



**Teens and Depression**

*December 2017/January 2018*

<http://www.acs.org/chemmatters>

**Teacher’s Guide**



**Teacher's Guide for**

***Teens and Depression***

**December 2017/January 2018**

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# Connections to Chemistry Concepts

|  |  |
| --- | --- |
| **Chemistry Concept** | **Connection to Chemistry Curriculum** |
| **Chemical bonding** | Antidepressant drug molecules use chemical bonding to block neurotransmitter reuptake channels. |
| **Catalysis** | When using the “lock and key” analogy to explain catalysis, link to its use to describe message transmission at a synapse. |
| **Organic functional groups** | While discussing organic functional groups, you can include the neurotransmitter molecules with an amino functional group. |
| **Organic structural diagrams** | While studying organic structures, note that this article uses abbreviated Lewis structures (skeletal formulas) to illustrate neurotransmitters. |

# Teaching Strategies and Tools

## Standards

* Links to **Common Core Standards for Reading**:

**ELA-Literacy.RST.9-10.1.** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

**ELA-Literacy.RST.9-10.5.** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, and energy).

**ELA-Literacy.RST.11-12.1.** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

**ELA-Literacy.RST.11-12.4.** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

* Links to **Common Core Standards for Writing**:

**ELA-Literacy.WHST.9-10.2F.** Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

**ELA-Literacy.WHST.11-12.1E.** Provide a concluding statement or section that follows from or supports the argument presented.

* In addition to the writing standards above, consider asking students to debate issues addressed in some of the articles. Standards addressed:

**ELA-Literacy.WHST.9-10.1B.** Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and **counterclaims** in a discipline-appropriate form and in a manner that anticipates the audience’s knowledge level and concerns.

**ELA-Literacy.WHST.11-12.1.A.** Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.

* Links to **Next Generation Science Standards**:

**HS-LS1-2 :** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

* **Disciplinary Core Ideas:**
* LS1.A: Structure and Function
* **Crosscutting Concepts:**
* Cause and effect: Mechanism and explanation
* Structure and function
* Stability and change
* **Science and Engineering Practices:**
* Constructing explanations and designing solutions
* Obtaining, evaluating, and communicating information
* **Nature of Science:**
* Scientific knowledge is based on empirical evidence

## Vocabulary

**Vocabulary** and **concepts** that are reinforced in the December 2017/January 2018 issue:

* Metric units
* Structural Formulas
* Fermentation
* pH
* Electrochemistry
* Oxidation & Reduction
* Amines
* Allotropes
* Physical properties
* London dispersion forces

# Reading Supports for Students

The pages that follow include reading supports in the form of an Anticipation Guide, a Graphic Organizer, and Student Reading Comprehension Questions. These resources are provided to help students as they prepare to read and in locating and analyzing information from the article.

The borders on these pages distinguish them from the rest of the pages in this Teacher’s Guide—they have been formatted for ease of photocopying for student use.

* **Anticipation Guide (p. 8):** The Anticipation Guide helps to engage students by activating prior knowledge and stimulating student interest before reading. If class time permits, discuss students’ responses to each statement before reading each article. As they read, students should look for evidence supporting or refuting their initial responses.
* **Graphic Organizer (p. 9):** The Graphic Organizer is provided to help students locate and analyze information from the article. Student understanding will be enhanced when they explore and evaluate the information themselves, with input from the teacher, if students are struggling. Encourage students to use their own words and avoid copying entire sentences from the article. The use of bullets helps them do this.

If you use the aforementioned organizers to evaluate student performance, you may want to develop a grading rubric such as the one below.

|  |  |  |
| --- | --- | --- |
| **Score** | **Description** | **Evidence** |
| 4 | Excellent | Complete; details provided; demonstrates deep understanding. |
| 3 | Good | Complete; few details provided; demonstrates some understanding. |
| 2 | Fair | Incomplete; few details provided; some misconceptions evident. |
| 1 | Poor | Very incomplete; no details provided; many misconceptions evident. |
| 0 | Not acceptable | So incomplete that no judgment can be made about student understanding |

* **Student Reading Comprehension Questions (p. 10):** The Student Reading Comprehension Questions are designed: to encourage students to read the article (and graphics) for comprehension and attention to detail; to provide the teacher with a mechanism for assessing how well students understand the article and/or whether they have read the assignment; and, possibly, to help direct follow-up, in-class discussion, or additional, deeper assignments.
* Most of the articles in this issue provide opportunities for students to consider how understanding chemistry can help them make decisions in their personal lives.
* To help students engage with the text, ask students which article **engaged** them most and why, or what **questions** they still have about the articles.
* You might also ask them how information in the articles might affect their health and/or consumer choices. Also ask them if they have questions about some of the issues discussed in the articles.

“Teens and Depression”, *ChemMatters*, December 2017/January 2018 Issue

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Anticipation Guide

“A Close-up Look at the Quality of Indoor Air” (*ChemMatters*, April/May 2016 Issue)

**Directions: *Before reading the article*,** in the first column, write “A” or “D,” indicating your agreement or disagreement with each statement. As you read, compare your opinions with information from the article. In the space under each statement, cite information from the article that supports or refutes your original ideas.

|  |  |  |
| --- | --- | --- |
| **Me** | **Text** | **Statement** |
|  |  | 1. In 2014, fewer than one in ten adolescents had a major depressive episode.
 |
|  |  | 1. Depression has several symptoms, including irritability.
 |
|  |  | 1. Only one area of the brain is affected in a depressed person.
 |
|  |  | 1. Neurons are highly specialized nerve cells that communicate information.
 |
|  |  | 1. Chemicals transmit information between neurons.
 |
|  |  | 1. Patients with depression have low levels of neurotransmitters.
 |
|  |  | 1. When teens experience side effects using antidepressants, they should stop taking the drugs immediately.
 |
|  |  | 1. There are two major types of antidepressants, SSRIs and MAOIs. The “I” in both types stands for “inhibitor.”
 |
|  |  | 1. Recent studies have shown antidepressants may encourage the growth of new neurons.
 |
|  |  | 1. Treating depression involves a combination of therapies.
 |

## Graphic Organizer

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

“Teens and Depression”, *ChemMatters*, December 2017/January 2018 Issue

**Directions**: ***As you read***, complete the graphic organizer below to compare SSRIs and MAOIs.

|  |  |  |
| --- | --- | --- |
|  | **SSRIs** | **MAOIs** |
| ***Examples*** |  |  |
| ***How they work*** |  |  |
| ***Side Effects*** |  |  |

**Summary:** On the back of this paper, write a short email (2-3 sentences) to a friend explaining the chemistry of depression.

## Student Reading Comprehension Questions

“Teens and Depression”, *ChemMatters*, December 2017/January 2018 Issue

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name

**Directions**: Use the article to answer the questions below.

* 1. When are sad and unhappy feelings considered clinical depression?
	2. What reason does the author provide to propose the belief that depression and substance abuse are linked?
	3. Complete the table below to identify the areas of the brain that shrink in people with symptoms of depression; describe the function of each area.

|  |  |
| --- | --- |
| **Affected brain area** | **Function of brain area** |
|  |  |
|  |  |
|  |  |

* 1. (a) Name the three parts of a neuron, and (b) describe how a signal is transmitted through each part.
	2. (a) Describe a synapse. (b) Why is the synapse important?
	3. (a) What is a neurotransmitter, and (b) how does it work?

**Student Reading Comprehension Questions, cont.**

“Teens and Depression”, *ChemMatters*, December 2017/January 2018 Issue

* 1. What is the monoamine hypothesis?
	2. (a) Name the three specific neurotransmitter chemicals referred to in the monoamine hypothesis. (b) How does the name “monoamine” describe these three chemicals?
	3. (a) How do SSRIs work? (b) Explain how SSRIs’ ability to mimic serotonin’s chemical structure allows enough serotonin to be transmitted to the next neuron.
	4. How do MAOIs work?
	5. Give two reasons why it is important for doctors to monitor newly diagnosed and medicated patients.
	6. What does depression research suggest about increasing the concentration of monoamines at synaptic terminals?

## Answers to Student Reading Comprehension Questions

1. **When are sad and unhappy feelings considered clinical depression?**

*Sad and unhappy feelings are considered clinical depression when they become chronic, prolonged and the person is unable to “will away” their bad mood.*

1. **What reason does the author provide to propose the belief that depression and substance abuse are linked?**

*A reason to think that depression and substance abuse are linked is that about 30% of teens with depression also have a substance abuse problem.*

1. **Complete the table below to identify the areas of the brain that shrink in people with symptoms of depression; describe the function of each area.**

|  |  |
| --- | --- |
| **Affected brain area** | **Function of brain area** |
| *amygdala* | *involved in memory and emotional reactions* |
| *thalamus* | *involved in speech, movement and learning* |
| *hippocampus* | *processes long-term memory* |

1. **(a) Name the three parts of a neuron and (b) describe how a signal is transmitted through each part.**

*The three parts of a neuron are dendrites, cell bodies and axons.*

*“A signal is received at the dendrite, travels through the cell body, and is released at the axon.”*

1. **(a) Describe a synapse. (b) Why is the synapse important?**
2. *A synapse is the space between the sending neuron’s axon and the receiving neuron’s dendrite.*
3. *The synapse is important because it is the place where information is passed via chemicals within the brain.*
4. **(a) What is a neurotransmitter, and (b) how does it work?**

*A neurotransmitter is a chemical that passes information from neuron to neuron.*

*Neurotransmitter chemicals are released from the axon of one neuron and received (across the synapse) by the dendrite of another.*

1. **What is the monoamine hypothesis?**

*The monoamine hypothesis states that low levels of monoamines cause inefficient signaling between neurons, resulting in symptoms of depression.*

1. **(a) Name the three specific neurotransmitter chemicals referred to in the monoamine hypothesis. (b) How does the name “monoamine” describe these three chemicals?**
2. *The three neurotransmitter chemicals referred to in the monoamine hypothesis are dopamine, norepinephrine, and serotonin.*
3. *The name “monoamine” describes each transmitter molecule that contains one amino (─NH2) group.*
4. **(a) How do SSRIs work? (b) Explain how SSRIs’ ability to mimic serotonin’s chemical structure allows enough serotonin to be transmitted to the next neuron.**
5. *SSRIs work by preventing serotonin reuptake.*
6. *SSRIs’ ability to mimic serotonin’s chemical structure allows them to tightly bind to the serotonin reuptake channel, preventing serotonin reuptake (thus allowing enough serotonin to be transmitted to the next neuron, restoring neural circuitry).*
7. **How do MAOIs work?**

*MAOIs work by inhibiting “the activity of monoamine oxidase to prevent the breakdown of monoamine neurotransmitters and increase their availability.”*

1. **Give two reasons why it is important for doctors to monitor newly diagnosed and medicated patients.**

*It is important for doctors to monitor newly diagnosed and medicated patients because*

1. *each person reacts differently to medication.*
2. *finding the right medication and dose may take time (trial and error) for the full effect and for side effects to ease as the body adjusts.*
3. **What does depression research suggest about increasing the concentration of monoamines at synaptic terminals?**

*Depression research suggests that increasing the concentration of monoamines at the synaptic terminals may encourage the growth of new neurons.*

# Possible Student Misconceptions

1. **“I’ve heard that only adults can become truly depressed.”** *This is a major misconception that may lead to teens being told to simply “cheer up”. In June 2016, scientists reported that 29.9% of high school students reported at least one major depressive episode during the past year.*
2. **“I can tell when someone is depressed because they look sad and walk around with their heads down.”** *There are other signs of depression besides looking sad. Depression may cause feelings of weakness and irritability, as well as changes in appetite, restlessness and substance abuse.*
3. **“My cousin told me that prescription drug treatment for depression is too strong for teens. He said that it’s better if they get over it by themselves.”** *Antidepressant medications have been shown to be effective in helping teens recover from depression. Untreated depression is the number one cause of teenage suicide.*
4. **“I’ve heard that once depression is treated with medication, it goes away completely.”** *Almost 75% of teenagers who experience a clinical depression episode may require further treatment later in life.*
5. **“I read that most people with depression can’t be helped.”** *Fortunately, this is not true because depression can be effectively treated in 90% of the cases through a combination of medication and therapy. Unfortunately, only one in three people with depression seek professional help.*

# Anticipating Student Questions

1. **“My mother has always suffered bouts of depression. If I’ve inherited depression, what can I do?”** *Depression often has a genetic component, so reduce your risk by creating a healthy life style for yourself. Manage your stress, stay connected with positive supportive friends, eat well, avoid drugs, exercise, and seek professional help if needed.*
2. **“Wow! The side effects of antidepressants sound worse than depression; are they really for teens?”** *Yes, antidepressants are often an effective way to treat teenage depression. However their use must be monitored carefully by a physician to avoid severe side effects.*
3. **“Why does teen depression affect girls more than boys?”** *Teen depression is twice as prevalent in girls. Girls experience twice as many “interpersonal stressors”, including cyberbullying, as boys and they react to these more strongly than boys.*
4. **“Are depressed kids always ‘loners’”?** *Depression doesn’t distinguish between “loners” and popular teens that socialize to avoid appearing depressed. The only connection is that depressed teens feel alone, even when surrounded by friends.*
5. **“Are the signs of teen depression the same as those of adults?”** *Teen depression often manifests itself differently from adult depression. Some depressed teens may become defiant and irritable, leading to being labeled as a “trouble maker”.*
6. **“When I feel depressed, my friend offers to share a few of her Paxil pills to get me over the slump. Is there a problem with this?”** *Always check with your doctor before taking medicine that was prescribed for someone else. For example, if an SSRI is taken with another medication that also increases serotonin the body’s reuptake system may be unable to handle the large excess of the neurotransmitter. When the body has too much serotonin a condition called serotonin syndrome occurs, resulting in excessive nerve cell activity. Side effects such as agitation, restlessness, muscle twitching, irregular heart beat and seizures require immediate medical attention. (*[*https://www.webmd.com/depression/guide/serotonin-syndrome-causes-symptoms-treatments#1*](https://www.webmd.com/depression/guide/serotonin-syndrome-causes-symptoms-treatments#1)*)*

# Activities

**Special note of caution: Due to the sensitivity of this topic, some teachers might prefer not to present some of the activities below to their students, considering that it might be more appropriate for students to discuss teen depression in a clinical educational setting, rather than in a chemistry class. Due to the need for extreme caution on the part of chemistry teachers in discussing this material, consultation with the school nurse or other professionals may be necessary if teachers intend to explore the topic in depth.**

**Simulations**

**This Web site allows stimulation of a neuron:** Note that the caution note above does not apply to this simulation, which is appropriate for all classes. This is a PhET simulation from the University of Colorado; the simulation is free, but teachers must register. There are tips on how to manipulate the diagram to show the ions moving across the membrane of the neuron. (<https://phet.colorado.edu/en/simulation/neuron>)

**Media**

**Video (0:28) “Teen Depression on the Rise”:** Video shows results of a November 2016 study published in the *Journal of Pediatrics* that finds a 37% increase in teen depression during the last decade without a corresponding increase in mental health treatment. An article explaining the results of this study accompanies the video. (<http://time.com/4572593/increase-depression-teens-teenage-mental-health/>)

**KhanAcademy video (11:09) “Treating Depression with Antidepressants”:** This educational video clearly explains neurotransmission using narration and illustration to describe the different mechanisms used by MAOIs and SSRIs and other types of antidepressants to correct the imbalance of neurotransmitters that results in depression. (OK for a chemistry class audience) (<https://www.khanacademy.org/science/health-and-medicine/mental-health/depression-and-related-disorders/v/treating-depression-with-antidepressants>)

**Lessons and lesson plans**

 **Lesson plan—small group discussion (1–2 50-min. class periods):** In this well-designed lesson plan and suggested PBS program, “Depression: On the Edge”, students discuss their personal experiences with teenage depression. **NOTE that this program and lesson contain material that is probably more appropriate for psychology or health classes.** (<http://www.pbs.org/inthemix/educators/lessons/depression1/>)

**Projects and extension activities**

**Research and debate**─**Does a link exist between creativity and depression?** Watch the video “Creativity and Depression: What causes the link?” (3:46).(<https://www.youtube.com/watch?v=CtOKjHgNsQw>). Then use internet research to gather data to debate this question in class.

This URL for teachers provides examples of famous artists (musicians, painters, scientists) who endured harsh physical and emotional hardships during their early lives. They survived early experiences yet suffered bouts of depression throughout their later lives, bringing the question about a possible link between creativity and depression: (<https://blogs.scientificamerican.com/beautiful-minds/the-real-link-between-creativity-and-mental-illness/>)

**Research on antidepressants:** Compose a question about antidepressants, and use research from the internet to write a letter to a friend explaining what you discovered. Examples for teachers:

* What is the history of antidepressant use? (<http://www.sciencemuseum.org.uk/broughttolife/techniques/antidepressants> or <http://www.brainphysics.com/articles/treatment/medication/the-history-of-antidepressant-drugs>)
* Is the use of antidepressants by Americans increasing or decreasing? (<https://www.health.harvard.edu/blog/astounding-increase-in-antidepressant-use-by-americans-201110203624>)

**Research project to investigate whether heredity plays a role in teen depression:** Use the internet or other resources to collect data about the possibility of a link between heredity and teen depression. Here are three Web sites to use as an introduction to this study: <https://www.recoveryranch.com/articles/therapy/depression-heredity/>, <https://link.springer.com/article/10.1007/s10964-015-0306-0>, and <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3565713/>.

# References

**The references below can be found on the *ChemMatters* 30-year DVD, which includes all articles
published from the magazine’s inception in October 1983 through April 2013; all available Teacher’s Guides, beginning February 1990; and 12 *ChemMatters* videos. The DVD is available from the American Chemical Society for $42 (or $135 for a site/school license) at this site:** [**http://ww.acs.org/chemmatters**](http://www.acs.org/chemmatters)**. Click on the “Teacher’s Guide” tab to the left, directly under the “*ChemMatters Online"* logo and, on the new page, click on “Get the past 30 Years of *ChemMatters* on DVD!” (the icon on the right of the screen)**

**Selected articles and the complete set of
Teacher’s Guides for all issues from the past three
years are available free online at the same Web site, above. Click on the “Issues” tab just below the logo, *“ChemMatters Online”*.**

***30* Years of *ChemMatters !***

Available Now!

This article describes herbal supplements including St. John’s Wort (page 19) that contain the active ingredient hypericin, which decreases depression by inhibiting the action of monoamine oxidase. (Roth, C. Extracting Medicine from Plants. *ChemMatters*, 2003, *1* (21), pp 17–19)

This article is an excellent reference with a focus on the chemistry of depression. Chemical structures are included with descriptions of the processes involved in the ability of SSRIs, MAOIs, and a third class of antidepressants, tricyclics, to reduce depression. (Kimbrough, D. More than Blue. *ChemMatters*, 2005, *1* (23), pp 8–11)

# Web Sites for Additional Information

**General information**

This Web site, “Transforming the understanding and treatment of mental illness”, prepared by the U.S. National Institute of Mental Health (NIMH), is a very comprehensive educational resource that covers most of the material in the *ChemMatters* Scaduto article and in this Teacher’s Guide. Through text and audio accompanied by excellent diagrams (option: a downloadable pdf version), “Brain Basics” covers the growing brain, how it works, genetics and basic brain research. (<https://www.nimh.nih.gov/health/educational-resources/brain-basics/brain-basics.shtml>)

**Teen depression—signs and dangers**

 This Mayo Clinic Web site is a “go-to” place for information about teen depression. In the overview, teen depression is defined as a “serious mental health problem”. Links on the site include emotional and behavioral changes, diagnosis and treatment, and self-management. (<http://www.mayoclinic.org/diseases-conditions/teen-depression/home/ovc-20164553>)

 The National Institute of Mental Health (NIH) runs clinical trials for the “Teen Depression Study: Understanding Depression in Teenagers”. Their Web site lists signs and symptoms of teenage depression and invites those who experience these most of the day or nearly every day for at least two weeks to consider joining the trials. (<https://www.nimh.nih.gov/health/topics/depression/index.shtml#part_145397>)

**Brain remodeling**

This paper describes the structural changes that occur in the brain due to stress and depression. Research data describes how these changes can be prevented and possibly reversed by mood-stabilizing medications. (<http://www.dbsalliance.org/site/PageServer?pagename=education_anxiety_stress_brain_structure>)

 *Psychology Today* compares research data from magnetic resonance imaging (MRI) studies of the brains of individuals with psychiatric disorders and/or substance abuse problems to MRIs of healthy individuals. Scans show measurable size reductions in the key areas of brains affected by psychosis and/or substance abuse. (<https://www.psychologytoday.com/blog/heal-your-brain/201107/depression-and-anxiety-disorders-damage-your-brain-especially-when>)

**Neurotransmission**

“What is neurotransmission?” is designed as a 7–12 grade student teaching tool. In a two minute video, “Synaptic Transmission”, an animator draws diagrams, while text explains the process, and a list of defined vocabulary are included. (<https://www.sciencenewsforstudents.org/article/explainer-what-neurotransmission>)

 This technical paper uses animations and text to explain how action potentials (electrical signals) are generated by ions as they move across the axon membrane and through ion channels. (<http://www.mind.ilstu.edu/curriculum/neurons_intro/neurons_intro.php>)

**Chemistry of neurotransmission**

 **KhanAcademy video (11:09) “Treating Depression with Antidepressants”:** This educational video is safe to use in all chemistry classes. It clearly explains neurotransmission, using narration and illustration to describe the different mechanisms used by MAOIs and SSRIs and other types of antidepressants to correct the imbalance of neurotransmitters that results in depression. (<https://www.khanacademy.org/science/health-and-medicine/mental-health/depression-and-related-disorders/v/treating-depression-with-antidepressants>)

**Neurotransmitters—classification**

When classified by function, neurotransmitters can be described by their action in one of two ways, inhibitory (creating calm balance in the brain) and excitatory (stimulating the brain). The article uses this classification to separate a selection of neurotransmitters; information about each neurotransmitter is included. (<https://www.biotecharticles.com/Biology-Article/Neurotransmitters-and-its-types-347.html>)

This neurophysiology site contains excellent diagrams that illustrate how ionic action potentials are developed and their role in opening and closing ion channels. Neurotransmitters are classified by their chemistry based on molecular structure. (<https://courses.lumenlearning.com/boundless-ap/chapter/neurophysiology/>)

**Treatment options**

Medication—Two antidepressants for teens have been approved (with Black Box warnings) by the U.S. Food and Drug Administration (FDA): fluoxetine (Prozac) and escitalopram (Lexapro). Adolescent response to antidepressants varies, so their use must be carefully monitored, may induce suicidal behavior, and are considered less effective for teenagers than psychotherapy. (<http://www.mayoclinic.org/diseases-conditions/teen-depression/diagnosis-treatment/treatment/txc-20164566>)

 Psychotherapy—This open-access paper explores research on the use of Cognitive-Behavioral Therapy (CBT) with depressed and suicidal adolescents. The rationale for the use of CBT with a focus on whether it effectively reduces suicidal thoughts and behaviors is developed through the results of prior studies and the specific techniques used. (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3073681/>)

**Antidepressants**

 Since antidepressant drugs have been developed to affect the behavior of neurotransmitters in different ways, this WebMd site is organized by links to different mechanisms: reuptake inhibitors, tetracyclics and SSRIs and tricyclics and MAOIs. Each section explains how the antidepressant works, which neurotransmitter it affects, and the relevant prescription drugs. (<http://www.webmd.com/depression/how-different-antidepressants-work#1>)

 Harvard Medical School discusses the importance of reanalyzing both the published and unpublished prior trials investigating the effects on teens of the antidepressant Paxil. Due to poor methodology (drug company funding or results not published), one trial found Paxil safe and effective for teens, while another found it no more effective than a sugar pill placebo. (<https://www.health.harvard.edu/blog/anti-depressants-for-teens-201601229018>)

**Antidepressants—side effects**

 The *Journal of Canadian Child Adolescent Psychiatry* published their 2016 Position Statement on the use of SSRIs and serotonin norepinephrine reuptake inhibitors (SNRIs) in children and adolescents, following a thorough review of the literature. A risk/benefit analysis of the data suggests that the SSRI fluoxetine (Prozac) is the best medication for adolescents suffering Major Depressive Disorder (MDD), due to its long half-life and lesser tendency toward suicide. (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4791100/>)

 This site provides lists of some SSRIs prescribed for children and teens by generic and brand names. Each name is linked to detailed information on uses, side effects, interactions, overdose, and an image of the medicine. (<http://www.webmd.com/depression/selective-serotonin-reuptake-inhibitors-ssris-for-childhood-and-adolescent-depression>)

**Causes—environmental and genetic**

This Harvard Health site can be a valuable classroom resource because it describes the effects of depression shown by brain images and neurotransmission. Environmental causes of depression such as stress, early childhood loss, grief, and the role of trauma are described. (<https://www.health.harvard.edu/mind-and-mood/what-causes-depression>)

 A summary of research leading to a possible link between depression and genetics by Stanford University Medicine provides estimates of the risk of inheriting depression, and the “further reading” section gives links to many studies. Studies of twins (fraternal and identical) suggest that a combination of genes may lead to a predisposition to depression. (<http://depressiongenetics.stanford.edu/mddandgenes.html>)

# About the Guide

Teacher’s Guide team leader William Bleam and editors Pamela Diaz, Steve Long and Barbara Sitzman created the Teacher’s Guide article material.

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Susan Cooper prepared the anticipation and reading guides.

Terri Taylor, *ChemMatters* Teacher’s Guide interim editor, coordinated production and prepared the Microsoft Word and PDF versions of the Teacher’s Guide.

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Articles from past issues of *ChemMatters* and related Teacher’s Guides can be accessed from a DVD that is available from the American Chemical Society for $42. The DVD contains the entire 30-year publication of *ChemMatters* issues, from February 1983 to April 2013, along with all the related Teacher’s Guides since they were first created with the February 1990 issue of *ChemMatters*.

The DVD also includes Article, Title, and Keyword Indexes that cover all issues from February 1983 to April 2013. A search function (similar to a Google search of keywords) is also available on the DVD.

The *ChemMatters* DVD can be purchased by calling 1-800-227-5558. Purchase information can also be found online at <http://tinyurl.com/o37s9x2>.