memory literature is that we are better able to remember items that we heard/studied first and last in a list, whereas we have a harder time remember items in the middle. BrainU.org has some [worksheets](#) for an in-class demonstration of this effect.

**Activity #2 – Mirror Tracing Task**

One skill that H.M. could learn was how to trace a star while looking at it in a mirror. This suggested that there were certain kinds of “procedural” memory that did not rely on the hippocampus. Have students try this task for themselves. BioInteractive has an [activity guide](#), with instructions and a star sheet for tracing.

**Activity #3 – Science in the Classroom Annotated Article on Sleep & Learning**

Science in the Classroom (SitC) is a collection of annotated research papers and accompanying teaching materials designed to help students understand the structure and workings of professional scientific research. This annotated paper, “[The Original GPS: How We Remember What Happened Where](#),” examines what happens in human neurons while subjects were playing a memory video game.

- Assign small sections of the article to student groups to read and discuss during class (or in a computer lab, as the interactive article is web-based).
- Then have each group present or use a jigsaw method to teach the entire class what is in their part of the article.
- See the [Teacher Resource guide](#) that accompanies the article.

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**Learning Disorders**

**Key points:**

- Dyslexia is a language-processing disorder that leads to difficulty in reading comprehension and spelling.
- People with dyslexia show less activity and connectivity in the left side of their brain, but there is evidence that, with training, the right hemisphere can help compensate.
- ADHD is characterized by the extended lack of ability to pay attention, control behavior, and by hyperactivity.
- One brain characteristic related to ADHD is an abnormal dopamine system. Stimulants help to counteract this by normalizing dopamine functioning.
Resources and Discussion Questions:

Dyslexia
The Yale Center for Dyslexia and Creativity has a number of very good articles on dyslexia. This article is a simple explanation of dyslexia to a child who has been diagnosed. This website debunks common myths associated with dyslexia.

The Mayo Clinic has a good overview of the symptoms, causes, and risk factors for dyslexia.

This article describes a study revealing how dyslexia may relate to a difficulty in identifying individual sounds within language. This has been shown to effect reading, writing, and listening to fast speech. The article also discusses the neuroscience of dyslexia:

- The left side of the brain is underactive in children with dyslexia.
- After a training intervention, children with dyslexia showed greater language-related activity in the left side of their brain, and they also showed activity in the right side of the brain that may be helping to compensate for deficits in the left side.

The Cognitive Neuroscience Society has an editorial from a Harvard researcher that describes some myths associated with dyslexia and some of the current neuroscientific research on dyslexia.

Attention Deficit Hyperactivity Disorder (ADHD)
The NIMH has a good site describing ADHD, the symptoms, causes, and treatments.

The American Academy of Child & Adolescent Psychiatry has a brief video (~3 min) that describes some facts and symptoms of ADHD.

The CDC has a page with facts and graphics about the prevalence of ADHD in the United States.

The New York Times has an article about recent research suggesting that people with ADHD have less dopamine (reward) receptors in their brain.

- This article focuses on one interpretation of these results: it may be that less dopamine means less reward signaling, and a person perceives their environment to be more dull or boring.
- So, part of what makes people with ADHD distractible is novelty-seeking behavior to keep things “interesting.”
- One of the ways stimulant medications for ADHD work is to increase levels of dopamine in the brain. According to the novelty interpretation, this would bring a person back to “baseline” in terms of finding interest in their environment (without needing to be constantly searching for novelty).

This short article from MIT briefly describes some new neuroscience research on ADHD that shows that in adults who have recovered from ADHD, asynchrony in the brain associated with ADHD seemed to be restored.

Classroom Activities:

Activity #1 – Learning with a Learning Disability
Watch this short video (2 min), which features young students with learning disabilities talking about how their brain works and how teachers can help. (If they feel comfortable, students who have personal experience with learning disabilities can also share their perspectives.) Discuss how classroom design and the physical and social structure of the school environment can be challenging for students with learning disabilities. What resources are already available? What recommendations would students make to improve their classroom and school for learning with a learning disability?
Assignment Idea:
Assignment #1 – Advocate for Learning Disabilities
Using scientific evidence, write a letter to the principal presenting an argument for why students with dyslexia or ADHD should have more time on tests.

**SLEEP**

During sleep, the brain does not “shut down” or “rest.” Instead, this is a time when the brain gets things done. While we are still learning a lot about sleep, we do know that sleep helps to maintain a healthy immune system and that sleep is very important for learning. It also may surprise you to learn that teenagers need more sleep than adults!

**Key points:**

- There are 5 major cycles through 5 stages of sleep, which can be measured using EEG. These five cycles are divided in REM and Non-REM sleep.
- Sleep is important for learning, both because it helps us stay focused and attentive during the day (for memory “acquisition”) and because memories are actually strengthened as we sleep (memory “consolidation”).
- Circadian rhythms influence when we feel tired, and these rhythms change over the course of a lifetime.
- Adolescents generally need at least nine hours of sleep a night and have a biologically-based tendency to stay up late and sleep in late.

**Resources and Discussion Questions:**

There are a few good overviews of sleep from NIH from the National Institute of Neurological Disorders and Stroke ([here](http://www.ninds.nih.gov/img/sleep-1.gif)) and the National Center on Sleep Disorders Research ([here](http://www.ninds.nih.gov/img/sleep-1.gif)).

**Stages of Sleep**

Scientists have shown that there are 5 stages of sleep: Stage 1, 2, 3, 4, and REM sleep. These different stages of sleep are determined by measuring brain waves with electromyography (EEG), eye movements, and muscle tension. The accompanying figure shows the different patterns of brain waves during each stage of sleep. More information [here](http://www.ninds.nih.gov/img/sleep-1.gif) on p. 14-15.

Stage 1 is considered “light sleep”: it is easy to wake up, and our muscles are still able to move. Stage 2 is also somewhat light. Stages 3 and 4 are “deep sleep“: it is hard to be woken up, and our eyes and muscles are no longer moving. REM sleep is the final stage in the cycle—here, our eyes move quickly and our heart rate increases, even while our muscles become paralyzed. This is the stage most similar to wakefulness, and it during this stage that we dream. REM sleep increases over the course of the night, whereas deep sleep decreases.
Circadian Rhythms, Light, and Sleep

- This PBS/Frontline website explains how circadian rhythms affect teenagers’ sleep/wake cycles.
- This is an interesting editorial about how exposure to blue light in particular at night may decrease our ability to get good sleep.

Sleep and Learning

- PBS has an interactive website that visually illustrates sleep stages and their relationship to learning/memory.
- Harvard Medicine has a great primer on how different stages of sleep may affect the consolidation of different kinds of memory. It also discusses the effects of lack of sleep on memory.
- This website from Frontline (also linked above) discusses how sleep influences learning and memory.

Classroom Activities:

Activity #1 - Sleep and Society
Dr. David Dinges, a sleep researcher at Penn, gives a very a thought-provoking 10-minute talk on the “24/7” lifestyle (video). Watch the video, and lead a discussion in class about some of his key points and questions:

- Society has created a 24/7 lifestyle that puts our biological needs at risk.
- Should we be treating a lifestyle issue (lack of sleep) with medication (caffeine)?
- Early school start times are terrible for adolescents who need large amounts of sleep and who naturally fall asleep late and sleep late.
- Sleep deprivation has been labeled the leading cause of catastrophic outcomes by the National Transportation Safety Board (NTSB).

Activity #2 – Science in the Classroom Annotated Article on Sleep & Learning
Science in the Classroom (SitC) is a collection of annotated research papers and accompanying teaching materials designed to help students understand the structure and workings of professional scientific research. This annotated paper, “Sleep; No Longer Just for Dreaming” studied how the dendrites of mouse neurons changed during sleep after the mice had learned a task.

- Assign small sections of the article to student groups to read and discuss during class (or in a computer lab, as the interactive article is web-based).
- Then have each group present or use a jigsaw method to teach the entire class what is in their part of the article.
- See the Teacher Resource guide that accompanies the article.

Assignment Ideas:

Assignment #1 - Sleep Diary
Keep a sleep diary for 1 week. At the end of the week, have students discuss:

- average amounts of sleep
- tiredness at different points of the day
- consistency of sleep patterns
- what events made it hard to fall asleep

This file includes other worksheets created by the NIH, aspects of which may be useful in creating in class or take home assignments on this topic.
Assignment #2 – Redesign the School Day
Using scientific evidence, prepare a proposal for the school board that advocates either in favor of or against a later start to the high school schedule. Students should include how their proposed schedule accounts for the amount of sleep and times of sleep that the teenage brain most requires. Students should also consider the adjustments and tradeoffs that this change in schedule would require, e.g. shifting extracurricular activities, bus schedules, etc.

ANNOTATED RESOURCES
Note: Articles published by the Dana Foundation are written specifically for a wide readership and therefore the easiest to read among the below list.

General
The Teen Brain: Primed to Learn, Primed to Take Risks
Dana Foundation/Jay N. Giedd
This article is a solid overview of the development of the adolescent brain and how it relates to behavior.

The Science of Education: Informing Teaching and Learning through the Brain Sciences
Dana Foundation/Mariale Hardiman and Martha Bridge Denckla
This may be of some interest to teachers as they think about how and whether they should implement neuroscientific research into the way they teach or work with students.

Genetics
Epigenetics and the Human Brain: Where Nurture Meets Nature
Dana Foundation/Isabelle M. Mansuy and Safa Mohanna
This is a great overview article to better understand the meaning and significance of epigenetics.

A New Kind of Inheritance
Scientific American/Michael K. Skinner
This is another very good overview of epigenetics, focusing more on cases of “epimutations” from toxins in the environment.

Sensitive Periods and Plasticity
The Role of Stress in Brain Development: The Gestational Environment’s Long-Term Effects on the Brain
Dana Foundation/Claudia Buss and others
This is a fairly detailed article, but worth skimming for its main points.

Effects of Stress on the Developing Brain
Dana Foundation/Bruce S. McEwen
Rather than the stress of a mother affecting a fetus (covered in the previous article), this article focuses on the effects of stress experienced by children themselves.
Re-opening Windows: Manipulating Critical Periods for Brain Development
Dana Foundation/Takao K. Hensch and Parizad M. Bilimoria
A longer but good article on the definition of critical periods, the neuroscience behind them, and how we might use this knowledge for treatment purposes.

The Brain-Games Conundrum: Does Cognitive Training Really Sharpen the Mind?
Dana Foundation/Walter R. Boot and Arthur F. Kramer
This is a great overview of the research on whether “brain training” really works – and what “works” actually means in the first place.

The Neurobiology of Brain Injury
Dana Foundation/Marcela Pekna and Milos Pekny
This article has an interesting paragraph on the difference between neural “repair” and neural “plasticity.”

Working Later in Life May Facilitate Neural Health
Dana Foundation/Denise C. Park
This shorter article touches on plasticity during late stages of life.

How Music Helps to Heal the Injured Brain: Therapeutic Use Crescendos Thanks to Advances in Brain Science
Dana Foundation/Michael Thaut and Gerald McIntosh
A very good article about the history and role of music therapy for neurological disorders or injuries.

Effects of Internet Use on the Adolescent Brain: Despite Popular Claims, Experimental Evidence Remains Scarce
Trends in Cognitive Science/Kathryn L. Mills
This is a very short and good summary article discussing whether internet use has debilitating effects on adolescent brain development.

Interventions Shown to Aid Executive Function Development in Children 4-12 years Old
Science/Adele Diamond and Kathleen Lee
A good review of multiple types of activities and the psychology of how they may boost executive function.

Learning and Memory
Remembering the Past to Imagine the Future
Dana Foundation/Karl K. Szpunar and Kathleen B. McDermott
This article gives a clear summary of research that shows the similarities in brain structures used for both remembering and imagining events.

Foundations for a New Science of Learning
Science/Andrew N. Meltzoff and others
This article is a really interesting and easy-to-understand overview of learning from a developmental and evolutionary perspective.

Retrieval of Emotional Memories
Psychology Bulletin/Tony W. Buchanan
This is a long paper, and could be used for reference rather than read through.
Memory Distortion: An Adaptive Perspective

This article is a relatively brief and interesting look at the potential reasons for memory distortion.

Sleep
*The Time of Your Life*
Dana Foundation / Paolo Sassone-Corsi

This article is a detailed look into what exactly are the biological mechanisms that drive our circadian rhythms. It gets a bit technical in the second half.

*Are We in the Dark About Sleepwalking’s Dangers?*
Dana Foundation / Shelly R. Gunn and Stewart Gunn

This article is an extremely fascinating description of sleepwalking, why it happens, the neurobiology of these events, the dangers involved, and what a potential sleepwalker can do to protect themselves and others.

*Dreaming and the Brain: From Phenomenology to Neurophysiology*
*Trends in Cognitive Science* / Yuval Nir and Giulio Tononi

This is a very readable, very interesting article on dream research – what we know and the many questions we still don’t know about the nature and content of dreams.

*Synaptic Plasticity in Sleep: Learning, Homeostasis and Disease*
*Trends in Neurosciences* / Gordon Wang and others

This is a more technical article, but certain sections may be of interest.

Learning Disorders
*Autism and Dyslexia*

*Perspectives in Psychological Science* / Uta Frith

This is a short and interesting article written by a pioneer in autism research who reflects on some current trends in the field.