EDFS 456-03 & 04: Teaching Strategies for Mathematics & Science Content Areas
Fall 2016

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Required Science Texts: Rutherford & Aldredge, Science for all Americans & Benchmarks (can be found online)
                        Chiapetta, E. & Koballa, T., Science Instruction in the Middle and Secondary Schools (8th ed)

Required Math Texts:  NCTM, Curriculum and Evaluation Standards for School Mathematics (can be found online)
                        Brahier, D., Teaching Secondary and Middle School Mathematics (4th ed)

Course Intent:
EDFS 456 is designed to unify science and mathematics content and thought with teaching practices that emphasize equity of outcome with high content expectations for all. The planned weekly sessions emphasize the natures of science and mathematics through the use of the laboratory, community, technology and research. Overall this course is designed to guide and develop the skills necessary to effectively teach secondary science and/or mathematics. You will be required to analyze, synthesize and evaluate all the theoretical education work you completed in previous education courses and put it to practical use for this course. Then you will apply the theory and practice in a classroom with a practicing teacher.

Objectives:
I. As a science teacher you will:
   A. Perform science as inquiry
      1. ask questions
      2. plan and conduct investigations
      3. use appropriate tools and techniques to gather data
      4. think critically and logically about relationships between evidence and explanations
      5. construct and analyze alternative explanations
      6. communicate scientific arguments and explanations
      7. understand scientific inquiry by the ability to identify and communicate a problem and to design, implement and evaluate a solution
   B. Use the content of Science and Technology:
      1. distinguish between natural objects and objects made by humans
      2. use your ability to understand the strengths and limitations of technology and technological design
      3. understand the relationship between science and technology
   C. Develop understanding about Science in Personal and Social Perspectives:
      1. types of resources
      2. changes in environment(s)
      3. local challenges
   D. Use the History and Nature of Science:
      1. science as a human endeavor
   E. Gain the ability to plan an inquiry-based science program for the public school students:
      1. develop a framework of year long and short term goals for the students with which you will be working
      2. select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of the students
      3. select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners
      4. work together as colleagues within and across disciplines and grade levels

II. As a mathematics teacher you will:
   A. Understand the importance of the NCTM’s Principles and Standards for School Mathematics
   B. Learn and practice techniques used to implement the NCTM’s standards and the South Carolina Standards in Mathematics in Grades 7-12 both within the present day middle and secondary school curriculum
   C. Develop and practice ways of effectively using and adapting different methods of instruction, including cooperative learning and working with instructional aids including technology and manipulatives to meet the needs of all students in mathematics in both block and traditional class schedules
D. Learn how to use the learning cycle approach to develop lesson plans that are performance based and incorporate manipulatives, visual aids, technology and multicultural aspects of mathematics in order to teach math to all children
E. Learn how to develop multiple assessment strategies to assess 7-12 students’ understanding of mathematics and to provide performance data that can be used for formative and summative purposes
F. Learn about the opportunities for professional growth in mathematics education through membership and active participation in the many professional organizations for mathematics educators so that learning is seen as a life-long process

III. As a science or mathematics teacher you will:
A. Guide and facilitate learning
B. Engage in the ongoing assessment of your own teaching and of the students’ learning
C. Design and manage learning environments that provide students with the time, space, and resources needed for learning science and mathematics
D. Develop communities of science and math learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science and mathematics learning

The Teaching and Learning Standards of the School of Education are: Standard I Evidence theoretical and practical understanding of the ways learners develop. Standard II Demonstrate understanding and application of the critical attributes and pedagogy of the major content area. Standard III Evidence a variety of strategies that optimize student learning. Standard IV Participate in informed personal and shared decision making that has as its focus the enhancement of schooling and the profession. Standard V Communicate effectively with students, parents, colleagues, and the community. Standard VI Demonstrate an understanding of the continuous nature of assessment and its role in facilitating learning. Standard VII Show an understanding of the culture and organization of schools and school systems and their connection to the larger society.

Teacher Competencies: 1. Understands and Values the Learner; 2. Knows What and How to Teach and Assess and How to Create an Environment in Which Learning Occurs; 3. Understands Self as a Professional.

Dispositions: This course will also be emphasizing and expecting evidence of the Dispositions and Values of the School of Education. Failure to exhibit these dispositions and values may jeopardize your ability to complete the course and earn teaching certification. These dispositions are: 1. We believe that all students can learn. 2. We value and respect individual differences. 3. We value positive human interactions. 4. We exhibit and encourage intellectual curiosity, enthusiasm about learning, and a willingness to learn new ideas. 5. We are committed to inquiry, reflection and self-assessment. 6. We value collaborative and cooperative work. 7. We are sensitive to community and cultural context. 8. We engage in responsible and ethical practice.

International Society for Technology in Education Standards: This course also implements the following technology standards. 1.b. Engage students in exploring real-world issues and solving authentic problems using digital tools and resources. 2.a. Design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity. 3. a. Demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations. 3.d. Model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning. 4.b. Address the diverse needs of all learners by using learner-centered strategies providing equitable access to appropriate digital tools and resources. 5.c. Evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning.


Student Learning Outcomes (Mathematics): 1. Apply knowledge of curriculum standards for mathematics and their relationships to student learning within and across mathematical domains. 2. Solve problems, represent mathematical ideas, reason, prove, use mathematical models, attend to precision, engage in mathematical communication, and make connections between mathematical domains through the development of a unit as per NCTM standards and elements. 3. Demonstrate dispositions that facilitate and enhance the learning of mathematics. Develop appropriate mathematics content, varied assessments strategies, integrate technology, and hold high expectations. (Science): 1. Write and implement an effective unit of content for a secondary science classroom. 2. Safely design and conduct science experiments with students. 3. Use assessment to inform instruction and explain the nature of science and practices to students.
Classroom Format

The class runs for three hours once a week. Plan to attend all sessions for the entire time. There are no formal breaks. If you must miss one session please inform me and either get the notes and handouts from a classmate or see me. It is imperative that you regularly attend and participate in class. You can lose up to 2 letter grades for failure to attend and participate. The activities and pedagogies are not something that you can read and learn. You will fail the course if you fail the practicum portion of the course. Science students must also pass the safety test with a 92%.

The materials assigned are to be read before arriving in class. This will allow you time to think about the ideas you are about to experience. It will also help you to understand that the words on the page do not come alive until you do them. There are weekly discussions that will assist with the reading and understanding process. These are due weekly prior to attending class.

Note: NO cell phones may be used during class. Persons using a cell phone during class will have points deducted from their participation grade and may receive less than satisfactory evaluations on their Dispositions Form for the School of Education.

Assignment for science students only:

Safety Test

A test covering laboratory safety will be conducted. Students must attain a 92% or higher on this test for satisfactory completion. Students scoring lower than 92% will be required to retake the exam.

Assignment for math students only:

Mathematics as a language

You will write and teach a lesson to our class that utilizes your knowledge of the language of mathematics that expressly assists others in learning this language.

Assignments to be completed by all

Practicum experience

(see attached guidelines)
- Laboratory Write Up The formal written plan will be in Oaks. Your plan will be produced for the laboratory that you chose from within your content area and anticipated teaching area. Choose one that your practicing teacher is interested in reviewing. (Science Students Only)
- Manipulative based lesson plan
  You will write a lesson plan to teach a specific concept in mathematics using manipulatives. You will test your lesson plan by teaching your peers in class. The level of this lesson plan must be 9th grade algebra or higher. (Math Students Only)
- Inquiry lesson of level 1 or higher
  (see attached guidelines you will submit 3 written lesson plans)
- Unit Plan
  (see attached guidelines you will submit 10 written lesson plans plus an assessment)

Final Paper

Professional Development Plan:
1). Find 2 professional organizations for science or mathematics teachers. Give their names, web sites, and a brief summary of the organizations.
2). Write the information on the annual conference for this year for both of those organizations.
3). Find two Professional Journals for Science or Mathematics Teachers. Write down their names and the titles of two articles in each one pertaining to something in science or mathematics teaching that interests you, with complete bibliographical information.
4). Write a summary of those articles.
5). Write out a 5-year plan for your professional growth after you obtain your teaching certification. What resources will you use? What continuing education plan could you implement? How will you work with other professionals to help you with your professional growth in the next five years? How will you take advantage of the professional communities for science or mathematics educators that you have researched for this project?
Summary of assessment

Attendance and Participation (graded via attendance & online discussions) 20 pts
Math as a language (Math only) 10 pts
Safety Test (Science only) 10 pts
Textbook reading confirmation (Quiz, Participation, etc) 8 pts
Integrated lesson plan 10 pts
Practicum experience (Time sheets, Teacher evaluation, Journal w/question response) 20 pts
Inquiry lesson plans--3 12 pts
Videotape of you teaching one inquiry lesson 10 pts
Manipulatives lesson plan (Math) or Laboratory write-up (Science) 10 pts
Unit Plan (minimum of 10 lessons plus an assessment) 30 pts
Final paper or Professional Development Plan 20 pts

The total possible points are 150. All School of Education grading policies will be followed with regard to assignment of a letter grade. All School of Education honor codes will also be followed.

Grading Scale:
A = 93-100 A- = 91-92 B+ = 89-90 B = 86-88 B- = 84-85 C+ = 82-83 C = 79-81
C- = 77-78 D+ = 75-76 D = 72-74 D- = 70-71 F = 0 - 69

PROFESSIONAL BEHAVIOR/DISPOSITIONS: Students are responsible for all content and assignments for each class. They will be expected to demonstrate professional behaviors consistent with the following dispositions:
- The belief that all students can learn.
- Value and respect for difference.
- Value of positive human interaction.
- Intellectual curiosity and willingness to learn new knowledge.
- A commitment to inquiry, reflection and self-assessment.
- Value of responsible, collaborative, and cooperative work.
- Sensitivity to community and cultural context.
- Responsible and ethical practice

HONOR SYSTEM:
All courses in the School of Education are conducted under the Honor Code of the College of Charleston. The Honor Code specifically forbids lying, cheating, attempted cheating, stealing, attempted stealing and plagiarism. Students at the College are bound by honor and by their acceptance of admission to the College to abide by the code and to report violations. As members of the College community, students are expected to evidence a high standard of personal conduct and to respect the rights of other students, faculty, staff members, community neighbors, and visitors on campus. Students are also expected to adhere to all federal, state, and local laws. Faculty members are required to report violations of the Honor Code or Code of Conduct to the Office of Student Affairs. Conviction of an Honor Code violation in this class will result in the grade of “F” for the course. As a student at the College you have agreed to uphold the policies outlined in the Student Handbook: A guide to civil and honorable conduct (2003/2004) both in your coursework and as a representative of the College of Charleston in field experiences and clinical practice situations. Violations to the Code of Conduct outlined on pages 10-11 in the Student Handbook will be reported to the Honor Board.

As EDFS is a dual program, in that we certify candidates for teacher certification, professors reserve the right to document violations that would impact student certification (e.g., attendance in field experiences and clinical practice, professionalism in schools, etc.).

ADA Accommodations:
In compliance with the American with Disabilities Act (ADA), all qualified students are entitled to “reasonable accommodations.” Please notify the instructor during the first week of class of any accommodations needed.

Required Technology:
Enrollment in this course requires you to utilize the following computer applications: PowerPoint, Excel, Internet/WWW, OAKS via Internet, e-mail, and Word Processing. It is expected that you can utilize the above listed computer applications. These computer applications are available in the College of Charleston managed computer labs located in JC Long, the Library, and various other campus locations. If you do not have reliable access to these applications you should plan to use the campus computer laboratories.
Center for Student Learning:
I encourage you to utilize the Center for Student Learning's (CSL) academic support services for assistance in study strategies, speaking & writing skills, and course content. They offer tutoring, Supplemental Instruction, study skills appointments, and workshops. Students of all abilities have become more successful using these programs throughout their academic career and the services are available to you at no additional cost. For more information regarding these services please visit the CSL website at http://csl.cofc.edu or call (843)953-5635.

School of Education Mission:
The mission of the School of Education at the College of Charleston is the development of educators and health professionals to lead a diverse community of learners toward an understanding of and active participation in a highly complex world. In pursuit of this mission, faculty and students will demonstrate:

- intellectual curiosity and rigor;
- reflective, research-based practice;
- collaboration and consensus building;
- field-oriented service and community outreach;
- and cultural sensitivity and understanding
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Questions to ponder</th>
<th>Science Readings</th>
<th>Math Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 29th Week 1</td>
<td>Introduction Practicum Requirements Cube Activity Adolescent development</td>
<td>What does it mean to teach for all? What are students like in the age range I plan to teach? What do adolescent characteristics have to do with the way I teach? What does the brain research say?</td>
<td>Text 1, 2</td>
<td>Text 1</td>
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<tr>
<td>September 5th Week 2</td>
<td>Inquiry—Level 2 and 3 Pretzel Pretzel debriefing Rolling down a hill</td>
<td>What is the nature of inquiry in your discipline? How did I learn that? What is an inquiry level? How do I get the resources to teach using inquiry methods?</td>
<td>Text 3 Benchmark 1</td>
<td>NCTM pp 1-12 Text 2</td>
</tr>
<tr>
<td>September 12th Week 3</td>
<td>Soils lab Soils debriefing Cooperative learning</td>
<td>What makes a lesson relevant to a student’s everyday life?</td>
<td>Text 4 Benchmark 10</td>
<td>Text 3</td>
</tr>
<tr>
<td>September 19th Week 4</td>
<td>Collaborative learning Attribute blocks Teach mini 5E lesson</td>
<td>What does the literature say? How does it work? Why does learning work more effectively and efficiently with integrated lesson plans?</td>
<td>Text 5 SFA 10</td>
<td>Text 3</td>
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<tr>
<td>September 26th Week 5</td>
<td>Laboratory management and techniques Create microscale lab Geo/Alg using Tech</td>
<td>What is microscale? How do I handle these materials? How do I know my students learned? What do I need to know to be safe in the lab?</td>
<td>Text 13, 14 SFA 1</td>
<td>Text 5</td>
</tr>
<tr>
<td>October 3rd Week 6</td>
<td>Safety Test (science) Math as Language lesson due Develop manipulative lesson plan/Lab write up Inquiry level 3 Tangrams Inquiry Beads</td>
<td>How do I match the nature of my discipline with my teaching?</td>
<td>Text 6 SFA 13</td>
<td>NCTM Standard 1 Text 4</td>
</tr>
<tr>
<td>October 10th Week 7</td>
<td>Peer Coaching Field notes Reflective teaching Questioning techniques</td>
<td>What is peer coaching, etc.? How do I take field notes? Ethics in the classroom? What do I need to know about questioning?</td>
<td>Text 7</td>
<td>NCTM Standard or Reasoning and disposition Text 6</td>
</tr>
<tr>
<td>October 17th Week 8</td>
<td>Teaching ELL’s Lab Write-up Due (science) Manipulative Lesson Due (math)</td>
<td>Write lesson plans</td>
<td>Text 8 Benchmark 3,11</td>
<td>Text 7</td>
</tr>
<tr>
<td>October 24th Week 9</td>
<td>Present lessons w/ELL accommodations</td>
<td>Using a rubric to check amounts of teacher/student action</td>
<td>Text 9 SFA 12</td>
<td>NCTM remaining standards Text 8</td>
</tr>
<tr>
<td>October 31st Week 10 (Fall Break Nov. 7-8th)</td>
<td>Using your interests to help you Voice lesson</td>
<td>What do I have to do to team teach a lesson? What is available? Why should I choose this?</td>
<td>Text 10</td>
<td>Text 9</td>
</tr>
<tr>
<td>November 14th Week 11</td>
<td>Team teaching Create team lesson Probeware</td>
<td>What is it like to work with teachers from other disciplines??</td>
<td>Text 11</td>
<td>Text 10</td>
</tr>
<tr>
<td>November 21st Week 12 **</td>
<td>Create Integrated Lesson Video and Write up Due 3 Taught Lesson Plans Due</td>
<td>How does all of this tie together? What makes teaching so complex? How do I keep from losing my mind?</td>
<td>Text 12 Benchmark 7</td>
<td>Text 11</td>
</tr>
</tbody>
</table>
### November 28th
**Week 13**

- Practicum analysis
- Class management
- Practicum Time Sheet Due
- Practicum Teacher Evaluations Due
- Practicum Journal Due

| How do I meet the needs of the diverse learners in my classroom? How do I assess the diverse learners in my classroom? | Benchmark 12 | Text 12 |

### December 5th
**Week 14**

- Teach Integrated Lesson
- Unit Plan Due w/ Assessment

| | Text 15 | Text 13 |

### December 12th

- Final Exam 7:30 pm

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1. **Practicum Experience**

The practicum experience consists of a minimum of **35 hours**. Students are required to keep a **practicum log** including date, time, teacher signature, and lesson description. You must **teach a minimum of 3 lessons** that your teacher approved. You must **videotape one** of these lessons and submit it to the course instructor.

**Observation Journal:**

Below are some fundamental questions you need to ask of each lesson you observe to assist in identifying the science and mathematics during a teaching session. Always supply descriptive evidence to support your answer(s)!

A. **Content**
   1. Does the lesson allow students to explore events, concepts, issues and themes from multiple perspectives?
   2. Are the perspectives broad enough so that the students don’t end up inadvertently creating new stereotypes of different groups?
   3. Does the lesson/unit reflect the lives of the students? Is it meaningful to them?
   4. Is it in-depth enough to meet the rigorous standards that give them the opportunity to advance in a career or profession?

B. **Instructional Strategies**
   1. Does the teacher hold high expectations for all students?
   2. Are a variety of pedagogy and learning activities provided?
   3. Are the 5 e’s (or another learning cycle lesson plan) present in the teacher’s actions?
   4. Does the pedagogy match the content?
   5. Is the teacher tactful when working with the students?

C. **Assessment**
   1. Are assessments done using a variety of techniques—written, oral, portfolio, performances, projects, observations, etc?
   2. Are assessments on going, formative and summative?
   3. Do the assessments match the learning?
   4. Do the assessments continue the learning or stop the learning?

2. **Videotape and analysis**—Tape a class that you designed an inquiry lesson for, use all the criteria discussed during the semester and evaluate your effectiveness at teaching science/mathematics in a manner consistent with your beliefs about the nature of science/mathematics.

Following your taped inquiry lesson you will complete a written self-evaluation on the lesson. The following questions should be answered:

1. What about your lesson was effective? Why? How do you know?
2. What about your lesson was ineffective? Why? What is your evidence?
3. How would you change your lesson if you taught it again? Explain.
4. Describe the general student response to your lesson.
5. Describe student success on your assessments of the lesson.
3. **Inquiry Lesson Plan**—Write an activity that teaches about the nature of science/math for use in your classroom.

   Explain the components of the nature of science/math that you are teaching. You must use one of the learning cycle lesson plan formats. As part of this class, thinking about teaching and learning is an essential element of observation. Observation means to examine, monitor, scrutinize, perceive, in-depth answer to the basic question, “What is happening here?”

   These observations then will be used to assist you, the teacher, in discerning the learning that is occurring. This means you will be constantly diagnosing, (meaning to analyze, assess, determine, probe, solve, understand) what the learner is doing as well as what the teacher is doing.

   We are asking you to complete these observations in various settings. You will observe in this class, in other classrooms, and in general living situations. To assist you in this endeavor we are providing you with two general outlines as a place to begin, as a class we will expand the outline and you as an individual may also chose additional ideas to include as your are observing.

   The first outline is about what I call a lesson plan. To others the outline is a way of thinking about teaching and learning in a classroom. The reason we are going to use this outline is that teachers who use this form of thinking about teaching and learning tend to get results with **ALL** students. One of our goals for this institute is to ensure that participants have access to methods that assist with **learning for all**. The format in the education literature is the learning cycle. The lesson plan format can take many forms. The form we will use for this institute is named the 5 e’s. The model is not linear even though it looks that way on paper. Excellent teachers who get results repeat or loop back through any of the 5 e’s as many times as necessary to achieve their goal. This format is useful in 15-minute situations and in yearlong in-depth studies.

   The 5 e’s are engage, explore, explain, expand and evaluate. It is not and should not be thought of as equivalent to any of the behaviorist lesson plans that you are more likely familiar with. You will want to explore this idea of a non-behaviorist lesson plan in depth and challenge your assumptions and ours about what it means to teach in a non-behaviorist way and what results you can achieve. We want you to challenge your assumptions about “who” can learn “what” via which methods. We want you to challenge your assumptions about using only one lesson plan format.

   We want you to enjoy the idea that your are being asked to think and think deeply about that same question, “What is happening here?” every time you see this model in practice, including when you use the model. We want you to look at yourself through these same lenses. We want you to know that it is not always comfortable to do these tasks. We want you to know that we are each learning from each other, just as you are learning from us. Ask questions, raise issues, gain a positive belief set about what our children in South Carolina can and will do if we challenge them.
### 5 e’s approach to teaching and learning:

<table>
<thead>
<tr>
<th>Teacher Behavior</th>
<th>Student Behavior</th>
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<tbody>
<tr>
<td><strong>Engage</strong></td>
<td><strong>Engage</strong></td>
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<tr>
<td>- create an interest in topic/lesson</td>
<td>- show interest in the topic/lesson</td>
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<tr>
<td>- raise questions</td>
<td>- ask questions, answer questions</td>
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<tr>
<td>- elicit what children know about the topic</td>
<td>- tell what they know about the topic</td>
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<tr>
<td>- cause curiosity</td>
<td>- be curious</td>
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<tr>
<td><strong>Explore</strong></td>
<td><strong>Explore</strong></td>
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<tr>
<td>- encourage children to work together</td>
<td>- work together to solve problems</td>
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<tr>
<td>- observe and listen to the children</td>
<td>- think freely about the topic</td>
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<tr>
<td>- ask questions to extend thinking</td>
<td>- record observations and ideas</td>
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<tr>
<td>- make sure children have supplies</td>
<td>- listen critically to others’ ideas</td>
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<tr>
<td><strong>Explain</strong></td>
<td><strong>Explain</strong></td>
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<tr>
<td>- have children explain in their own words</td>
<td>- explain possible solutions to others</td>
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<tr>
<td>- have children define in their own words</td>
<td>- use observations and data in word explanations</td>
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<tr>
<td>- use children’s previous experiences and understandings to explain concepts</td>
<td>- listen critically to others’ explanation and</td>
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<tr>
<td>- provide formal labels after children have described the concept</td>
<td>- compare to personal explanation</td>
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<tr>
<td><strong>Expand</strong></td>
<td><strong>Expand</strong></td>
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<tr>
<td>- encourage children to apply and extend learnings to new situations</td>
<td>- apply new learning in new but similar situations</td>
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<tr>
<td>- remind children to think of alternatives</td>
<td>- think of alternatives</td>
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<td>- expect children to use formal labels</td>
<td>- use the new formal labels</td>
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<tr>
<td>- ask “What do you think about...” &amp; “Why”</td>
<td>- make reasoned conclusions</td>
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<tr>
<td>- record additional observations and explanations</td>
<td>- ask open-ended questions to assess</td>
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<td>- discuss investigations and conclusions with peers</td>
<td>- make sure the evaluation looks like the learning</td>
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<tr>
<td><strong>Evaluate</strong></td>
<td><strong>Evaluate</strong></td>
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<tr>
<td>- observe and record as children apply what they know</td>
<td>- have children draw, write, speak, &amp;-show new learnings</td>
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<tr>
<td>- look for evidence that children have changed their thinking and understanding of new learnings</td>
<td>- demonstrate reasoning</td>
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<tr>
<td>- encourage children to self-evaluate</td>
<td>- evaluate own progress and learning</td>
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<tr>
<td>- ask open-ended questions to assess</td>
<td>- answer open-ended questions</td>
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<tr>
<td>- make sure the evaluation looks like the learning</td>
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