Neuroscience and Society
Curriculum for High School Teachers

Unit 7: Law and Criminology

Center for Neuroscience & Society, University of Pennsylvania

The Franklin Institute
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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
“Judge, my brain made me do it,” says the defendant in court. In some sense that is true, because all behavior is caused by brain function—but should the law give anyone a pass just because of this? That’s a complicated question, which calls for an understanding of both neuroscience and law. In this unit we will explore the many ways in which neuroscience intersects with the law. Among these are: the neuroscience of ethical and law-abiding behavior; why some people have a tendency to commit criminal offenses; the different reasons we have for punishing offenders and how those reasons relate to the brain; and the ways in which neuroscience might assist in the courtroom by clarifying the limits of eye witness identification, measuring “pain and suffering,” and even detecting lies.

LEARNING OBJECTIVES:
Students will be able to ...

- Explain why humans like to punish wrong-doers and what that means for our justice system.
- Detail a number of biological and environmental factors that increase a person’s risk for criminal behavior.
- Explain the difference between correlation and causation.
- Describe ways in which the adolescent brain and behavior differs from that of an adult.
- Discuss arguments for and against why free will relates to responsibility in the courtroom.
- Describe how a polygraph works, its reliability, and how this technology is similar and different from fMRI lie detection.
- List alternative explanations for why some companies claim fMRI is a reliable lie detection device.
- Discuss how brain damage or the developing brain might impact guilt or responsibility for crimes in the courtroom.

TABLE OF CONTENTS:
A. Terms and Definitions
B. Topics:
   1. Punishment
   2. Lie Detection
   3. Biological Predictors of Crime
   4. Guilt and Responsibility
C. Annotated Resources by Topic (for further reading)
**Polygraph** – A machine used for lie detection, which measures three different signs of autonomic arousal: blood pressure, heart rate, and respiration rate. Because most people are nervous when lying, their autonomic “fight or flight” response is activated and these three measures increase.

**Environmental Toxins** – Chemicals or other factors that harm or adversely impact the development of the child (in the womb or throughout childhood) as well as adults. Can be found in the air or water and can include lead (in paint, automobile exhaust) chemical pesticides, chemicals found in cigarette smoke, etc.

**Psychopathy** – A set of behaviors and traits associated with crime and anti-social behavior, including being self-centered, charming, and manipulative but also lacking guilt and empathy for others.

**Antisocial** – Behavior that disregards the well-being of others, including directly harming others and doing so indirectly by breaking laws. This term comes from being “anti” society and the people in it, and does not mean someone dislikes socializing.

**External Validity** – Whether the results of an experiment can be applied beyond (or “external” to) that experiment. For example, an experiment on methods to boost learning in one high school probably has good external validity for high school students more generally, but its external validity for kindergarten students is more questionable.

**Internal Validity** – Whether the reasoning that links the experimental design, the data and the conclusions (all “internal” to the experiment) are valid or not. For example, consider an experimental program to decrease criminal behavior that uses *self-reported* criminal behavior as its data. If its conclusions claim to pertain to actual criminal behavior, then it has a problem of internal validity—just because people say they are committing fewer crimes, doesn’t mean they are.

**Fear Conditioning** – A kind of simple learning that all creatures, including humans, automatically do. When a cue stimulus, such as a tone, is always followed by a fear stimulus, such as an electric shock, we eventually learn to feel afraid of the cue stimulus.

**Mentalizing** – Process of attributing mental states to others, often automatic for most people. For example, we know how someone is feeling if we see them cry (sad) or what someone is trying to do if we see them repeatedly wiggling a key in a locked door (trying to open it).
Before beginning this unit, introduce some potential pros and cons about how neuroscience can be used in the courtroom. BrainFacts.org has a good overview.

THE HOWS AND WHYS OF PUNISHMENT

Why do we punish?
Punishment for bad behavior is ubiquitous, from a parent telling her teenager “you're grounded!” to a parking officer ticketing an illegally parked car. In the criminal justice system, punishments can be much more severe, as in a prison term or even the death penalty.

Scientists believe that humans evolved to want to punish wrong-doing. The instinct to punish helped our ancestors discourage members of their communities from harming others or stealing from them. By discouraging such antisocial behavior by punishing it, people made their communities safer, were more likely to survive, and bore children to pass on their genes, including those “punishment instinct” genes. In the language of natural selection theories of evolution, people today want to see harmful behavior punished because, thousands of generations ago, those who happened to feel that way were more likely to survive and reproduce. (This will make sense and be good preparation for the unit if students are familiar with the idea of natural selection/heredity. If they are not, it is still worth mentioning that we evolved to punish because it kept society safer, but no need to discuss the selection mechanism.)

The minds and brains of modern humans may have been shaped by evolution to favor punishment, but punishment is more than just a reflex reaction. We generally think about whether and how punishment should be imposed, and we have reasons for punishing that may be different in different circumstances. Here are some different rationales for inflicting punishment in our society:

1. **Deterrence.** If people know they will suffer an unpleasant punishment when they break society’s rules, they are more likely to obey those rules.

2. **Retribution.** When someone has done something bad, then the rest of us may feel that person deserves to suffer in some way. Just as we feel someone who does something kind or heroic deserves our thanks and perhaps even a reward, when someone does something cruel or unfair we feel they deserve punishment (“justice is served”).

3. **Sequestration.** To sequester someone is to keep them away from others. This rationale intended is to protect citizens from dangerous people by incarcerating them and therefore keeping them from hurting others in society.

4. **Rehabilitation.** This sentence is not meant as a punishment but as a way of improving the person and making them less antisocial. Drug treatment, education, psychotherapy and job skills training are sometimes offered or even required before the wrong-doer is allowed to rejoin society in a Hopefully more productive way than before.

How do we make punishment decisions?
Judges, jurors, crime victims and everyone else brings their own perspectives to the decision of whether someone should be punished for a crime and how they should be punished. Especially where retribution is concerned, our decisions involve a combination of feelings (about how bad or cruel or harmful the criminal action was) and logical thought (about how intentional the action was, how much responsibility the criminal bears for their action, and how to weigh the badness of the crime against the harshness of the punishment). Not surprisingly then, areas of the brain involved with both emotion and cognition play
important roles when people decide on what an appropriate punishment for a wrong-doer might be.

Neuroscientists have asked people being scanned using fMRI to evaluate how much punishment a wrong-doer deserves. One important factor in the punishment decision is how harmful the criminal act was, and the process of judging this engages emotional parts of the brain.

Another important factor is how knowingly and intentionally the act was done. Someone who injures another person through carelessness seems less deserving of a harsh punishment than someone who injures another person on purpose. Neuroscientists have discovered that we use certain brain regions to make assumptions about the intentions of others, a process known as **mentalizing**, because it involves thinking about the mental processes of others. When people consider if a harmful action was intentional, they use these parts of the brain.

Finally, people must put information about harm and intentionality together to come up with a level of punishment to recommend. This integration (a type of executive function) is thought to be performed by the dorsolateral prefrontal cortex.

**Key Points:**

- Humans have evolved to want to punish wrong-doers for a variety of reasons, some related to the concept of justice, some related to preventing future harmful actions.
- When deciding upon an appropriate punishment, people consider both the “badness” of the crime as well as how intentional it was.
- Several parts of the brain involved in emotion (in the limbic system) help make these judgements in collaboration with parts of the frontal lobe.

**Classroom Activities:**

**Activity #1 – Match the Rationale**

Read these statements aloud and have students try to match each quote about punishing wrong-doers to the four rationales for punishment. Have them justify their reasons.

1 - deterrence  
2 - retribution  
3 - sequestration  
4 - rehabilitation

“By sentencing him to death, we can be sure he will never kill again.” (3)

“Our loved one lost his life because of this criminal, so he deserves even worse than his 20-year sentence—he got off easy.” (2)

“Son, this whooping hurts me more than it hurts you.” (1, 4)

“You will be an old man by the time you get out of prison, so society will be safe from you.” (3)

“In view of your good previous record, and the fact that your crimes were all committed under the influence of alcohol, I am sentencing you to intensive therapy for alcoholism.” (4)
“She deserves to rot in prison for the rest of her days on earth.” (2)

“This will teach you not to lie to your father in the future.” (1, 4)

“If you are going to change the rules and start towing people’s cars when they park here, you better tell people about it first.” (1)

“The judge sentenced me to anger management therapy.” (4)

“I don’t deserve to pay a $500 fine for littering, because I only dropped one little Kleenex.” (2)

**Lie Detection**

Polygraphs, or ordinary ‘lie detectors,’ which have relatively poor accuracy, rely on unconscious autonomic responses such as heart rate, breathing, blood pressure, and sweating to predict when a person is engaging in deception. Functional brain imaging, on the other hand, offers the possibility of revealing brain activity during the process of fabricating a lie. Two companies offer fMRI lie detection services, and there have been several attempts to introduce fMRI lie detection as evidence in criminal trials. How justified is the claim that fMRI offers a more accurate picture of truth telling and deception than polygraphs?

Neuroscientists have attempted to answer this question by directing subjects to alternate between telling the truth and telling lies while in an fMRI scanner. Comparing patterns of activity during these two conditions reveals a number of brain areas, including prefrontal cortex, anterior cingulate cortex, and parietal cortex, that are active in a person during lie telling/deception. So can we conclude that if someone’s brain displays increased activation in those areas, they are lying? Not so fast!

First, researchers do not agree on precisely which brain areas are activated during deception: a recent study combined the data from 23 different fMRI lie detection studies and found that no one region was active in all or even nearly all of the studies. In many of these experiments, there were methodological factors that might have affected the lie-telling/deception conditions. Even if all of these complications were fixed, it would still be unclear whether the average patterns of brain activity seen and averaged across a large group of people could be used to make accurate predictions about any one individual.

Additionally, laboratory studies are done under different conditions and with different populations than would be the case for criminal fMRI lie detection. Most laboratory participants have no motivation to interfere with the study’s results. In contrast, a real-life fMRI lie detection scenario might involve asking questions of psychopathic individuals, who are known to lie frequently and have a strong incentive to avoid telling the truth or cooperating with researchers. Studies indicate that rehearsing lies, or making small finger and toe movements during scanning, can greatly reduce the accuracy of fMRI lie detection techniques. These issues highlight the tension between external validity and internal validity.

While the prospect of fMRI lie detection has created societal concerns about self-incrimination, invasions of personal privacy, and the possibility of punishing people for their thoughts rather than their actions, the reality is that functional brain imaging is (at present) little better than old-fashioned methods. Articles with supporting data can be found in *Annotated Resources.*
Key Points:
- Polygraphs essentially measure anxiety and stress, and can ultimately not reliably distinguish between this broad response and a lie.
- fMRI lie detection currently does no better at detecting lies than a polygraph.
- It will always be much easier to get a lie detector to work under “experimental” conditions than in situations where people may be attempting to beat the system.
- Even if lie detection works, there are ethical and legal questions regarding the use these technologies as evidence in a courtroom (i.e. self-incrimination?).

Resources and Discussion Questions:
*What are the promises and disadvantages of fMRI as a lie detection tool? How could a person “beat” the system?*

**Brains on Trial** (Alan Alda):
- [How Criminal Law Views fMRI Lie Detection](#) – Dr. Nita Farahany of Duke University talks about how, just as criminal courts do not allow polygraph data as evidence because of its unreliability, fMRI lie detection is also not currently admissible.
- [The Business of Commercial fMRI Lie Detection](#) – Dr. Hank Greely, a law professor from Stanford University, talks about fMRI lie detection and its implications.
- [Can Alan Alda Get Caught in a Lie](#) - Alan Alda goes through the process of “stealing” a ring and then telling lies in a brain scanner. Dr. Steve Laken used to be in the commercial lie detection business, and his brain analyses reveal that Alan did indeed take the ring!
- [How Memory Association Affects fMRI Lie Detection](#) – Dr. Anthony Wagner, a memory researcher at Stanford, give alternative interpretations of why the watch/ring task may have succeeded, having nothing to do with lie detection.
- [Why fMRI Lie Detection Isn’t Ready for Court](#) – Dr. Nancy Kanwisher, a neuroscientist at MIT, explains why fMRI lie detection with experimental subjects is very different than a true lie detection situation.

Classroom Activities:
**Activity #1 – The Speed Lying Task**
To introduce the topic of the difficulty of lie detection, students attempt to determine which questions their partner is lying about. Use the “[Lie Detection Activity” worksheet](#) to facilitate the activity

**Activity #2 – Polygraph Discussion**
- Watch this humorous [Simpsons polygraph clip](#) (30 sec).
- Lead a discussion with students about whether they’ve seen lie detectors in the media and whether they know how they work.
- Explain how a polygraph actually works using the “[How Do Polygraphs Work](#)” video (3 min), then discuss why autonomic nervous system activity might be related to lying.
Assignment Ideas:
Assignment #1 – Self-Incrimination
In the United States, the 5th amendment provides protections against a person having to testify against him/ herself. Have students research this amendment and write a brief report how self-incrimination relates to technologies such as the polygraph and fMRI lie detection (for a starter, watch the clip from Brains on Trial with Alan Alda: “How Criminal Law Views fMRI Lie Detection”).

BIOLOGICAL PREDICTORS OF CRIME

In the film Minority Report, a set of psychics have visions of crimes that will be committed in the future. People are then arrested for “pre-crime” on the basis of the psychics’ predictions, resulting in the complete elimination of crime. Could a program like this, relying on predictions based in neuroscience rather than psychic forecasts, ever become a reality?

Careful longitudinal studies, in which groups of individuals are followed from birth to adulthood, suggest a set of factors that may increase the probability that an individual will grow up to commit violent crimes. These include prenatal exposure to toxins such as alcohol, tobacco, and lead, and social stressors such as experiencing maternal rejection during infancy.

Measurements of heart rate during childhood are also associated with later aggression. More than 40 studies, carried out in thousands of children, have repeatedly demonstrated a strong link between having a low resting heart rate (which may indicate fearlessness and stimulation-seeking) and antisocial/violent behavior. Abnormal fear conditioning at age 3 also predicts crime at age 23, meaning that those children who showed less fear at a young age were more likely to commit a crime later in life.

How should we interpret this type of evidence?
• Brain differences are not evidence of fate or an unchangeable condition.
• Interpreting behavioral results (such as poor fear conditioning) can only be applied at the group level and are far from being specific enough to be used to predict an individual’s behavior.
• Crime results from complex interactions of biological and environmental factors; it cannot be explained solely by neurological or behavioral traits.
• Research should be used to benefit those children who are at greatest risk and to design interventions that are tailored to their needs.

Interventions that may decrease criminal behavior include nutritional supplementation, parenting classes and home visits from nurses, enriched preschool programs, and coping skills programs for teenagers.

For more information, refer to this editorial in the American Journal of Psychiatry.
Key points:
- There are many factors in childhood that lead to increased risk for criminal behavior.
- Biological factors include low resting heart rate and abnormal fear-conditioning responses.
- Environmental factors include prenatal exposure to leaded gasoline, alcohol, and tobacco, and maternal rejection in infancy.
- Predictive factors only increase the likelihood of a person committing a crime. It is impossible to judge with certainty whether a specific individual will commit a crime in the future.

Resources and Discussion Questions:
Click here for an overview of Adrian Raine’s research on childhood predictors of later aggression and criminality, and here for a radio interview with Dr. Raine.

Lead Exposure:
- A very engaging article from Mother Jones detailing the history of research on leaded gasoline and crime rates.
- Another very good article from BBC Magazine.

An article about low resting heart rate in the New Yorker.

“What is a psychopath?” from Psychology Today. An article that discusses the definition of psychopath and sociopath, and some related neuroscience research related to the various traits of psychopathy.

One neuroscientist discovered that he himself has neural activity extremely similar to that of a psychopath. The Smithsonian Magazine has a brief article on his discovery.

Classroom Activities:
Activity #1 - Correlational Studies
It is a fact that ice cream sales and murders are highly correlated. So, does that mean that eating ice cream leads people to commit murder? Lead a discussion with the studies about the difference between correlation and causation.

- A brief description of the use of correlation studies in research on criminality is below:
  Carefully controlled, randomized experiments are the gold standard for establishing the causes of a phenomenon. Nevertheless, there are some topics for which experiments would be unethical or impossible. For example, if we wanted to establish whether malnutrition, stress, or exposure to environmental toxins played a greater role in later criminality, we wouldn’t randomly assign one group of children to be malnourished, another to be mistreated, and a third to be exposed to cigarettes in the womb, and then compare the children’s outcomes. Instead, we have to use correlational studies, which examine how frequently certain factors vary together in a given sample of participants. However, we can’t say that because two variables are correlated, one definitely causes the other; it’s possible that the two variables are explained by a third variable. Longitudinal studies follow the same group of participants over long periods of time, and thus help diminish the problem of third variables because, often, fewer alternative explanations can be correlated with a specific behavior over a long length of time. Nevertheless, even with well-matched groups and sophisticated statistical techniques, it can be difficult to tease apart cause and effect in longitudinal studies.
• Here are a few useful YouTube videos to get the point of correlation and causation across to your students with humor:
  • Junk Science (2:25)
  • Ionica Smeets at TEDxDelft (5:56)
• There are several websites dedicated to looking at variables that can be shown to be correlated and yet obviously have no connection with one another. Spurious Correlations is one, this website is another.

**Classroom Activities:**

**Activity #1 – Discussion: Are You Your Brain?**
Discuss with the class:

• If a schizophrenic OR a person who was abused as a child kills someone, is one person more or less guilty than the other? Are they more or less guilty than a socially well-adjusted person who was not abused and commits the same crime?
• Should criminals be held responsible if their brain “made them do it”? What does this mean in the context of neuroscience? Is the brain always responsible for what you do?
• How does our knowledge of slow prefrontal cortex development during adolescence change judgments of adolescent culpability? Should a 15-year-old ever be tried as an adult? Does the type of crime matter?
• Sentencing takes into account both the ideas of retribution and deterrence. How might neuroscience help us understand better whether a criminal is likely to commit a crime again?

**Activity #2 – Defense and Prosecution Arguments**
The intent of this activity is to get students to think deeply about what neuroscience evidence can be used for in the court.

• Present a case to the class in which neuroscience evidence was used in the courtroom (such as one taken from the Atlantic or Reuters articles found here and here). Assume that the defendant was found guilty, but that sentencing has not yet taken place.
• Without revealing the actual sentence, have half of the class work together to write a defense statement based on the evidence and other half of the class write a prosecution statement against the neuroscience evidence.
• Each team will choose one representative to state the defense and prosecution case.
• Discuss the actual decision given by the court and how similar the reasons given were to those mentioned in the statements.

**GUILT AND RESPONSIBILITY**

“Mr. Oft” was a schoolteacher who, despite having no psychiatric history of sexually deviant behavior, became interested in child pornography in middle age and molested his stepdaughter. It was later discovered that he had grown a tumor on his right orbitofrontal cortex (abnormalities in this area have been associated with poor impulse control, altered sexual behavior, and sociopathy). When Mr. Oft’s tumor was removed, his pedophilia subsided; later, the tumor grew back, and the urges returned and he began secretly collecting child pornography. Again, the tumor was removed, and Mr. Oft’s urges subsided. Should Mr. Oft be held responsible for his crimes?

According to the law, he should. “The fact is, I did what I did,” he stated. “I am responsible for it; I am the one to blame.” Mr. Oft knew what he was doing, and knew that the act was illegal and immoral. Because of this,
his behavior is consistent with *mens rea*, ‘a guilty mind.’ At the same time, most people have the intuition that it wasn’t exactly Mr. Oft’s fault—it wasn’t really him, it was his brain.

Most people instinctually feel that there is a nonmaterial part of us—a mind, soul, or spirit—that is separate from our physical bodies and determines our behavior. We have the sense our behaviors are consciously willed and carried out freely. In contrast, neuroscience holds that the mind and the brain are one and the same: every thought and feeling has a corresponding brain state, and the mind cannot exist without the brain. Few of us would think that a person with extensive brain damage could be held responsible for his actions in the same way as a person who appears healthy and normal would be. However, as the state of neuroscience progresses, we may one day be able to trace all of the brain patterns that precede a given behavior. Does the fact that behavior can be traced to a ‘cause’ in the brain excuse someone from responsibility?

This question relates closely to issues surrounding sentencing for people with intellectual disabilities, mental illness, and children and adolescents. For example, it has been ruled unconstitutional for people with an intellectual disability to be given the death penalty. Also, laws governing adolescents’ criminal culpability have been increasingly modified over the last three decades in light of neuroscientific research about how the teenage brain differs from the adult brain and how it develops.

**Key points:**

- In law, there is a difference between a guilty/not-guilty verdict and the subsequent sentencing that determines the punishment. Both of these aspects of a trial could be influenced by neuroscientific evidence.
- A ‘mitigating factor’ is information or evidence brought to the court that may reduce or lessen a sentence. Neuroscience is playing an increasing role in various mitigating factors related to development, mental illness, and disease.
- The adolescent brain is not yet fully developed, particularly in the frontal cortex, the region responsible for self-control and inhibiting our “gut” or first reactions.

**Resources and Discussion Questions:**

**Free Will, Responsibility, and Mitigating Factors**

- This [pair of short videos](#) presents the facts of an actual [case](#) of violent crime, the brain pathology of the defendant, and potential interventions for at-risk youth.
- In this [video](#), Dr. Steven Morse, psychiatrist and law professor, briefly argues that free will is not a requirement from criminal responsibility. Rather, it is the capacity to act *rationally*.
- A very good article from the [Atlantic](#) on brain tumors, disease, and criminal behavior. Another article from [Reuters](#) with a similar theme.

**Insanity Defense**

- An [article](#) on the historical origin of the insanity defense
- An extremely good article in [Psychology Today](#) about the current state of the insanity defense.

**Adolescent Brains**

- [Saccade Movements and Overriding Impulsivity](#) (Brains on Trial) - Dr. Bea Luna from the University of Pittsburgh talks about how to measure impulsivity in adolescents and adults.
- [What fMRI Scans Tell Us about the Adolescent Brain](#) (Brains on Trial) – Dr. Jay Giedd discusses his own research on the structural changes of the brain during development (these were MRI, not fMRI scans).
**Peer Influence and Adolescent Behavior** (Brains on Trial) – Dr. Larry Steinberg demonstrates a task in which their lab study brain activity in adolescents while peers make risky decision in the presence of peers.

**The Mind of the Adolescent** (Brains on Trial) – Dr. B.J. Casey talks about adolescents and increased risky behavior. Her research shows that peer-related are more rewarding for adolescents than for people of other ages.

**How the Courts View Age when Determining Sentencing** (Brains on Trial) – Dr. Nita Farahany discusses sentencing for youths versus adults, and how these rules may change based on research.

The NIH has a good overview of the adolescent brain [here](#).

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**Memory and Eye Witness Testimony**

- How reliable is eye-witness testimony? How easy is it to coax people into remembering something that did not actually happen? The video “Can You Trust Your Memory” discusses some recent studies into false memories and how prevalent they really are.

- The brain has “shortcuts” for processing sensory information that influences how we perceive the world. For instance, this [audio illusion](#) demonstrates how past experience influences our perception of new information. How might this thought process influence a witness’s observations of a scene?

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**Assignment Ideas:**

**Assignment #1 – Neuroscience & Law Project**

This assignment takes a project-based learning approach as described [here](#). Students choose a neuroscience/law topic to research, then share their findings with the class through a creative presentation, focusing on examining the topic from multiple sides and fairly presenting these different viewpoints.

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**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 Impact of Modern Neuroscience on Treatment of Parolees: Ethical considerations in using pharmacology to prevent addiction relapse**
  Dana Foundation/Richard J Bonnie, Donna T. Chen, Charles P. O’Brien
  A great overview of the current state of naltrexone research, and thoughtful writing on the ethics of using this drug within the court system.

- **Forecasting Aggression: Toward a new interdisciplinary understanding of what makes some troubled youth turn violent**
  Dana Foundation/Daniel Schechter
  A detailed review of the neuroscience and genetics of risk factors for violent behavior.

- **From Lab Bench to Court Bench: Using science to inform decisions in juvenile court**
  Dana Foundation/Cindy S. Lederman
  A judge in the court system writes about her experience having to make quick decisions regarding children and families. She makes a call for judges to be better informed about the developmental science that will preserve the health of the children under question.
The Neuroscience of Memory: Implications for the courtroom
Nature Reviews Neuroscience/Joyce W. Lacy, Craig E. L. Stark
A very helpful and clear review of behavioral and neuroscience research on memory distortion related to the legal process. The authors also discuss potential applications.

Neural Components of Altruistic Punishment
Frontiers in Neuroscience/Emily Du, Steve W.C. Chang
This paper gets into a fair amount of detail regarding specific brain regions and experimental design.