

# WebQuest: Neurotransmitters, Cravings & Addiction

By: Sandra R. Holmes

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## **Objectives:**

- 1.) The student will be able to explain the structure and the function of each part of the neuron.
- 2.) The student will be able to explain the connection between neurotransmission and addiction.

**Audience:** High School: General Biology, Anatomy & Physiology, Health



Have you ever wondered why you *crave* chocolate or have to *have* your morning coffee?  
Have you ever wondered why you *need* that can of cola to keep awake during the day?

In this investigation you will explore the connection between addiction and neurotransmission to help answer the question why. You will take a look at how caffeine, as well as how nicotine, alcohol, marijuana and cocaine can affect neurotransmission in the human body. You will also learn the parts of a neuron and how they function.

**Nicotine**

**Alcohol**

**Marijuana**

**Cocaine**

This webquest is divided into three parts:

### **1.) The Basics: “The neuron – its parts & how it works”**

- A.) What is a neuron?
- B.) What are the parts of a neuron?
- C.) How do neurons work?
- D.) What is the connection between neurons, the brain and the body?
- E.) Quiz: What did you learn about the neuron?

### **2.) An Example: “Is caffeine addictive?”**

- A.) What is caffeine?
- B.) Which foods and beverages contain caffeine?
- C.) How does caffeine affect neurotransmission?
- D.) And ...what about chocolate?

### **3.) The Project: “How does nicotine, alcohol, marijuana & cocaine affect neuron transmission?”**

- A.) Investigate the affects of one drug on neurotransmission.
- B.) Design a poster and present an oral report on your findings.
- C.) Produce a pamphlet that explains your findings to the public.

#### **NOTATION TO TEACHERS:**

This webquest includes websites, investigation worksheets, a quiz, project instructions and rubrics. Refer to the “Resource Section” at the end of this webquest. Graphics are also available.

## Part 1 - The Basics: “The neuron – its parts & how it works”

Directions: To investigate the structure & function of the neuron you will:

- 1.) Visit the websites assigned in this webquest for Part 1.
- 2.) Complete the “Investigation Worksheets #1 and #2”
- 3.) Prepare for the quiz. View attached graphics.

### A.) What is a neuron?

- 1.) Go to: <http://faculty.washington.edu/chudler/what.html>
  - a.) Find and record the definition for a neuron.

### B.) What are the parts of a neuron?

- 1.) Go to: <http://faculty.washington.edu/chudler/cells.html>
  - a.) Draw the neuron and label its parts.
  - b.) Play “Build a Neuron”

### C.) How do neurons work?

- 1.) Go to: <http://faculty.washington.edu/chudler/ap.html>
  - a.) Read about how neuron carry “messages” through the “Action Potential”.
- 2.) Go to: <http://sun.science.wayne.edu/~wpoff/cor/bod/neurons.html>
  - a.) Read about how two neurons work together.
- 3.) Go to: <http://faculty.washington.edu/chudler/synapse.html>
  - a.) Read about the “Synapse”
- 4.) Go to: <http://www.sfn.org/content/Publications/BrainBackgrounders/communication.htm>
  - a.) Read about how nerves communicate with one another.
- 5.) Go to:  
[http://science.education.nih.gov/supplements/nih2/addiction/activities/lesson2\\_neurotransmission.htm](http://science.education.nih.gov/supplements/nih2/addiction/activities/lesson2_neurotransmission.htm)
  - a.) View “How Neurotransmission Works”
  - b.) View “Neurotransmitter Action”
  - c.) View “Neurons in Series”
- 6.) Go to: <http://faculty.washington.edu/chudler/chnt1.html>
  - a.) Read about “Neurotransmitters”
  - b.) Find and record the six “Small Molecule Neurotransmitter Substances”

### D.) What is the connection between neurons, the brain and the body?

- 1.) Go to: <http://faculty.washington.edu/chudler/cells.html>

How many neurons does the human brain contain?
- 2.) Go to: <http://faculty.washington.edu/chudler/nsdivide.html>
  - a.) Read about the two parts of the nervous system: (CNS & PNS)
  - b.) Answer questions listed on Investigation Worksheet #2.

**Resource:** Terms & Definitions for Neuroscience.

Go to: <http://www.sfn.org/content/Publications/BrainBackgrounders/glossary.htm>

## **Part 2 - An Example: "Is caffeine addictive?"**

Directions: To investigate caffeine and neurotransmission you will:

- 1.) Visit the websites assigned in this webquest for Part 2.
- 2.) Complete the "Investigation Worksheet #3".

### **A.) What is caffeine?**

- 1.) Go to:  
<http://chemistry.about.com/od/moleculescompounds/a/caffeine.htm?terms=what+is+caffiene%3F>
  - a.) Find the chemical structure of caffeine.
- 2.) Go to: <http://faculty.washington.edu/chudler/caff.html>
  - a.) Read about the chemical compound that is caffeine.

### **B.) Which foods and beverages contain caffeine?**

- 1.) Go to: <http://faculty.washington.edu/chudler/caff.html>
  - a.) Look at the list of foods and beverages that contain caffeine.

### **C.) How does caffeine affect neuron transmission?**

- 1.) Go to: <http://faculty.washington.edu/chudler/caff.html>
  - a.) Read about how caffeine affects neurotransmission.
- 2.) Go to:  
<http://chemistry.about.com/od/moleculescompounds/a/caffeine.htm?terms=what+is+caffiene%3F>
  - a.) Read about how caffeine affects the neurons.
- 3.) Go to:  
[http://www.hhmi.org/cgibin/askascientist/highlight.pl?kw=&file=answers%2Fneuroscience%2Fans\\_010.html](http://www.hhmi.org/cgibin/askascientist/highlight.pl?kw=&file=answers%2Fneuroscience%2Fans_010.html)
  - a.) Read about: how caffeine affects the synapse.

### **D.) And what about chocolate...how does it affect neuron transmission in the brain?**

- 1.) Go to: <http://faculty.washington.edu/chudler/choco.html>
  - a.) Read about how various chemical compounds in chocolate affect the way we feel!

Now you are ready to do the project!

Go to the next page for the directions and the websites.

Good luck & have fun!

## The Project: How does nicotine, alcohol, marijuana and cocaine affect neuron transmission?"

Directions: 1.) Investigate the affects of one drug on neurotransmission.

2.) Use this information to:

- a.) Design a poster and present an oral report on your findings.
- b.) Produce a pamphlet that explains your findings to the public.

3.) Work in teams of two.

4.) Use the Project Worksheet to collect your information.

### 1.) What causes addiction?

- a.) Go to: <http://www.sfn.org/content/Publications/BrainBriefings/addiction.html>  
Read "Addiction's Path", Brain Briefings, Society for Neuroscience, July 1997.
- b.) Go to: [http://teens.drugabuse.gov/facts/facts\\_brain1.asp](http://teens.drugabuse.gov/facts/facts_brain1.asp)  
Read "Brain and Addiction", National Institute on Drug Abuse

### 2.) Information on specific drugs.

Drug	Websites
Caffeine	<a href="http://faculty.washington.edu/chudler/caff.html">http://faculty.washington.edu/chudler/caff.html</a> <a href="http://chemistry.about.com/od/moleculescompounds/a/caffeine.htm?terms=what+is+caffiene%3F">http://chemistry.about.com/od/moleculescompounds/a/caffeine.htm?terms=what+is+caffiene%3F</a> See #3 under ... C.) How does caffeine affect neurotransmission? ... as listed above.
Nicotine	<a href="http://faculty.washington.edu/chudler/nic.html">http://faculty.washington.edu/chudler/nic.html</a> <a href="http://www.sfn.org/content/Publications/BrainBriefings/nicotine.html">http://www.sfn.org/content/Publications/BrainBriefings/nicotine.html</a> <a href="http://parentingteens.about.com/cs/drugsofabuse/l/blnicotine1.htm?terms=What+is+nicotine%3F">http://parentingteens.about.com/cs/drugsofabuse/l/blnicotine1.htm?terms=What+is+nicotine%3F</a>
Alcohol	<a href="http://faculty.washington.edu/chudler/alco.html">http://faculty.washington.edu/chudler/alco.html</a> <a href="http://www.sfn.org/content/Publications/BrainBriefings/alcoholism.htm">http://www.sfn.org/content/Publications/BrainBriefings/alcoholism.htm</a> <a href="http://www.sfn.org/content/Publications/BrainBriefings/brain_on_alcohol.html">http://www.sfn.org/content/Publications/BrainBriefings/brain_on_alcohol.html</a>
Marijuana	<a href="http://faculty.washington.edu/chudler/mari.html">http://faculty.washington.edu/chudler/mari.html</a> <a href="http://parentingteens.about.com/cs/marijuana/l/blmjl.htm">http://parentingteens.about.com/cs/marijuana/l/blmjl.htm</a> <a href="http://teens.drugabuse.gov/facts/facts_mjl.asp">http://teens.drugabuse.gov/facts/facts_mjl.asp</a>
Cocaine	<a href="http://faculty.washington.edu/chudler/coca.html">http://faculty.washington.edu/chudler/coca.html</a> <a href="http://www.sfn.org/content/Publications/BrainBriefings/glutamate.html">http://www.sfn.org/content/Publications/BrainBriefings/glutamate.html</a> <a href="http://psychology.about.com/library/clinical/bladdicton_cocaine.htm">http://psychology.about.com/library/clinical/bladdicton_cocaine.htm</a>
Other Drugs	<a href="http://www.drugabuse.gov/drugpages.html">http://www.drugabuse.gov/drugpages.html</a>

# WebQuest: Neurotransmitters, Cravings & Addiction

By: Sandra R. Holmes

To: Teachers

Resources attached to this webquest include:

- 1.) Investigation Worksheet #1 for **The Basics: “The neuron – its parts & how it works”**
- 2.) Quiz: **“The neuron – its parts & how it works”**
- 3.) Investigation Worksheet #2 for **The Basics: “The neuron – its parts & how it works”**  
Question: **What is the connection between neurons, the brain and the body?**
- 4.) Investigation Worksheet #3 for **“Is Caffeine Addictive?”**
- 5.) Project Worksheet for **Poster, Oral Report and/or Pamphlet**
- 6.) Project Assignment: **Poster and Oral Report**
- 7.) Project Assignment: **Pamphlet**
- 8.) Rubric for **Poster & Oral Report**
- 9.) Rubric for **Pamphlet on Selected Drug and Neurotransmission**
- 10.) Graphic: **An example of a neuron**
- 11.) Graphic: **The Process of Neurotransmission**
- 12.) Graphic: **What does a synapse look like?**

Go to the next 13 pages for the resources.

## **Notation to Teachers:**

This webquest can be completed in its entirety or in parts.

Clipart of the chocolate candy, coffee cup & soda can by Microsoft Office software.





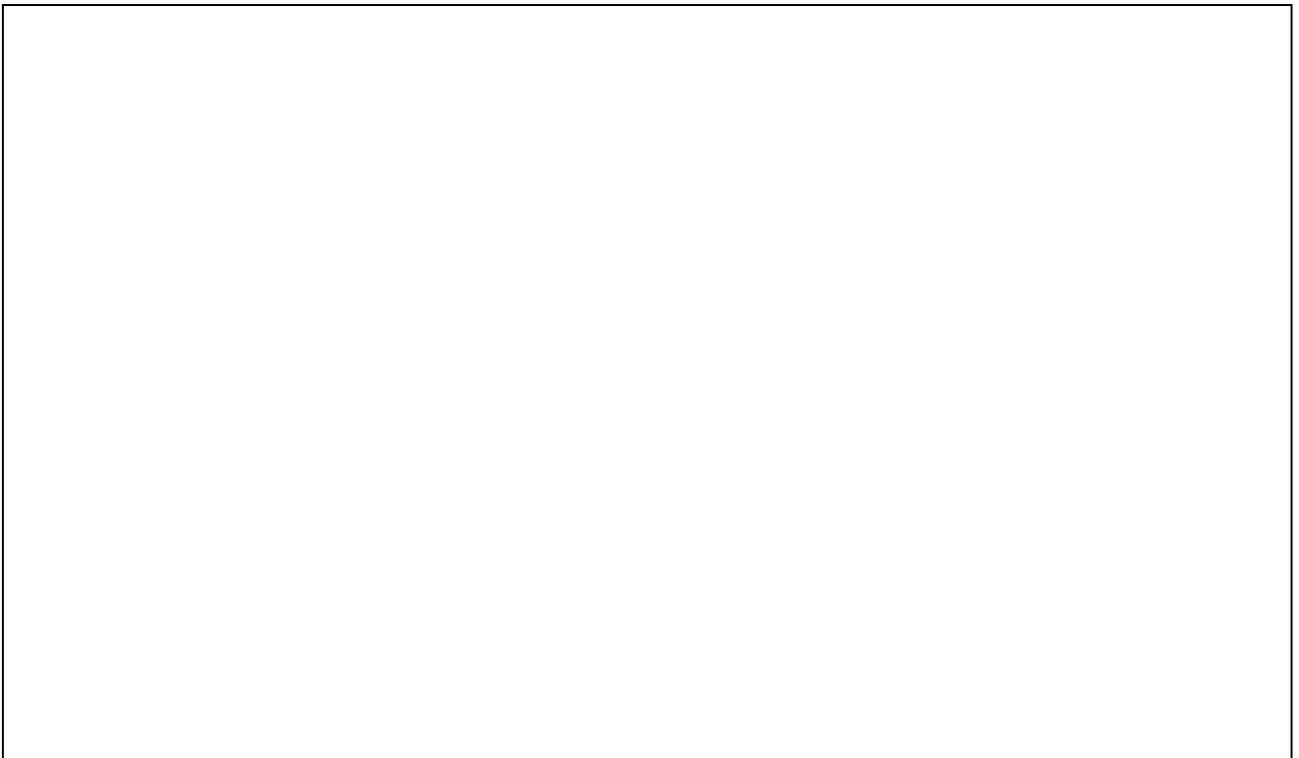
**Quiz: "The neuron – its parts & how it works"**

Directions: Do all drawings & labeling requested.

1.) Draw and label all the parts of a neuron.



2.) Draw and label all the parts of the synapse between two neurons.



3.) Draw and label the process of neurotransmission.



4.) Draw and label the passing of a "message" from one neuron to the next.



Name: \_\_\_\_\_ Date: \_\_\_\_\_

Investigation Worksheet #2 for **The Basics: "The neuron – its parts & how it works"** (page 1 of 1)

**Question: What is the connection between neurons, the brain and the body?**

Directions: Find, gather and record the requested information from assigned websites as listed on  
"WebQuest: Neurotransmitters, Cravings & Addiction"

1.) How many neurons are in the human brain?	<hr/> <hr/> <hr/> <hr/>
2.) What is the process that allows neurons to communicate with each other?	<hr/> <hr/> <hr/> <hr/>
3.) The nervous system is made up of what two systems?	a.) _____ b.) _____
4.) What are the two parts of the central nervous system?	a.) _____ b.) _____
5.) What are the two parts of the peripheral nervous system?	a.) _____ b.) _____
6.) What is the somatic nervous system?	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
7.) What is the autonomic nervous system?	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Investigation Worksheet #3 for **“Is Caffeine Addictive?”**

(page 1 of 1 )

Directions: Find, gather and record the requested information from assigned websites as listed on “WebQuest: Neurotransmitters, Cravings & Addiction”

1.) What is caffeine? (chemical compound)	_____ _____ _____
2.) How does caffeine affect the central nervous system? (stimulant or depressant)	_____ _____ _____
3.) Name two beverages that contain caffeine.  List the caffeine content of each item.	1.) _____ mg 2.) _____ mg
4.) Name two foods that contain caffeine.  List the caffeine content of each item.	1.) _____ mg 2.) _____ mg
5.) Which neurotransmitter is affected by caffeine?	_____ _____
6.) How does caffeine affect this neurotransmitter?	_____ _____ _____
7.) If caffeine has a physical dependency, then what are some of the withdrawal symptoms?	_____ _____ _____
8.) Is caffeine addictive? Why or why not?	_____ _____ _____ _____

Name: \_\_\_\_\_ Date Due: \_\_\_\_\_

WebQuest: "Neurotransmitters, Cravings and Addiction"

(page 1 of 1)

Project Worksheet: **for Poster, Oral Report and/or Pamphlet**

Directions: Use this worksheet to collect information for your project(s).

List the drug you are investigating.

Record the sources of your information.

Use additional sheets of line paper (folded in thirds) and attach to this worksheet.

Drug \_\_\_\_\_

<b>Question</b>	<b>Findings</b>	<b>Source of Information</b> Name of Site and the Web Address
1.) How does the drug affect the nervous system?	_____ _____ _____	_____ _____ _____
2.) Is it a stimulant or a depressant?	_____ _____	_____ _____
3.) How does the drug affect the human body?	_____ _____ _____	_____ _____ _____
4.) Which neurotransmitters are affected by the drug?	_____ _____	_____ _____
5.) How are the neurotransmitters affected by the drug?	_____ _____ _____ _____	_____ _____ _____ _____
6.) If the drug is addictive, then why is it addictive?	_____ _____ _____	_____ _____ _____
7.) What are the symptoms of withdrawal from the drug?	_____ _____ _____	_____ _____ _____

Name: \_\_\_\_\_ Due Date: \_\_\_\_\_

### Project Assignment: Poster and Oral Report

#### 1.) Template for the Poster:

<b>Title of the Poster</b>		
<b>Information:</b>  How does the drug affect the human body?  How is the nervous system affected by the drug?  Which neurotransmitters are affected & how?	<b>Picture or Drawing</b> of the Drug and/or Source of the Drug	<b>Information:</b>  Is the drug is addictive?  What are the withdrawal symptoms caused by the drug?
<b>Your Name &amp; Teammate's Name</b>		

#### 2.) Rubric: Poster

- a.) Overall, the poster must be neat, colorful and have no spelling errors.
- b.) Must include at least one picture or drawing of your drug and/or source of your drug.
- c.) Lettering must be readable from a short distance with block lettering.
- d.) Poster must include these five facts/concepts in outline form or with the use of bullets:
  - 1.) How the drug affects the human body.
  - 2.) How the nervous system is affected by the drug.
  - 3.) Which neurotransmitters are affected and how?
  - 4.) Is the drug addictive?
  - 5.) What are the withdrawal symptoms caused by the drug?
- e.) The five facts/concepts must be explained in your own words or cited with a source.
- f.) The poster must be formatted into three sections as indicated in the template, with a title on top and your names listed in the lower right hand corner.

#### 3.) Rubric: Oral Report

- a.) Must have a "hook" – Do you know? ... to entice your listener's attention.
- b.) Both student team members must speak for part of the presentation.
- c.) Do your presentation with minimal amount of reading from your notes.  
Be prepared with note cards and practice your presentation.
- d.) Speak on each of the 5 areas indicated on the poster.  
Speak loud and clear - to be heard - with no mumbling!
- e.) Use your poster as your visual.
- f.) Must submit a completed "Project Worksheet" as evidence of your research.

**Rubric for Project: Oral Report & Poster**  
**WebQuest: "Neurotransmitters, Cravings and Addiction"**

Name: \_\_\_\_\_ Due Date: \_\_\_\_\_

Name: \_\_\_\_\_ Today's Date: \_\_\_\_\_

Topic: \_\_\_\_\_

Criteria	Score (Max: 100 points)			
	Missing (0 points)	Novice (1 point)	Apprentice (3 points)	Proficient (5 points)
All materials are ready to use for the oral presentation: 1.) Note Cards _____ (Max: 10 points) 2.) Poster _____				
Oral Presentation included: (Max: 10 points) 1.) A Hook – Do You Know? _____ 2.) Five Important Facts/ Concepts _____				
Each student spoke for part of presentation. Each student spoke loud and clear. (Max: 10 points)				
Each student spoke with a minimum amount of reading from his/her notes. (Max: 5 points)				
Poster is neat, colorful, and readable. Poster includes a drawing or picture, as required. Poster is formatted into 3 sections as required. Poster has no spelling errors (Max: 20 points)				
Poster includes the 5 important facts/ concepts for the topic. Accurate information. (Max: 40 points)				
Evidence of Research: Submitted completed "Project Worksheet" for team. (Max: 5 points)				

Total Points Earned: \_\_\_\_\_ out of a possible 100 points.

Grade for the Project: \_\_\_\_\_ %

Name: \_\_\_\_\_ Due Date: \_\_\_\_\_

### Project Assignment: Pamphlet

#### 1.) Template for Pamphlet:

Outside:

<b>Resources:</b>  Name of Sites and the Web Addresses for each.		<b>Title of Pamphlet</b>  <b>Picture or Drawing</b> of the Drug and/or Source of the Drug  <b>Your name</b> <b>Your teammate's name</b>
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Inside:

<b>Information:</b>  What is the source of the drug?  How does the drug affect the human body?	<b>Information:</b>  How is the nervous system affected by the drug?  Which neurotransmitters are affected & how?	<b>Information:</b>  Is the drug addictive?  What are the withdrawal symptoms caused by the drug?
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#### 2.) Rubric: Pamphlet

- a.) Overall, the pamphlet must be neat & colorful, and have no spelling errors.
- b.) The pamphlet must be formatted into three sections as indicated in the template for the both outside and the inside of the pamphlet.
- c.) The cover must include: one picture or drawing of your drug and/or source of your drug, a title on top and your names listed in the lower right hand corner.
- d.) Lettering must be readable with block lettering.
- e.) Pamphlet must include these five facts/concepts in outline form or with the use of bullets:
  - 1.) How the drug affects the human body.
  - 2.) How the nervous system is affected by the drug.
  - 3.) Which neurotransmitters are affected and how?
  - 4.) Is the drug addictive?
  - 5.) What are the withdrawal symptoms caused by the drug?
- f.) The five facts/concepts must be explained in your own words or cited with a source.
- g.) The five facts/concepts must be placed on the pamphlet as indicated on the template.
- h.) Resources must be included on the back of the pamphlet.
- i.) Pamphlet must be written for the public to understand.

**Rubric for Project: Pamphlet****WebQuest: "Neurotransmitters, Cravings and Addiction"**

Name: \_\_\_\_\_ Due Date: \_\_\_\_\_

Name: \_\_\_\_\_ Today's Date: \_\_\_\_\_

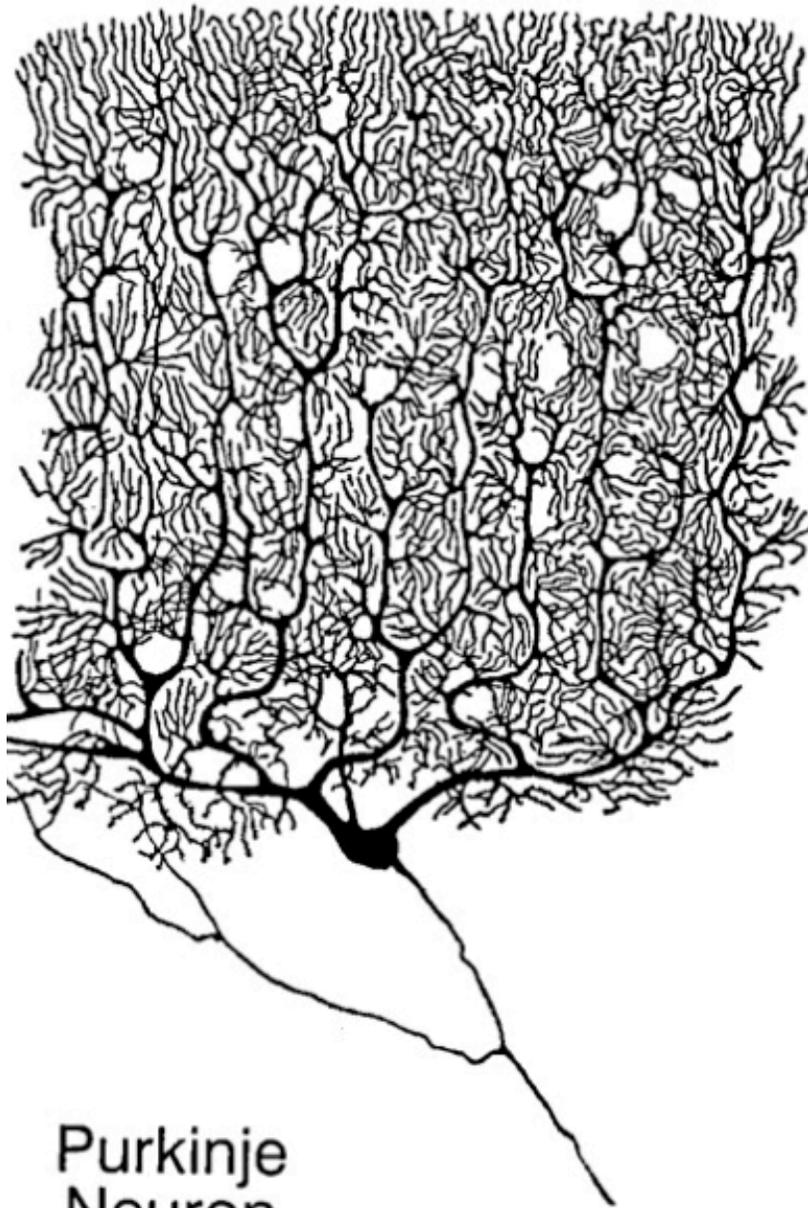
Topic: \_\_\_\_\_

Criteria	Score (Max: 100 points)			
	Missing (0 points)	Novice (1 point)	Apprentice (3 points)	Proficient (5 points)
Pamphlet is neat, colorful, and creative. Pamphlet is readable and has no spelling errors (Max: 10 points)				
Pamphlet is formatted into three sections for both the inside and the outside of the pamphlet.  All five facts/ concepts are placed in the pamphlet as indicated by the template. (Max: 10 points)				
Pamphlet includes a title and a picture or drawing, as required, on the front cover.  Pamphlet includes resources on the back. (Max: 10 points)				
Pamphlet includes the 5 important facts/ concepts for the topic. Accurate information. (Max: 50 points)				
The 5 facts/concepts are explained in the student's own words or cited for a source.  Each fact/concept includes a title and is outlined or bulleted for easy reading.  The pamphlet is written for the public to understand. (Max: 15 points)				
Evidence of Research: Submitted completed "Project Worksheet" for team. (Max: 5 points)				

Total Points Earned: \_\_\_\_\_ out of a possible 100 points.

Grade for the Project: \_\_\_\_\_ %

## An Example of a Neuron

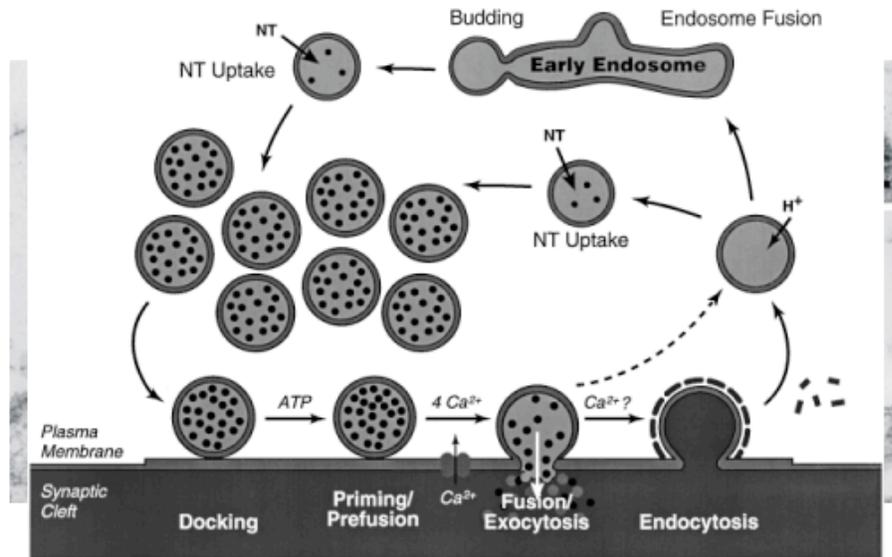


Purkinje  
Neuron

Joshua Sanes, "How do neurons look and what do they do?", Harvard University

## The Process of Neurotransmission

### Neurotransmitter release and synaptic vesicles



Professor Venkatesh Murthy, “Synapses: from vesicle to circuits”, Harvard University

### What does a synapse look like?



Professor Venkatesh Murthy, “Synapses: from vesicle to circuits”, Harvard University