

# WAYNE STATE UNIVERSITY

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## COLLEGE OF EDUCATION

**Division:** Teacher Education      **Program Area:** Science Education

**Course Section #:** SCE 5020-001   **CRN#** 31086   **Term/Year:** Spring 2015

**Course Title:** Physical Science for Elementary and Middle School Teachers

**Course Credit:**      Three Semester Hours

**Course Location:**    255 Education

**Day:** Monday/Wednesday   **Time:** 5:00 PM – 7:45 PM

**Instructor:**    Dr. Sandra Yarema

**Mailbox: Main Campus: 280 COE, South Office Corridor**

Office Hours: To be arranged by appointment

**Office Phone/Direct Voice Mail:** (313) 577-5754

**Department secretary:** (313)577- 0991 Leave detailed message

**Email:** [ar3209@wayne.edu](mailto:ar3209@wayne.edu)

**Website:** <http://blackboard.wayne.edu>

### **Course Description:**

This course covers significant physical science principles, generalizations, and understandings with relation to their use with children in elementary and middle school. Appropriate learning activities, experiments, field trips, text and reference materials, technological applications, and evaluations will be a part of this course.

### **Course Outcomes:**

As a result of participating in the activities related to this course, the students should be able to:

1. Know and apply basic concepts and principles related to physical science.
2. Relate understanding of physical science to current societal issues.
3. Use scientific and engineering practices to learn about natural phenomena - design and conduct investigations on topics related to physical science using appropriate methodology and technology.
4. Apply mathematics in the collection, analysis and interpretation of data.
5. Communicate findings using appropriate technologies.
6. Use various sources (professional journals, textbooks, the Internet and the community) to access new and reconstruct previously learned knowledge.
7. Develop and express a more positive and enthusiastic attitude about physical science.

### **Course Philosophy:**

The class involves discussion of major physical science concepts, principles and generalizations interspersed with group activities addressing science as a process. These activities stress learning science through inquiry. The *National Science Standards* call for the use of inquiry as a means for learning/teaching science in grades K-12. In order for teachers to use this approach in their own teaching, they must become thoroughly comfortable with it through their own learning.

Integration of various subject-discipline areas, such as math, language, and social studies, are also modeled with the teaching/learning of science. Science is perhaps the best subject for the development of an integrated curriculum. Students will have the opportunity to become familiar with some of the ways in which this can be done.

### **Required Text(s):**

The required textbooks are:

Kane Publishing. (2006). *ScienceSaurus grades 6-8: A student handbook*  
Wilmington, MA: Great Source Education Group.

Michigan Department of Education. (2007). *Science grade level content expectations* (v.12.07). Lansing, MI: (Available at [http://www.michigan.gov/mde/0,1607,7-140-28753\\_33232---,00.html](http://www.michigan.gov/mde/0,1607,7-140-28753_33232---,00.html))

National Research Council/Lead States. (2013) *Next Generation Science Standards*. Free .pdf available: <http://www.nextgenscience.org/next-generation-science-standards>

### **Policies:**

Each class meeting is almost three hours long, and a large amount of material is covered in each meeting. Thus, it is **essential that you attend each class to do well in the course**. Attendance will be taken at the beginning of class. Absences will be excused under certain circumstances such as illness and death in the family **when the student provides the instructor with evidence** of such emergencies. Excused absences will be by notes from doctor or other relevant official. Absentees are responsible for: (1) getting any handouts passed out during the missed class, (2) any in-class announcements, (3) changes in syllabus, and (4) material discussed in class. There will be no make-up of activities missed.

**Please arrive to class on time. Class announcements are given at the beginning of class, which you will miss if arriving late. Late arrivals are also disruptive to everyone in class. Cancellations of Class & "Snow/No-Power"** If, for any reason, WSU cancels class, I will post an announcement in Blackboard and attempt to notify students through CAMPUS e-mail. If Campus is open, expect to attend class. (Campus Newline: (313)577-5345 or [www.wayne.edu](http://www.wayne.edu)) See above responsibilities of absentees.

**\*Unless Specifically Designated: NO Cell phone/text device use during class time. Please turn cell phone off/silent mode before entering class.** Smart Phones/PDAs/Laptops must be stored away unless necessary for assigned class work; Printing available in Computer Lab, Downloading from blackboard and printing should be done outside of class time.

**Course Communication:** Class communication will utilize Blackboard and the class email list. Students must be able to access the course Blackboard site to retrieve important information about the course. This syllabus will be posted on the Blackboard site, along with assignment details, lecture presentations, notes and other communications. The site may be entered through <http://blackboard.wayne.edu>. WSU provides free email to students. Unless you use your WSU user ID as your email, you will miss any communication sent to you using such email. You may connect your WSU email to another email address by going to <http://webmail.wayne.edu> by following these steps:

1. Click on “**Preferences**” on top side of the page
  2. Click on “**Accounts**”
  3. Click on “**Add external Account**” on the top right of the page
- Enter the information requested

**Academic Dishonesty/Plagiarism:** The College of Education has a “zero tolerance” approach to plagiarism and other forms of academic dishonesty. (See Student Code of Conduct <http://doso.wayne.edu/assets/student-code-of-conduct-brochure.pdf>). Plagiarism includes copying material (any more than 5 consecutive words) from outside texts or presenting outside information as if it were your own by not crediting authors through citations. It can be deliberate or unintended. Specific examples of academic dishonesty, including what constitutes plagiarism, can be found in the University’s Undergraduate Bulletin (<http://bulletins.wayne.edu/ubk-output/index.html>) and Graduate Catalog (<http://www.bulletins.wayne.edu/gbk-output/index.html>) under the heading “Student Ethics.” These university policies are also included as a link on Blackboard within each course in which students are enrolled. It is every student’s responsibility to read these documents to be aware which actions are defined as plagiarism and academic dishonesty. Sanctions could include failure in the course involved, probation and expulsion, so students are advised to think carefully and thoroughly, ask for help from instructors if it is needed, and make smart decisions about their academic work.

**If you are in doubt about the use of a source, cite it. Please read the handout titled “Plagiarism” under “Assignments” on the course’s Blackboard site.**

**Attention Students with Disabilities:** Wayne State University is committed to providing students with disabilities an equal opportunity to benefit from its programs, services, and activities. If you have a disability that limits your participation in class in any way, please inform the professor and accommodations in the course will be made. The Student Disabilities Services (SDS) is located in room 1600 in the Adamany Undergraduate Library. Phone number: (313) 577-1851. The SDS Student Handbook, on-line at <http://studentdisability.wayne.edu/> includes departmental procedures and policies, in addition to the many forms that may be used to request the services and accommodations that you require.

**Academic Success:** The Academic Success Center in the Adamany Undergraduate Library provides tutoring by appointment at no cost as well as training in areas such as time management, study and testing skills. Contact Info: Tel. 313/577-3165 **Web.** <http://www.success.wayne.edu/> **Do visit the Success center if you begin having difficulty in any of the courses you are taking.**

**Wayne State University Writing Center:** The Writing Center (2<sup>nd</sup> floor, UGL) provides individual tutoring consultations free of charge for students at Wayne State University. While the center serves both graduate and undergraduate students, undergraduate students in General Education courses, including composition courses, receive priority for tutoring appointments. The Writing Center serves as a resource for writers, providing tutoring sessions on the range of activities in the writing process – considering the audience, analyzing the assignment or genre, brainstorming, researching, writing drafts, revising, editing, and preparing documentation. The Writing Center is **not** an editing or proofreading service; rather, students are guided as they engage collaboratively in the process of academic writing, from developing an idea to correctly citing sources. To make an appointment, consult the Writing Center website: <http://www.clas.wayne.edu/writing/>.

**Religious Observance Policy:** Because of the extraordinary variety of religious affiliations represented in the University student body and staff, the Wayne State University calendar makes no provision for religious holidays. It is University policy, however, to respect the faith and religious obligations of the individual. Students who find that their classes or examinations involve conflicts with their religious observances are expected to notify their instructors well in advance so that alternative arrangements may be worked out.

**Regarding a Grade of Incomplete:** All students are expected to complete the course by the end of the semester. If during the semester, you feel that at that time, you cannot handle the amount of work required for this course, please drop the class. A grade of incomplete “I” will be given only to a student who is doing well in the course and who, due to unforeseen circumstances such as a serious accident, is unable to complete all the course assignments. Under these circumstances, the student must make arrangements with the instructor, ***before the final exam is administered***, in order to fill out a “contract” in which the student’s responsibilities are stipulated and agreed upon. Incompletes will revert to a failing grade after one calendar year, there will be no extensions. **A grade of incomplete will not be given to a student who at the time of the request is failing the course.**

### **Enrollment/ Withdrawal Policy**

Students must add classes no later than the end of the first week of classes. This includes online classes. Students may continue to drop classes (with full tuition cancellation) through the first two weeks of the term.

Students who withdraw from a course after the end of the 5th week of class will receive a grade of WP, WF, or WN.

- WP will be awarded if the student is passing the course (based on work due to date) at the time the withdrawal is requested
- WF will be awarded if the student is failing the course (based on work due to date) at the time the withdrawal is requested
- WN will be awarded if no materials have been submitted, and so there is no basis for a grade

Students must submit their withdrawal request on-line through Pipeline. The faculty member must approve the withdrawal request before it becomes final, and students should continue to attend class until they receive notification via email that the withdrawal has been approved.

Beginning the fifth week of class students are no longer allowed to drop but must **withdraw** from classes. The last day to withdraw will be at the end of the 10<sup>th</sup> full week of classes. The withdrawal date for courses longer or shorter than the full 15-week terms will be adjusted proportionately.

This means that **the course withdrawal deadline is Sunday, June 14, 2015.** See the university webpage for full details: <http://reg.wayne.edu/students/information.php>

### **Grading System:**

The final grade is calculated from the various assignment grades, class attendance and participation in activities, and the research project. **These categories will be weighted by value.** Scores/Point values will be recorded in blackboard to help you keep track of your progress throughout the semester and may not reflect the final value weighting.

<b>Class Attendance, Activities and Participation (75 points)</b>	<b>20 %</b>
<b>Exams (104 points)</b>	<b>30 %</b>
<b>Assignments (350 points)</b>	<b>30 %</b>
<b>Research Project (180 points)</b>	<b>20 %</b>
Design                   5 %	
Presentation           5 %	
Final Report           10 %	

### **General Note**

The College of Education Faculty members strive to implement assessment measures that reflect a variety of strategies in order to evaluate a students’ performance in a course. For undergraduates C grades will be awarded for satisfactory work that satisfies all course requirements. B grades will be awarded for very good work and A grades will be reserved for outstanding performance. Please note that there is a distribution of

grades from A – F within the College of Education and that plus and minus is recorded and distinguish distinct grade point averages.

**Undergraduate Grades will be assigned as follows:**

93-100 %	=	A
90-92 %	=	A-
87-89%	=	B+
83-86 %	=	B
80-82 %	=	B-
77-79 %	=	C+
73-76 %	=	C
70-72 %	=	C-
67-69 %	=	D+
63-66 %	=	D
60-62 %	=	D-
Less than 60%	=	F

**Graduate Grades will be assigned as follows:**

93 – 100%	=	A
90 - 92%	=	A-
87 - 89%	=	B+
83 - 86%	=	B
80 - 82%	=	B-
77 - 79%	=	C+
73 - 76%	=	C
Less than 73%	=	F

**COURSE ASSIGNMENTS:**

The instructor will provide criteria and a grading rubric for each assignment. (Available in Blackboard). These criteria should be used as guidelines for what the instructor expects in each assignment.

- Assignments may be submitted electronically by the end-of-day on the date the assignment is due **or** hard copy turned on the due date during class.
- **Late assignments will decrease in point value by 5% of the allocated points for each day the assignment is late.**
- To meet professional quality and presentation standards required of practicing teachers, assignments will be graded on clarity of ideas, grammar, spelling, and adequate word choice. **Assignments must be typed on a word-processor. Submissions must be accessible in Blackboard ( MS-Office compatible, or .pdf file)**

**Class Participation, Readings, In-class Activities, and Homework:** Consideration will be given to attendance, participation in class discussions and in-class activities, quality of homework and entries on the discussion board. **Your attendance and promptness are important.**

**Assignments:**

• **Scientific Method Inquiry Project & Presentation**

In this course, you must design and conduct an experiment to test a selected hypothesis (List of suggested topics will be provided). You are to use accepted scientific methods and demonstrate science process skills. The topic you choose to investigate must be congruent with any physical science concept in Michigan Curriculum Framework. You will prepare a power point presentation of your findings.

**The project will have 3 parts:**

1. **Project Design** should include the hypothesis that you will test, the variables (identified and defined), and the materials that will be needed to conduct the experiment.
2. **Power Point Presentation** - you will design a 10-minute Power Point Presentation on your project. Please refer to the guidelines for the Power Point Presentation. Everyone will present their project, symposium style, and rotate around to peer- review other presentations.
3. **Final Project Report Paper** The final report is a detailed description of every aspect of your research project. Please refer to the guidelines for your research project report.

- **Real World Questions**

This assignment is comprised of 4 “real-world” questions that target specific physical science benchmarks found within the Science Content Grade Level Expectations. This assignment has two purposes: (1) it will help you develop understanding of various science topics; (2) it will help you practice formulating clear and thorough explanations for others. It is important that teachers not only know the subject they teach, but that they also can effectively communicate important ideas to their students. This assignment requires the development of both of these skills.

- **Scientific Model**

You must develop a deep understanding of science and engineering practices. Choose a Physical Science topic or major concept covered in class and develop a model that can be used to help explain the topic/concept. Refer to the guidelines and grading rubric provided for the assignment.

- **Choice Assignments** Choose **ONE** of the assignments listed below:

- **Attend a Conference or Workshop**

- See the rubric on blackboard for submitting a report related to this experience.

- **Annotated Webliography**

- Create an Annotated Webliography of 10 or more interactive physical science web resources. Each resource must be aligned with a physical science Grade Level Content Expectation. The rubric for the Webliography is posted on Blackboard.

- **Concept Map**

- Choose a topic within **Physical science** and use the graphic tools or software such as *Inspiration*® to draw a concept map that shows the interrelationships among its various concepts. Please refer to the guidelines and grading rubric provided for the assignment.

- **Jeopardy Quiz**

- To demonstrate your understanding of the concepts for this course you are to create a Jeopardy Game using physical science concepts or topics. The directions and rubric for creating the game is posted on Blackboard. You are to select 5 concepts as categories.

- **Technology Integration Session:** One class session will be presented as technology work sessions. You will log into blackboard, access the web-links on the designated topics, and then complete and submit the response assignment. There will be **no on-campus meetings for this session**; you may complete the assignment from whenever and wherever you have access to *Blackboard*.

- **Course Portfolio File:** An organization of all the materials in the Blackboard site into an electronic Course Portfolio File Resource. May be submitted as a CD-ROM or flash drive, or as a link to a cloud-memory (*Dropbox*®), must be clearly labeled with student's name. must be clearly labeled with student's name. **Refer to guidelines and grading rubric provided.**

- **Exams**

There will be **Three Exams** in this course. These exams are a combination of multiple-choice, short answer, and essay items. The material for each examination will include items from class activities, handouts, and articles assigned for reading. The 2<sup>nd</sup> and 3<sup>rd</sup> exams will cover only the concepts and activities presented after the preceding exam.. **A study guide will be available before each exam.** We will discuss the possibility for us to schedule exams to be done in Blackboard environment instead of during a class meeting on-campus.

You will be informed of changes to the scheduled topics and /or due dates should the necessity arise. ALL work must be submitted before 7:45 p.m., Wednesday, June 24 to be considered for grading. See Pipeline <http://www.pipeline.wayne.edu> for other important dates and deadlines.

**Class Schedule and Topics:**

Date	Topics Considered
<b>May 11</b> 1	Orientation --Assignments Science & Engineering Practices Grade Level Content Expectations (GLEC's) Next Generation Science Standards (NGSS/MiSSciS) Nature of Science <b>Related text reading –Pages 068, 001—019</b>
<b>May 13</b> 2	Matter & Its Properties: Motion of Molecules Structure of Atoms The Periodic Table of Elements Phases/States of Matter <b>Due: Information Page (submit in Blackboard)</b> <b>Related text reading –Pages 250-274</b>
<b>May 18</b> 3	Models—Atoms and Molecules Law of Conservation of Matter Chemical Formulas <b>Due: Inquiry Project Design</b>
<b>May 20</b> 4	Elements, Ions, Compounds and Mixtures Acids and Bases Chemical and Physical Changes
<b>May 25</b>	<b>Memorial Day Holiday</b> <b>Wayne State University Closed</b>
<b>May 27</b> 5	Forms of Energy- <b>Related text reading –Pages 299-321</b> Law of Conservation of Mass & Energy, Forms (P.E & K.E.), Kinds & Conversions
<b>FRIDAY</b> <b>May 29</b> 6	<b>Matter and Its Properties</b> <b>Exam #1</b> <b>In Blackboard</b>
<b>June 1</b> 7	<b>Technology Integration Session: Energy</b> <i>U. S. Energy Kids:</i> <a href="http://www.eia.doe.gov/kids/energyfacts/index.html">http://www.eia.doe.gov/kids/energyfacts/index.html</a> <i>BBC Kids:</i> <a href="http://www.bbc.co.uk/schools/ks3bitesize/science/energy_electricity_forces/energy_transfer_storage/revise1.shtml">http://www.bbc.co.uk/schools/ks3bitesize/science/energy_electricity_forces/energy_transfer_storage/revise1.shtml</a> <i>NSTA SciPacks and Science Objects- Thermal Energy</i> <a href="http://learningcenter.nsta.org/lcms/default.aspx?a=so&amp;gid=909&amp;tid=299&amp;soid=59">http://learningcenter.nsta.org/lcms/default.aspx?a=so&amp;gid=909&amp;tid=299&amp;soid=59</a> <b>Due: Response to Questions</b> <b>In Blackboard</b>

<b>June 3</b> 8	Forms of Energy— Waves & Particles: Light and Color, Sound	<b>Related text reading –Pages 299-321</b> <b>Due: Scientific Model</b>
<b>June 8</b> 9	Forms of Energy-Electricity and Magnetism	
<b>June 10</b> 10	<b>Forms of Energy</b>	<b>Exam #2</b> <b>In Blackboard</b>
<b>June 15</b> 11	Forces and Motion— Gravity/Friction/Magnetic Newton's Laws	<b>Related text reading –Pages 274-298</b>
<b>June 17</b> 12	Forces and Motion— Forces, Work, Power	<b>Related text reading –Pages 322-331</b> <b>Due: Choice Assignment- Science Jeopardy Game Conference Report Webliography Concept Map</b>
<b>June 22</b> 13	Forces and Motion— Balanced Forces Simple Machines	<b>Due: Real World Questions</b>
<b>June 24</b> 14	<b>Inquiry Project Presentation Sharing</b>	<b>Due: Inquiry Project Final Report, Power Point Presentation, Course Portfolio File</b>
<b>June 29</b> 15	<b>Forces, Motion, and Simple Machines</b>	<b>Final Exam (Quiz # 3)</b> <b>In Blackboard</b>

## **MTTC Tests - Michigan Test for Teacher Certification**

In the state of Michigan, a pre-service teacher must take and pass a test in each of the content areas in which s/he plans to be certified. At Wayne State University, passing the basic MTTC test is a requirement to the student teaching field experience. As a result, it is imperative that pre-service teachers prepare for the tests. There are a number of resources available to teachers to help them prepare for the tests. First, students should check the MTTC Tests website: <http://www.mttc.nesinc.com/index.asp> to find out test schedules, how to register for the tests, test objectives and other pertinent information. Second, students must study for the tests. Even if you have a major in a subject area the chances are you have forgotten most of what you once learned. Therefore, you need to go over the information for a fresh understanding of the concepts in order to pass the tests. The tests usually cover the basic information in a content area and going over a freshman biology, chemistry, or physics textbook and relearning the concepts related to that specific test's objectives will maximize the chances of succeeding. If you do not have access to such textbooks, you might want to search for some free textbooks online. Below are a few links to online textbooks.

- Biology <http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookTOC.html>
- Chemistry <http://library.thinkquest.org/3659/>
- Earth Science <http://www.solarviews.com/eng/earth.htm>
- Physics and Astronomy <http://www.lightandmatter.com/>

In addition to reviewing the material from a basic textbook, study guides are excellent resources to prepare for these tests. The following websites have study guides that students may purchase at an affordable price:

- Mo-Media - <http://www.mo-media.com/mttc/> - have study guides in all areas including Integrated Science.
- Amazon also has a variety of study guides - [http://www.amazon.com/s/?ie=UTF8&keywords=mttc+study+guides&tag=googhydr-20&index=aps&hvadid=1147468841&ref=pd\\_sl\\_9caca812mo\\_b-](http://www.amazon.com/s/?ie=UTF8&keywords=mttc+study+guides&tag=googhydr-20&index=aps&hvadid=1147468841&ref=pd_sl_9caca812mo_b-)

**Remember the key passing the tests is preparation. Discuss your plan for scheduling the MTTC with your advisor.**

**APA References** WSU Library: Citation Style Guides: <http://guides.lib.wayne.edu/referencetools>  
Purdue Online Writing Lab: <http://owl.english.purdue.edu/owl/resource/560/01/>

## **Resources and References**

The following list of science activity books, journals, and other resources will be useful to you as a teacher. Add to the list as you encounter additional ones and start a file for your future use. You will find it very useful once you become a teacher.

### **Science Education Journals:**

*Science and Children*  
*Science Scope*  
*Science Teacher*  
*Teaching K-8*  
*Creative Classroom*  
*Wonder Science*

### **Community Resources:**

Cranbrook Institute of Science. (Natural History and Science, Planetarium, Observatory, Hands on Exhibits,

Laser Light Shows). 1221 N. Woodward Bl. Hls. (Between Lone Pine Rd. & Long Lake Rd. Tel. (810) 645-3200. <http://science.cranbrook.edu/>

Detroit Zoo. 8450 W 10<sup>th</sup> Mile, Royal Oak (at I696 and Woodward). Tel. (810) 398-0900.  
<http://www.detroitzoo.org/>

Ann Arbor Hands On Museum. 220 E. Ann St. Ann Arbor, MI 48104 734.995.5439 <http://www.aahom.org/>

Michigan Department of Natural Resources. <http://www.michigan.gov/dnr/>

Michigan Math and Science Centers Network <http://www.mimathandscience.org/>

Michigan Science Center. 5020 John R. (Corner of John R. and E. Warren). [www.mi-sci.org/](http://www.mi-sci.org/)  
1- (313) 577- 8400

**Science organizations** Consider becoming a member of:

Michigan Science Teachers Association (MSTA)	<a href="http://www.msta-mich.org/">http://www.msta-mich.org/</a>
Metropolitan Detroit Science Teachers Association (MDSTA)	<a href="http://www.mdsta.org/">http://www.mdsta.org/</a>
National Science Teachers Association (NSTA)	<a href="http://www.nsta.org/">http://www.nsta.org/</a>

## **Books**

Bosak, S. V. (Latest edition). *Science is....* Markham, Ontario: Scholastic Canada, Ltd.

Exploratorium Teacher Institute. (Latest Edition). *The Exploratorium Science Snackbook*. San Francisco, CA: Exploratorium Teacher Institute.

Ford, L. A. (1993). *Chemical Magic*. New York: Dover Publications, Inc.

Gardner, M. (1981). *Entertaining Science Experiments with Everyday Objects*. New York: Dover Publications, Inc.

Hann, J. (1991). *How Science Works: 100 Ways parents and kids can share the secrets of science*. New York: The Reader's Digest Association, Inc.

Lorbeer, G. C. (Latest Edition). *Science Activities for Elementary Students*. McGraw-Hill.

Perdue, P.K. (1991). *Schoolyard Science*. East Lake, Illinois: Scott, Foresman.

Peters, J.M., & Stout, D.L. (2011). *Science in elementary education: Methods, concepts and inquiries, 11<sup>th</sup> edition*. Boston, MA: Pearson.

Renner, J.W. & Marek, E.A. (1988). *The Learning Cycle and Elementary School Science Teaching*. Portsmouth, NH: Heinmann.

## **Additional Recommended References:**

Abruscato, Joseph. *Teaching Children Science*. Allyn and Bacon.

- AIMS, Primarily Physics—Investigations in Sound, Light and Herat Energy, AIMS Education Foundation
- Center for Science Education, Michigan Operation Physics, Sound, Western Michigan University
- CESI, Physical Science for Elementary and Middle School, Council for Elementary Science International
- FOSS, Balance and Motion, Delta Education
- Hewitt, Paul, Conceptual Physics, The High School Physics Program, Addison-Wesley Publishing Company
- Lowery, Lawrence, The Everyday Science Source Book-Ideas for Teaching Elementary and Middle School, Dale Seymour Publications
- Michigan Science Education Resource Project, Chemistry That Applies, Michigan Department of Education
- National Research Council. (2011). A Framework for K-12 Science Education: Practices: Crosscutting Concepts, and Core Ideas. (Committee on Conceptual Framework for the New K-12 Science Education Standards. **FREE.pdf** :Retrieved from: [http://www.nap.edu/catalog.php?record\\_id=13165](http://www.nap.edu/catalog.php?record_id=13165)
- National Science Teachers Association Learning Center. On-line PD resource repository: <http://learningcenter.nsta.org/>
- National Science Teachers Association. Science and Children (a monthly publication for elementary teachers). Washington, DC: NSTA.
- National Science Teachers Association. Science Scope (a monthly publication for middle school science teachers). Washington, DC: NSTA.
- Ostlund, Karen, Science Process Skills, Assessing Hands on Student Performance, Addison Wesley Publishing Company
- Robertson, William, C. Stop Faking It! Finally Understanding Science So You Can Teach It (Series includes: Chemistry Basics, Electricity, Energy, Force & Motion, Sound, & more). NSTA press.
- Stephans, Joseph, Targeting Students Misconceptions—Physical Science Concepts Using the Conceptual Change Model, Idea Factory Inc.
- Taylor, Beverley, Poth, James, Portman, Dwight, Teaching Physics with TOYS, Learning Triangle Press
- Victor, Edward, Kellough, Richard, Science for Elementary School, Macillan Publishing Company