EDUCATOR'S GUIDE

Addiction: Disease or Behavior?

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the Eyes of Nye

For six seasons, millions of students came to understand, appreciate and enjoy the exploration of science through the series, *Bill Nye the Science Guy*. Bill returns with *The Eyes of Nye*, a more in-depth look at science subjects making news, changing lives, and impacting policy. From the future of alternate fuel sources and genetic engineering to population growth trends and issues of race, Bill and his expert cohorts bring science to life right in your classroom, helping you **Motivate** investigation; **Assess** available information; and **Propose** lines of argumentation.

This Educator's Guide includes:

- An **Introduction** that clearly defines the subject and offers an overview of the issue objectives of the guide; how it relates to science from both a social and personal perspective; as well as pertinent questions and insights regarding the topic.
- A listing of all **National Science Education Standards Addressed**.
- Detailed procedures highlighted in the MAP Framework (**Motivate, Assess, Propose**).
- Illustrative **Video Clips** from *The Eyes Of Nye* DVDs with pinpoint chapter cues.
- **Web Site Resources** to help students further investigate and locate research, charts, data as well as experts featured in the program material.
- Easily downloadable **Support Materials** that include articles, transparencies, charts, and much more.

Introduction:

"Addiction" refers to dependence or need. *The Eyes of Nye - Addiction: Disease or Behavior?* points out disagreement with the common notion that addiction is only physiological, and raises the issue of whether it is a disease and therefore subject to certain identification and treatment procedures as with other diseases.

These biological distinctions, juxtaposed with our recognition of the dangers of addiction and our natural desire to help those who are addicted, lie at the heart of the issue. Answers to the broad question, "Is addiction a disease?" provide insight to *how* we can help. They also provide a better chance of ensuring resources (e.g., time, money, and even the lives we hope to improve) are put to their most productive use. The objectives in this guide focus on the relationship of addiction to disease—to help students dismantle the meaning of disease, investigate what we know about the science of addiction, compare and contrast findings, and identify additional, more narrowly focused questions based on those findings.

*Check the **MAP Teaching and Learning Framework** to explore the phases (motivate, assess, and propose) used in this guide.*

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National Science Education Standards Addressed

Science As Inquiry

- Abilities necessary to do scientific inquiry
  - Identify questions and concepts that guide scientific investigations
  - Recognize and analyze alternative explanations and models
- Understanding about scientific inquiry

Life Science

- Behavior of organisms

Science in Personal and Social Perspectives

- Personal and community health
- Science and technology in local, national, and global challenges

History and Nature of Science

- Science as a human endeavor
- Nature of scientific knowledge

On the DVD:

Addiction: Disease or Behavior? – Chapters

Chapter 1: ***Addiction Preview***
Beginning through 00:57
Ends with title screen.

Chapter 2: ***Addiction: Not Just for Humans***
1:21—8:42
Begins with "ON AIR" sign and ends with Ronald Siegel quotes about mammals.

Chapter 3: ***Brain Mapping***
8:44—14:44
Begins with Dr. Edythe London segment and ends with NIDA quotes on the costs of drug abuse.

Chapter 4: ***Or Is It Drugs?***
14:46—21:33
Begins with Dr. Marlatt and Dr. George and ends with 1998 NIDA study findings.

Chapter 5: ***Selection and Addiction***
21:35 through end of program
Begins with Bill saying, "If the cost of addiction is so high…"

Addiction: Disease or Behavior? – Activity Clips

Defining Disease
4:51—5:10
(referenced in Educator's Guide step 3)
Starts just after Dr. Drew says, "You've got to be able to understand what a disease is." Ends right after he says, "That's it. That's a disease."

Disassembling Disease
5:20—5:52
(referenced in Educator's Guide step 5)
Begins after Dr. Drew says, "That's a disease." Ends with Bill saying "…they all respond to treatments in predictable ways."

Addiction and the Brain
5:52—8:42
(referenced in Educator's Guide step 3)
Ends just after the frame containing information on mammals and specifically "catnip."

Brain Mapping and Addiction Research
8:44—10:04
(referenced in Educator's Guide step 7)
Ends with Dr. London saying "…are really hot."

Drugs and the Executive Center
10:10—12:29
(referenced in Educator's Guide step 8)
Starts with Bill saying, "So let me ask you this…" and ends with Dr. London saying "…and color," and Bill saying "…and blue, and orange."

Dopamine and Decision Making
12:30—13:32
(referenced in Educator's Guide step 8)
Ends with Dr. Drew saying "…that they can't later on."

Placebo Effect
14:46—16:50
(referenced in Educator's Guide step 11)
Starts with introduction of Dr. Alan Marlatt and Dr. Bill George and ends when Bill says, "…a lot of beer."

Procedure: Motivate Phase

1) Ask students what they think it means to be "addicted." Most responses will imply need or desire for drugs or alcohol, though some may describe it more broadly. Focus on references to biological need, usually physiological in students' (and our) typical perspective. Further discuss any references made to disease but leave its connection to addiction undetermined for now.

2) Help students relate various aspects of their tentative descriptions above to negative consequences (e.g., needs cost money and deplete financial resources, physical dependence causes deterioration of health, inability to think clearly or focus interferes with career opportunities, and so forth). Explain these costs of addiction barely touch the surface. Distribute or display *Costly Addictions* on an overhead and discuss what we pay—whether addicted or not.

3) Tell students to consider the word "disease." Many thoughts come to mind, some significant and some semantic. Suggest that, as with addiction, there may be many ways to define disease. Ask them to listen closely and note what they can of the definition provided by Dr. Drew Pinsky, addictionologist, from the Las Encinas Hospital. Play

See ***The Eyes of Nye*** *Issue Support* ***Costly Addictions***

"Defining Disease" a couple of times. Put together a rough definition gleaned from notes taken by various students (it does not need to be complete as it will be analyzed in the "assess" phase). Repeat the words "physiology," "symptoms," and the phrase near the end "…we can create a predictable response to treatment." Ask if there is any way to *treat* addiction. Briefly discuss what is generally meant by *treatment* (e.g., putting established scientific processes to work, using medical knowledge, analyzing symptoms and results of treatment). Briefly discuss advantages (to people) and costs (effort, money, time) of treatment. Ask students to consider the following: *If* addiction were a disease, would we be better able to plan and foresee the results of our attempt to help people who are addicted? Suggest there are many opinions regarding this.

4) Play ***"Chapter 1: Addiction Preview"*** and restate the broad question posed, "Is addiction a disease?" Reemphasize the need-to-know certain information in order to answer by succinctly restating two points previously made: (1) If we wrongly do not call addiction a disease and thus treat it incorrectly, or not at all, then people remain addicted and those costs (see step 2) remain; (2) If we wrongly call addiction a disease then we incur great costs in finding and using methods to fight something that does not exist. Ask students to suggest questions to help determine if addiction is a disease. Categorize responses into those that are "scientific" and those that are "social" in nature. Narrow or combine items to at least two choices that are scientific and one that is social (see possibilities below).

Potential scientific questions

a) What is a disease?

b) What scientific causes, effects, or possible "cures" are there for addiction?

Potential social questions

c) What outside factors influence what we can do through science to help those who are addicted?

Procedure: Assess Phase

5) Repeat the first scientific question above and explain that it often helps to break a definition with multiple components into its various parts. Tell students to take notes as you play ***"Disassembling Disease"*** in which Dr. Drew's definition is repeated and then broken down part for part into basic meaning, cause, and result. Discuss and clarify each point briefly using "A Disease Is…" (see sidebar).

6) Repeat the term "physiological." Tell students we have heard the term several times—it refers to the normal functioning of organisms and/or their parts. Ask them to recall what Dr. Drew said about people getting "hung up" on the term physiological and not realizing addiction is a disease of the brain. Ask if our brain is one of our normally functioning parts; expect humorous but still relevant responses. Recall the second scientific question outlined in step 4, and tell students the causes and effects of addiction can tell us more about this dilemma. Play ***"Addiction and the Brain"*** and review the

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See ***The Eyes of Nye*** *Issue Support* ***A Disease Is…***

See ***The Eyes of Nye*** *Issue Support* ***The Reward Pathway***

information in *The Reward Pathway* (see sidebar). An additional glossary is provided for further assistance.

Teacher Note: *Steps 6 and 7 pose a variety of interesting instructional possibilities as extensions. They may be addressed separately or in combination. They may also be addressed independently or in groups. If you choose the latter, consider assigning "expert" groups to locate and synthesize information dealing with a specific topic (and those individuals and institutions making the claims), then reassign groups so that one "expert" is in each group. Ask members of the new group to "jigsaw" the information together into one picture of Our Brain, Effects of Drugs, and New Research. Alternately, you may have expert groups present their findings, then jigsaw the information as a class. Further guidance on topics and sites is available.*

For more, go to eyesofnye.org

7) Suggest that to determine if addiction is a disease, according to the considerations we have been discussing, it is useful to determine if we actually know addiction affects the *normal functioning* of the brain. Tell them that, though it is difficult to know anything with absolute certainty, it helps to look at recent research on the topic. Play ***"Brain Mapping and Addiction Research"*** in which Dr. Edythe London from the Brain Mapping Center at UCLA discusses ongoing findings revealed by magnetic resonance imaging (MRI) and positron emission tomography (PET) scans.

8) Recall people's differing opinions regarding whether or not addiction is a disease (in preview, step 4) and explain the notion of addiction as a disease of the brain is partly responsible for these variances. Remind students of the person who said that addiction is *not* a disease because you can stop whenever you want; ask students if this is true. Ask, "*Is* someone who is addicted possibly *not able* to make decisions?" Expect students' opinions to mirror those in the preview—they will vary. Tell students that differing viewpoints are normal—it is the nature of an issue—but to listen further to what Dr. London's research is beginning to indicate about the physiological effect of drugs on the brain's decision-making center. Play ***"Drugs and the Executive Center"*** and discuss her findings and her assertion—in large part due to these findings—that addiction is indeed a disease.

To allow students to further explore the processes and production of specific chemicals in the brain and the relationship to drug addiction, play ***"Dopamine and Decision Making."***

9) Explain that some findings in genetics could also possibly support the biological basis for addiction—that some of us inherit a predisposition to addiction. Briefly discuss the concept of natural selection—that certain genetic mutations that occur randomly are selected because they help an organism survive and produce more offspring. Play ***"Chapter 5: Selection and Addiction"*** and stop at the end of Dr. Drew's discussion. Review his theory that certain tendencies to take risks seem to be a trait of individuals who also exhibit addiction. The phenomenon is not unique to addiction; for instance, individuals have been found to exhibit competing selective tendencies toward resistance

to malaria and susceptibility to sickle-cell anemia, or vice-versa.

Procedure: Propose Phase

10) Remind students that we have looked closely at several scientific aspects of addiction, and we have discussed the costs of addiction to people, businesses, and society. Ask students to consider the following: Are there instances in which addiction is *not* a disease? What are the costs of these instances? Tell them these types of social considerations are unavoidable if we are to propose a solution to an issue such as addiction.

11) Play ***"Placebo Effect"*** featuring psychology professors Dr. Alan Marlatt and Dr. Bill George from the University of Washington, and discuss the notion that the mind is a difficult thing to predict, and that psychological effects can be strong—sometimes strong enough to make us believe in a reality that does not exist. Repeat again the preview comment "…they can stop anytime they want." Suggest, though this instance does not refute the scientific basis for considering addiction a disease, it does raise very real questions in the minds of those who pay the costs for treating addiction (e.g., taxpayers, medical facilities, insurance companies, even those with real addiction problems seeking assistance from an overextended set of resources).

12) Rearrange class into groups of 3-4 students each. Suggest that usually when we attempt to propose a solution to a complex issue, we don't (can't) have *everything* we need to make the best decision possible. With any issue it is important to *use what we learn through outlining questions and assessing information* immediately available to decide *what else we need to know*. Explain this need is more pronounced with some issues than with others, and the issue of addiction is an excellent case in point. Ask each group to review the questions explored throughout the lesson, and design three additional questions they believe need to be investigated in order to begin to propose possible solutions. Ask them to write each of these questions on chart paper or poster board, along with a rationale and a brief plan for acquiring and assessing information that relates to their new questions. They may call their resulting work, *What We Want to Know Is…*

In considering new questions, students should also note that experts' occupations and/or institutions affect their claims. Encourage them to consider purpose.
For more on exploring claims and claimants, go to eyesofnye.org

13) Ask each group to present its questions and further research plans to the rest of the class. Encourage dialogue among all students in the class around why or why not the questions will offer useful information, how that information might be addressed, and what (if any) changes may need to be made to improve the effectiveness of the questions.

Final Teacher Note: *The issue of addiction lends itself particularly well to helping students understand the scientific nature of deep investigation, and how assessing information related to a question—whether scientific or social—forms the perfect preface to construction of new questions and further, deeper assessment. Need-to-know is similarly sustained, and even magnified as students become more proficient at designing questions that can be directly investigated. Note that for interest and success students must develop—or play a large role in developing—the questions they intend to investigate. However, their success (and interest) will suffer if they do not receive significant assistance in this crucial undertaking. Be prepared to help as much as needed for each group, and to decrease the assistance as you see definite improvement in their ability. For more guidance on the connection of the procedure to the learning/teaching process employed in* The Eyes of Nye *teacher guides, see the MAP Framework.*

For more information related to the issue of addiction, the featured experts or claimants, and the resources presented in The Eyes of Nye - Addiction, *visit the Web site*

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Further Research

Investigating the Issue: Addiction

Investigating the socio-scientific issue of addiction involves exploring and assessing scientific (constitutive) criteria related to concepts such as signal transmittal in our brain and the impact of drugs on the production of dopamine. As with many medical issues, unique terminology is common. This requires that students work with specialized technical vocabulary throughout lessons or extended learning opportunities. The social aspects of the issue—those that deal with how we use what we learn to improve people's lives—are more difficult. No single social issue stands out and there are few (aside from those that are very fringe) examples of quality research or claims that are clearly opposed to one another. Yet the issue holds relevance and importance; its relevance to students ages 14-18 especially sets it apart from topics of study. It also presents, due in part to its myriad smaller issues, an excellent opportunity to practice and hone the important skill of generating quality, targeted questions that can be explored, and that lead to new questions.

Numerous topics will be of interest and assistance to students should they seek to extend or expand their questioning and investigation cycle on addiction. The principal Web site is from the National Institute on Drug Abuse (NIDA) at the National Institutes of Health (NIH). Allow students to access many others as well, however—in and of itself, the questions they may ask about credibility of many of the fringe sites offer a valuable social (contextual) learning experience. Also included for further investigation by students are the principal experts s (and their respective institutions) featured in *The Eyes of Nye – Addiction*.

Exploring Addiction

The resources at the National Institute on Drug Abuse are helpful throughout as students search for information. It also provides guidance for students who wish to locate additional sources through links. Effects of many different drugs are documented thoroughly for those students who narrow questions to comparative studies, including smoking, alcohol, and steroids.

Information is provided as well on drug abuse prevention, statistics (including teen and pregnancy), and research being conducted on the treatment of addiction. Access at: http://nida.nih.gov/

Teachers may choose to guide student research through use of the following resources, allowing students to conduct open searches, or a combination.

Other dopamine pathways (aside from mesolimbic):

- mesocortical pathway
- nigrostriatal pathway
- tuberoinfundibular pathway

Further "reward center" topics include:

- ties of dopamine to psychosis and antipsychotic medication
- Relationship of structures to limbic system:
  - amygdala
  - archicortex
  - cingulate gyrus
  - fornicate gyrus
  - hippocampus
- Debate regarding tie of the hypothalamus to the limbic system

Organizations:

- Drug Information and Strategy Clearinghouse
- National Clearinghouse for Alcohol and Drug Information (NCADI)
- National Drug and Alcohol Treatment Referral Service
- Drug Policy Information Clearinghouse
- National Prevention Information Network
- National Technical Information Service (NTIS)
- Office on Smoking and Health

Brain research technologies:

- Magnetic resonance imaging (MRI)
- Positron emission tomography (PET)

Exploring Addiction Claims and Claimants

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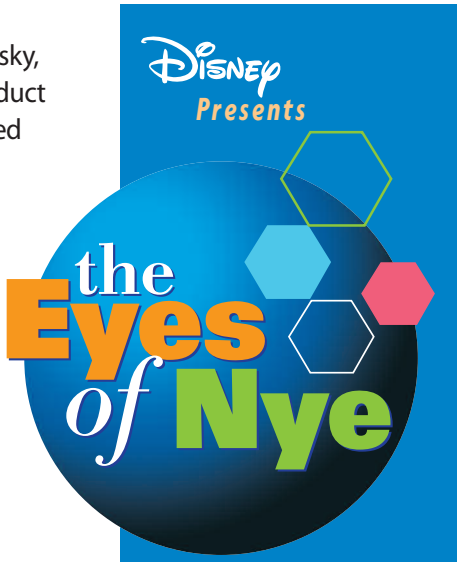
In *The Eyes of Nye - Addiction,* the principal information is provided by Doctors Drew Pinsky, Edythe London, Alan Marlatt, and Bill George. Teachers may encourage students to conduct open-ended searches for this type of information, or direct students to the links provided below.

Dr. Drew Pinsky, addictionologist	Las Encinas Hospital
Dr. Edythe London, scientist	Psychiatry and Biobehavioral Sciences Brain Mapping Center, UCLA
Dr. Alan Marlatt, psychology professor	University of Washington
Dr. Bill George, psychology professor	University of Washington



ISSUES SUPPORT MATERIAL

Addiction: Disease or Behavior?

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Costly Addictions

In the year 2000, hospital emergency department data indicated:

- 1,100,539 drug mentions.
- 601,776 estimated drug-related episodes. Of these, there were:
  - 217,224 that claimed dependence;
  - 193,061 that were attempted suicide;
  - 264,240 that had overdosed;
  - 90,625 seeking detoxification.

In the year 1992, economic cost data indicated:

- $245.7 billion total estimated economic cost of substance abuse. Of this cost:
  - $97.7 billion was due to drug abuse. This figure includes costs for drug-related treatment, prevention, other healthcare, reduced job productivity and lost earnings, crime, and welfare.
  - 46% of these costs are borne primarily by governments.
- 50% cost increase over 1985. The four primary contributors were:
  - heavy cocaine use;
  - the HIV epidemic;
  - an eightfold increase in drug-related incarcerations;
  - a threefold increase in drug-related crime.

In the year 1995, the White House Office of National Drug Control Policy study data indicated that, between 1988 and 1995, money spent on illegal drugs that otherwise would have supported legitimate spending or savings by the user in the overall economy amounted to:

- $57.3 billion on drugs, of which loss was attributed in the amount of:
  - $38 billion on cocaine;

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- $9.6 billion on heroin;
- $7 billion on marijuana;
- $2.7 billion on other illegal drugs and on the misuse of legal drugs

Information acquired from NIDA InfoFacts: Science-Based Facts on Drug Abuse and Addiction, National Institute of Drug Abuse, National Institutes of Health.

- *Hospital Trends*, revised 2001. Hospital emergency department data provided by the Drug Abuse Warning Network (DAWN) for 2000, produced by the Substance Abuse and Mental Health Services Administration (SAMHSA).
- *Costs to Society*, 1992. Economic cost data prepared by the The Lewin Group.
- *Drug Control Strategy Study*, 1995. Data provided by The White House Office of National Drug Control Policy.

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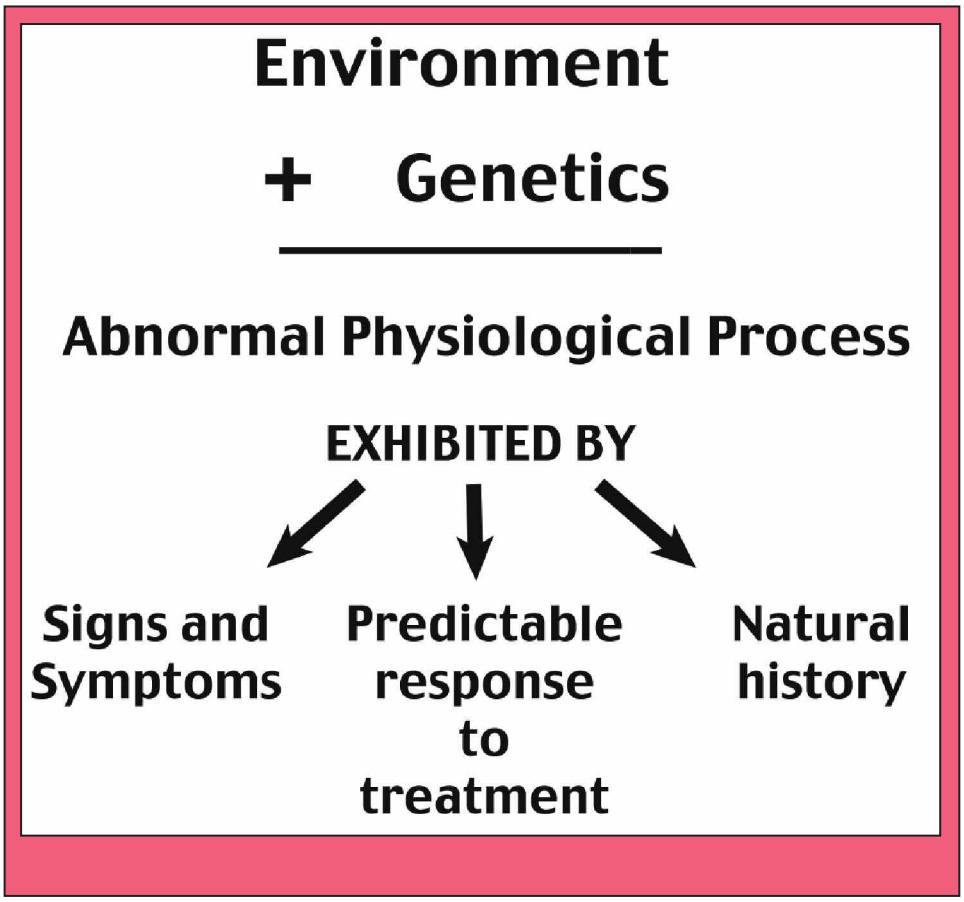
A Disease is…

An abnormal physiological process that is caused by a combination of environment and genetics and exhibits signs and symptoms, predictable response to treatment, and natural history.



The Reward Pathway

The brain is made up of billions of cells called neurons. Messages are carried from neuron to neuron with tiny chemical signals across gaps called synapses.

Just the details…

Information is received at a neuron's dendrites (or cell body), and transmitted over distance by axons of the nerve cell. Neural pathways are primarily composed of these axons. The pathways, called tracts, consist of bundles of neurons that connect parts of the nervous system or brain. Neurotransmitters are chemical signals that transmit information from neuron to neuron across spaces called synapses. The mesolimbic pathway is a neural pathway that links the brain to the nucleus accumbus in the limbic system.

Everything we find pleasurable results in a microscopic flood of a neurotransmitter called dopamine. We call this the reward pathway.

Just the details…

The limbic system refers to the group of brain structures involved in emotion (such as pleasure). This system is also involved in long-term memory, aggression, fear, and according to some, even hunger, thirst, heart rate, and sexual arousal. It is considered in evolutionary terms to be one of the oldest parts of the brain, and exists in other mammals, besides humans, as well amphibians, reptiles, and even fish.

The limbic system houses the pleasure center, where the neurotransmitter dopamine is active. Dopamine provides the pleasure or enjoyment addicts feel. The substance is released naturally by certain rewarding experiences such as food and sex. Drugs in general cause the release of dopamine in the limbic system, and according to many theories, alter the dopamine pathways in the process. Recent evidence suggests that dopamine is also released by unpleasant stimuli as much as by pleasant. Possibly through ability to notice or judge importance, dopamine has also been suggested to influence people's ability to make decisions.

Glossary of Terms

Addiction - persistent compulsive use of a substance known by the user to be physically, psychologically, or socially harmful

Axon - a long and single nerve-cell projection that usually conducts impulses away from the cell body

Dendrite - any of the branching projections of a neuron that conduct impulses toward the body of a nerve cell

Dopamine - a neurotransmitter in the brain, intended to be used in later production of a chemical compound called epinephrine, or adrenaline

Environmental - the parts of social and cultural conditions that influence the life of an individual or community

Genetics - the hereditary makeup of an organism

Limbic system - a group of nerve centers in the inner portion of the brain concerned especially with emotion and motivation

Mesolimbic system - the more central portion of the group of nerve centers of the brain that consists especially of dopamine-stimulated neurons involved with the control of memory, emotion, and smell

Natural history - the natural development of something (as an organism or disease) over a period of time

Neurons - one of the cells that make up nervous tissue that transmit and receive nervous impulses, and that are composed of dendrites, axons, a cell body, and nerve endings

Neurotransmitter - a chemical or hormonal substance that transmits nerve impulses across a synapse

Nucleus accumbens - a nucleus in the limbic system of the brain that is responsible for memory

Physiological - characteristic of an organism's healthy or normal functioning

Soma - the nucleus-containing central part of a neuron exclusive of its axons and dendrites that is the major structural element of the gray matter of the brain and nervous system; the cell body

Stimuli - something that directly influences the activity of living cells, as by exciting a sensory organ, evoking muscular contraction or glandular secretion

Symptoms - subjective evidence of disease or physical disturbance observed by the patient

Synapses - the place at which a nervous impulse passes from one neuron to another

Terminal - a part that forms an end, especially nerve ending

Treatment - the action or manner of caring for or dealing with a patient medically or surgically

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