EDFS 456: Teaching Strategies for Science and Mathematics

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Class Hours: Mondays 7:00 pm – 9:45 pm
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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: Developing Fundamental Knowledge and Skills (8th ed)

Required Math Texts: NCTM, Curriculum and Evaluation Standards for School Mathematics (can be found online)
Posamentier, A. & Smith, B., Teaching Secondary Mathematics: Techniques and Enrichment Units (9th 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 way 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
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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 this 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.

Performance Standards/Objectives:
1. Long range planning
2. Short range planning
3. Planning, assessing and using data
4. Establishing and maintaining high expectations for learners
5. Using instructional strategies to facilitate learning
6. Providing content for learners
7. Monitoring, assessing and enhancing learning
8. Maintaining an environment that promotes learning
9. Managing the classroom
10. Fulfilling professional responsibilities
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. 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.

Online Course Components:

**OAKS** is the College of Charleston’s course management system. It is an integral part of many of our courses here at the College. We will be making extensive use of it during the semester. There are many aspects to the site and I will introduce the functionality of it as the semester progresses. All course content and assignments will be found here.

Academic Support:

**Center for Student Learning:** I encourage you to utilize the Center for Student Learning’s (CSL) academic support services for assistance in study strategies 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](http://csl.cofc.edu) or call (843)953-5635.

Course Policies and Grading:

**Missing Class Time:** Being in class is an essential component of our course. All the good stuff is going to happen in the interactions between us as we work through the material. If for whatever reason you cannot make it to class, it is your responsibility to communicate that to me and arrange to get any missed work or material from one of your fellow students. Students must provide a valid and documented excuse from the Undergraduate Dean’s Office in the case of missing an exam or major deadlines. Acceptable excuses include illness, personal tragedy or circumstances beyond the student’s control. Attendance is part of your course engagement grade for this class. **Three absences from this course, excused or unexcused, will result in you failing the course.**

**Tardiness:** Showing up late to class is both disrespectful and prevents you and your fellow students from being fully engaged in the course. Showing up in the last half of the class meeting time will be treated as an absence. Three tardies (arriving late/leaving early) count as one absence. These strict policies are based on the professionalism required of teachers.

**Course Grade:** I will ask a lot of you in this class and I am confident that you are up to the challenge. There is no curve in this class; your grade depends only on your own effort put forth in the class. Grades will be assigned based on the total points you have accumulated.

**Equal Access:** I am happy to work with all students to ensure that they have equal access to the educational experience of this class. The College will make reasonable accommodations for persons with documented disabilities. Students should apply at the Center for Disability Services / SNAP, located on the first floor of the Lightsey Center, Suite 104. Students approved for accommodations are responsible for notifying me as soon as possible and for contacting me one week before accommodation is needed.

**Honor Code and Academic Integrity**
Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each instance is examined to determine the degree of deception involved. Incidents where I believe that a student’s actions are clearly related more to ignorance, miscommunication, or uncertainty, will be addressed by consultation with me. We will craft a written resolution designed to help prevent future repition of this error in the future. This resolution, submitted by form and signed by both the student, and me is forwarded to the Dean of Students and remains on file.
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I will report cases of suspected academic dishonesty directly to the Dean of Students. A student found responsible for academic dishonesty will receive a XF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student’s transcript for two years after which the student may petition for the X to be expunged. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

It is important for students to remember that unauthorized collaboration—working together without permission—is a form of cheating. Unless I specify that you can work together on an assignment and/or test, no collaboration is permitted. Other forms of cheating include possessing or using an unauthorized study aid (such as a PDA), copying from another’s exam, fabricating data, and giving unauthorized assistance.

You can find a complete version of the Honor Code and all related processes in the Student Handbook.

Course Evaluation:

During the last few classes of the course, you will be asked to fill out the online Course Evaluation Form. I appreciate all feedback to help me continue to grow as an educator.

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. You will test this lab by teaching your peers in class. (Science Students)

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)

Inquiry lesson(s) of level 1 or higher
(see attached guidelines you will submit 3 written plans)

Observation Log
Include date, times, classes observed, and teacher signature (see attached sample)

Observation Journal w/responses
You will write down your observations each time you visit your class. You will answer response questions.

Video Lesson w/ responses
You will video yourself teaching two-three lessons. You will then evaluate your lessons and answer response questions.

Long Range Plan
Write a sample long range plan using subject specific rubric as a guide (see attached)

Unit Plan
10 lesson plans plus final assessment of unit w/answer key (see attached)

Integrated Lesson Plan
You will work with your assigned group to develop an integrated lesson plan that you will then teach to the class.
ELL Lesson Plan
You will work with your assigned group to develop an ELL science or math lesson that you will then teach to the class.

Final Paper

Professional Development Plan:
1. Find 2 professional organizations for science or mathematics teachers. Give their names and web sites.
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 total).
4. Write a summary of those articles (4 total).
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?

Prerequisites: EDFS 201

Summary of assessment

| Attendance and Participation (graded via attendance, activities, & discussions) | 20 pts |
| Math as a language (Math only) | 20 pts |
| Safety Test (Science only) | 20 pts |
| Textbook reading confirmation (Quiz, Participation, etc.) | 10 pts |
| Integrated lesson plan | 10 pts |
| ELL science or math lesson plan | 10 pts |
| Practicum experience (Time sheets, Teacher evaluations, Journal w/question responses) | 30 pts |
| Taught lesson plans w/ question responses--3 | 15 pts |
| Videotape of you teaching your lessons w/ question responses | 10 pts |
| Manipulatives lesson plan (Math) or Laboratory write-up (Science) | 10 pts |
| Long Range Plan | 15 pts |
| Unit Plan (minimum of 10 lessons plus an assessment) | 30 pts |
| Final paper - Professional Development Plan | 20 pts |

The total possible points are 200. 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
<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 28th 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 4th 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</td>
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<tr>
<td>September 11th 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 2 pp. 53-74</td>
</tr>
<tr>
<td>September 18th 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 5 pp. 180-197</td>
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<tr>
<td>September 25th 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 pp. 198-225</td>
</tr>
<tr>
<td>October 2nd 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 9th Week 7 (Fall Break Oct. 16-17th)</td>
<td>Peer Coaching Field notes Reflective teaching Questioning techniques Long-Range Plan Due</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 3 pp. 75-104</td>
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<tr>
<td>October 23rd Week 8</td>
<td>Teaching ELL’s Lab Write-up Due &amp; Present (science) Manipulative Lesson Due &amp; Present (math)</td>
<td>Write lesson plans</td>
<td>Text 8 Benchmark 3,11</td>
<td>Text 3 pp. 105-143</td>
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<tr>
<td>October 30th 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 6</td>
</tr>
<tr>
<td>November 6th Week 10</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 7</td>
</tr>
<tr>
<td>November 13th 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 8</td>
</tr>
<tr>
<td>November 20th 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 pp. 309-432 Enrichment Units 1-42</td>
</tr>
</tbody>
</table>
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 3 lessons that your teacher approved. You must videotape two-three 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 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.

   I am 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 I am providing you with one general outline 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 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 class 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 class 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. I want you to challenge your assumptions about “who” can learn “what” via which methods. I want you to challenge your assumptions about using only one lesson plan format.

   I want you to enjoy the idea that you 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. I want you to look at yourself through these same lenses. I want you to know that it is not always comfortable to do these tasks. I want you to know that everyone is learning from each other. 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>- draw diagrams etc. to assist when explaining</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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<tr>
<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>
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<tr>
<td>- discuss investigations and conclusions with peers</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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<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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