

## TRANSMITTAL AND ABSTRACT OF SENATE REPORT

**Date Presented to the Senate:** April 23, 2009

**Presenter:** Carmen Balthrop, Chair, Senate Programs, Curricula, and Courses Committee

**Subject of Report:** Proposal to establish a Post-Baccalaureate Certificate in Science Education

**Senate Document Number:** 08-09-27

**Voting:** (a) on resolutions or recommendations one by one, or  
(b) in a single vote  
(c) to endorse entire report

### A. Statement of Issue:

The College of Education and the Department of Curriculum and Instruction propose to establish a new Post-Baccalaureate Certificate in Science Education. The proposed academic outreach program helps current elementary school teachers to increase their knowledge both of “big ideas” in science content and of new pedagogical approaches specific to teaching science to elementary school-aged students. The Certificate also responds to a state-wide need for improving science education at the elementary school level. The initial cohort of students will be teachers in the Montgomery County Public Schools, and the courses will be offered at the Shady Grove Regional Center.

The program is comprised of 18 credits: EDCI 604: Learning and Teaching in the Physical Sciences I; EDCI 605: Learning and Teaching in the Physical Sciences II; Learning and Teaching in the Biological Sciences I; Learning and Teaching in the Biological Sciences II; EDCI 675: Learning to Teach and Learn Science; and EDCI 676: Reflection and Practice in School Science Teaching. The program director will be advised by a steering committee, including representatives from the College of Education, the College of Computer, Mathematical and Physical Sciences, and the College of Chemical and Life Sciences.

The proposal was submitted to the Senate by the Office of Academic Affairs following favorable recommendation by the Academic Planning Advisory Committee (APAC) on February 2, 2009, the Graduate Council Programs, Curricula and Courses Committee on March 12 (with email notification to the full Graduate Council) and the Senate Programs, Curricula & Courses Committee on March 27. If the Senate approves the proposal, it would still require further approval by the President and the Chancellor (with notification to the Maryland Higher Education Commission).

## **B. Recommendation:**

The Senate Committee on Programs, Curricula, and Courses recommends that the Senate approve the proposed Post-Baccalaureate Certificate program.

## **C. Committee Work:**

The Committee considered the proposal at its meeting on March 27, 2009. David Cooper (Associate Dean, College of Education) and Janet Coffey (Assistant Professor, Department of Curriculum and Instruction) were present to answer questions. After discussion, the Committee voted unanimously to recommend the proposal.

## **D. Alternatives:**

The Senate could decline to approve the proposed Certificate.

## **E. Risks:**

If the Senate does not approve the proposed Certificate, the opportunity for outreach to nearby school districts may be lost.

## **F. Financial Implications:**

There are no indications of a financial risk. The program will be funded through a self-support model.

**THE UNIVERSITY OF MARYLAND, COLLEGE PARK  
PROGRAM/CURRICULUM PROPOSAL**

**DIRECTIONS:**

- Provide one form with original approval signatures in lines 1 - 4 for **each** proposed action. Keep this form to one page in length.
- Early consultation with the Office of the Associate Provost for Academic Planning & Programs is strongly recommended if there are questions or concerns, particularly with new programs.
- Please submit the signed form to Claudia Rector, Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus.
- Please email the rest of the proposal as an MSWord attachment to [pcc-submissions@umd.edu](mailto:pcc-submissions@umd.edu).

DATE SUBMITTED: October 28, 2009

PCC LOG NO.

08029

COLLEGE/SCHOOL: College of Education

DEPARTMENT/PROGRAM: EDCI

PROPOSED ACTION (*A separate form for each*) ADD   X   DELETE        CHANGE         
DESCRIPTION (*Provide a succinct account of the proposed action. Details should be provided in an attachment. Provide **old** and **new** sample programs for curriculum changes.*)

The proposed graduate certificate seeks to address challenges counties face with respect to science education, particularly the education of elementary and middle school students. Representatives from Science Education at UMCP, in consultation with colleagues in the Department of Physics and the College of Chemical and Life Sciences, and Montgomery County Public schools developed a 6-course sequence (3 credits each class) for certified elementary school teachers. Courses will target big ideas in the science disciplines as well as issues involving teaching and learning science. Courses focus on core principles in the life and physical sciences, addressing big ideas highlighted in the State's voluntary science standards and in district indicators. Such courses offer elementary-certified, practicing teachers with an opportunity to learn how to support their students' growth in scientific understanding and reasoning.

Upon completion of the 18 graduate level credits, we propose graduates earn a certificate in Elementary and Middles School Science Education.

JUSTIFICATION/REASONS/RESOURCES (*Briefly explain the reason for the proposed action. Identify the source of new resources that may be required. Details should be provided in an attachment.*)

Existing resources are adequate to support the proposed program. The size of the program relative to the size of existing programs administered by the EDCI Science Teaching Center means that the program will have minimal impact on the use of existing facilities and equipment. For the initial cohort, state funds were obtained that will cover costs for teaching, course and program design, and partial tuition for participating teacher.

**APPROVAL SIGNATURES - Please print name, sign, and date**

1. Department Committee Chair Anna O. Graeber Anna O. Graeber 10/28/2008
2. Department Chair Linda R. Valli Linda Valli 10-28-08
3. College/School PCC Chair Whit Mann 12/1/08
4. Dean DAVID COOPER [Signature] 11/25/08
5. Dean of the Graduate School (if required) \_\_\_\_\_
6. Chair, Senate PCC \_\_\_\_\_
7. Chair of Senate \_\_\_\_\_
8. Vice President for Academic Affairs & Provost \_\_\_\_\_

PROPOSAL FOR A SCIENCE EDUCATION CERTIFICATE  
FOR ELEMENTARY AND MIDDLE SCHOOL TEACHERS

UNIVERSITY OF MARYLAND, COLLEGE PARK

University of Maryland/Montgomery County Public Schools  
Elementary and Middle School Science Partnership Program  
Certificate in Elementary and Middle School Science Education

COLLEGE OF EDUCATION

DEAN DONNA WISEMAN

KIND OF DEGREE: POST-BACCALAUREATE CERTIFICATE

Proposed Initiation Date: Fall 2009

**I. Overview and Rationale**

**A. Briefly describe the nature of the proposed program and explain why the institution should offer it.**

This proposal seeks to address challenges counties face with respect to science education, particularly the education of elementary and middle school students. We propose a 6-course sequence that offers elementary-certified, practicing teachers with an opportunity to learn how to support their students' growth in scientific understanding and reasoning. While we anticipate expanding this program in the future to serve other counties, initial work will begin in partnership with teachers from Montgomery County Public School (MCPS).

Both Montgomery County and University System of Maryland have identified Science, Technology, Engineering and Math (STEM) education as a high priority. Since 2002, MCPS has been involved in the Vertically Integrated Partnership (VIP) K-16, an NSF-funded partnership with the University System of Maryland to build capacity at the high school level and to improve teaching skills of college faculty members. These grant monies have funded summer professional development and curriculum development efforts for all county *high school* teachers. Despite this sustained and systemic professional development effort at the high school level, gaps in achievement across economic and racial groups continue to exist on the state's science assessment. MCPS countywide exams for other high school science subject areas reveal similar discrepancies: Caucasian and Asian students significantly outperform minority, lower socioeconomic, and ESOL students.

MCPS had not developed any standard measures for elementary or middle school science achievement until the 2007-08 school year. As a result, no district-wide science achievement results exist for these grade levels. However, in 2000 and 2005, Maryland participated in the National Assessment of Education Progress (NAEP) Science Assessment, testing 4<sup>th</sup> and 8<sup>th</sup> grade students. Maryland students' performance on NAEP fell below national averages as a whole, including among students who have traditionally lower achievement levels in school science. Results from the 2005 administration of the test indicate that 64% of Grade 4 students in Maryland performed at or above the "Basic" level. (This is slightly below the national performance average of 66%.) Lower income Maryland students performed significantly worse than this statewide average: Only 38% students from this demographic performed at or above a "Basic" level. In 2005, 54% of Maryland 8<sup>th</sup> graders demonstrated performance at or above "Basic," falling below the national average of 57%. Here, again, lower income students did not fare as well. Only 28% of students from lower income backgrounds performed at the "Basic" level.

Population	% at or above “Basic”
<b>Total 4<sup>th</sup> graders in MCPS</b>	64 (national average 66%)
Low income – 4 <sup>th</sup> graders	38
<b>Total 8<sup>th</sup> graders in MCPS</b>	54 (national average 57%)
Low income – 8 <sup>th</sup> graders	28

Table 3. Performance for 4<sup>th</sup> and 8<sup>th</sup> graders from Maryland on 2005 NAEP exam NAEP 2000 and 2005 Science Assessments (see for standard errors of estimates); USED, NCES. *Council of Chief State School Officers, State Education Indicators, Washington, DC 2007.*

While high quality science education at all grade levels has long been a priority of professional development in the elementary grades in science has taken a back seat to literacy and mathematics. The results of the high school science assessments, namely the achievement gap among subgroups, and the results from Maryland’s NAEP performance in elementary and middle school point to the importance of focusing attention on elementary and middle school science teaching.

The issue of teacher science content knowledge is a particular challenge at the elementary grade levels. Most elementary school teachers have limited backgrounds in science and have experienced only minimal science coursework at the college level. The problem does not reside in grades K-5 alone. In the state of Maryland, many teachers teaching science at the middle school level have elementary certification, and few of those had concentrations or majors in science as part of their initial certification studies. Of the 314 current middle science school teachers, 99 of them are not considered to be “highly qualified” per No Child Left Behind legislation (NCLB) because they do not have degrees in science.

The need to invest in the existing science teaching corps is now pressing, particularly at the elementary and middle grade levels. For one, science has recently been added to the battery of state assessments that feed into a school’s AYP rating, which will elevate science in the curriculum. No longer will teachers be able to overlook the teaching of science in order to teach other core subjects. More importantly, elementary and middle years are foundational for laying groundwork for science learning in later years. It is here where students develop early ideas about the nature of science and begin to explore the seeds of key conceptual ideas. Teachers’ support of students’ science learning at the elementary and middle school levels can fuel students’ future success in the high school grades.

To address the specific issue of the science content knowledge and understandings of their elementary certified teachers (which includes current elementary and middle school teachers), in 2005 MCPS administrators (Russ Fazio and Michael Szczeze) approached the Department of Curriculum and Instruction (EDCI) at the University of Maryland (UM) to begin conversations about a partnership aimed at addressing professional development needs in science. Initial conversations focused primarily at the middle grades level, as the county tried to figure out how to come into compliance with NCLB requirements. In response to MCPS’ growing needs at the elementary school level, conversations expanded to include elementary teachers as well. After several meetings, MCPS staff invited UM faculty to visit county elementary leadership team meetings. At these meetings, UM faculty had opportunities to meet with district elementary teachers to hear their concerns and perceptions of professional development needs in science. The teachers’ comments echoed much of the perspective of the county science administrators: teachers needed improved content knowledge and understandings of scientific reasoning in order to better support their students’ science learning. Many expressed an interest for sustained science professional development but felt unable to commit to an entire master’s program. Together, faculty from the Department of Curriculum and Instruction, the Department of Biological Sciences, Department of Physics, and MCPS representatives have designed a certificate program for science education. The proposed certificate track consists of six 3-credit courses (18 credits total), that focus on science disciplinary content and reasoning and science teaching and learning.

The target audience is elementary and middle school teachers who need additional studies to strengthen their understandings of science (both content and reasoning) and abilities to teach science.

Such an emphasis is responsive to the needs in elementary and middle school teachers in Montgomery County and elsewhere, and forms the basis for this partnership.

**B. How big is the program expected to be? From what other programs serving current students, or from what new populations of potential students, onsite or offsite, are you expecting to draw?**

The proposed certificate program will admit cohorts of 20 candidates (maximum) yearly. These candidates will be certified, currently practicing elementary and middle school teachers interested in improving their science content and teaching knowledge.

Our current master's program in science education primarily attracts secondary science teachers. This program will expand our reach and appeal to local teachers.

## **II. Curriculum**

**A. Provide a full catalog description of the proposed program, including educational objectives and any areas of concentration.**

To address the needs stated above, representatives from Science Education at UM, in consultation with colleagues in the Department of Physics and the College of Chemical and Life Sciences, and MCPS developed a 6-course sequence (3 credits each class) for certified elementary school teachers. Upon completion of the 18 graduate level credits, we propose graduates earn a Post-Baccalaureate Certificate in science education.

Courses will target big ideas in the science disciplines as well as issues involving teaching and learning science. Courses focus on core principles in the life and physical sciences, addressing big ideas highlighted in the Voluntary State Curriculum (VSC) science standards and in District indicators. As teachers develop more robust ideas of science, they will be learning how to learn science, enabling them to tackle "content" they have not been exposed to. Other program courses focus on student learning and reasoning in science and implications for instruction. This strand of coursework will focus on helping teachers recognize and respond to the seeds of students' good scientific reasoning, and to support these in tandem with content goals.

The objectives for the certificate program are to support the development of candidates' science content knowledge and knowledge about teaching and learning in science:

### Science Content Knowledge

- Deep conceptual understanding of fundamental areas of physical science: especially the nature of matter, basic kinematics and dynamics, buoyancy, and electric circuits;
- Deep conceptual understanding of fundamental areas of biological science: especially ecology, structure and function of organisms, genetics, evolution;
- The ability and propensity to approach the learning of new topics in physical science through tangible sense-making, argumentation, and coherence-building, even when learning from "traditional" textbooks and lectures;
- The ability and propensity to engage in scientific argumentation, which includes engaging with other people's ideas, defending claims with evidence, and seeking coherence between different ideas;
- The ability and propensity to engage in scientific coherence-seeking, by which we mean trying to explain a large range of phenomena in terms of a small number of basic concepts and models.

## Knowledge about Teaching and Learning in Science

- Understanding of the difference between sense-making and other common approaches to learning physical and biological sciences (such as rote memorization, focus on vocabulary, etc.);
- The ability to evaluate local curricular materials in terms of how well they scaffold the above activities;
- Planning and implementing instruction that elicits student thinking, in class discussions and assignments;
- Identifying and interpreting the substance of students' thinking as evident in their work, with respect to conceptual understanding, scientific inquiry, epistemologies and learning contexts;
- Formulating appropriate instructional responses to student thinking, including in customizing curriculum materials and objectives based on formative assessment;
- Analyzing student thinking, discussing possible responses, and providing constructive feedback based on case studies presented by colleagues.

**B. List the courses (number, title, semester credit hours) that would constitute the requirements and other components of the proposed program. Provide a catalog description for any course that will be newly developed or substantially modified.**

The six courses in the certificate program are as follows:

EDCI 604: Learning and Teaching in the Physical Sciences I (3 credits)

Engagement in laboratory and inquiry-based methods to develop coherent understandings about the physical world and explore issues of learning in the physical sciences. Personal engagement with phenomena and reflection on the learning and teaching experiences.

EDCI 605: Learning and Teaching in the Physical Sciences II (3 credits) (prerequisite: EDCI 604 or permission)

A second course in a sequence using laboratory and inquiry-based methods to study physical science learning and teaching. Candidates will move toward more sophisticated understandings of elementary/middle school curriculum topics in the physical sciences. Personal engagement with phenomena and reflection on the learning and instructional experiences.

EDCI 606: Learning and Teaching in the Biological Sciences I (3 credits)

Engagement in laboratory and inquiry-based methods to develop coherent understandings about the natural world and explore issues of learning in biology. Engagement with phenomena and reflection on learning and instructional experiences.

EDCI 607: Learning and Teaching in the Biological II (3 credits) (prerequisite: EDCI 605 or permission)

A second course in a sequence using laboratory and inquiry-based methods to study learning and teaching in biology. Candidates will move toward more sophisticated understandings of elementary/middle school curriculum topics in the life sciences. Personal engagement with phenomena and reflection on the learning and instructional experiences.

EDCI 675: Learning to Teach and Learn Science (3 credits)

Use of written and video case studies of student learning in science. Candidates focus on science as inquiry, looking for the beginnings of science in students' thinking, and examining students' thinking for tangible sense-making and argumentation. Candidates read and discuss literature on students' science learning and science instruction and construct case studies from students' science learning in their own classes.

EDCI 676: Reflection and Practice in School Science Teaching (3 credits)

Construction of case studies from students' science learning in candidates' own classes. Candidates present case studies of students' learning and discuss implications for teaching and curriculum design.

**C. Describe any selective admissions policy or special criteria for students selecting this field of study.**

Participants in the program will be certified, practicing elementary and middle school teachers who are interested in improving their science content knowledge and teaching approaches. The initial cohort will also specify that teachers currently teach in a public school system. Candidates for admission must meet the requirements of the University of Maryland Graduate School. All applications will be reviewed by faculty in the Science Teaching Center with respect to program capacity.

**III. Student Learning Outcomes and Assessment**

**A. List the program's learning outcomes and explain how they will be measured.**

The learning outcomes for the certificate program are listed above as the educational objectives for the program. The table below describes the assessments that will be used to measure each of these outcomes and the courses in which each of the assessments is administered.

<b>Learning Outcome</b>	<b>Assessment</b>
<b>Science Content Knowledge</b>	
Deep conceptual understanding of fundamental areas of physical science: especially the nature of matter, basic kinematics and dynamics, buoyancy, and electric circuits.	EDCI 604, 605 Midterm and final exams Student work
Deep conceptual understanding of fundamental areas of biological science: especially ecology, structure and function of organisms, genetics, evolution.	EDCI 606, 607 Midterm and final exams
The ability and propensity to approach the learning of new topics in science through tangible sense-making, argumentation, and coherence-building, even when learning from "traditional" textbooks and lectures.	We will be unable to reasonably assess this outcome, but still think it is an important course goal.
The ability and propensity to engage in scientific argumentation, which includes engaging with other people's ideas, defending claims with evidence, and seeking coherence between different ideas.	EDCI 604, 605, 606, 607 Weekly argument/counterargument papers
The ability and propensity to engage in scientific coherence-seeking, by which we mean trying to explain a large range of phenomena in terms of a small number of basic concepts and models.	EDCI 604, 605, 606, 607 Weekly argument/counterargument papers
Understanding of the difference between sense-making and other common approaches to learning physical and biological sciences (such as rote memorization, focus on vocabulary, etc.)	EDCI 604, 605, 606, 607 Weekly argument/counterargument papers



<b>Knowledge about Teaching and Learning in Science</b>	
The ability to evaluate local curricular materials in terms of how well they scaffold the above activities.	EDCI 675 Curriculum analyses
Planning and implementing instruction that elicits student thinking, in class discussions and assignments.	EDCI 675, 676 Lesson plans Case studies
Identifying and interpreting the substance of students' thinking as evident in their work, with respect to conceptual understanding, scientific inquiry, epistemologies and learning contexts;	EDCI 675, 676 Lesson plans Case studies
Formulating appropriate instructional responses to student thinking, including in customizing curriculum materials and objectives based on formative assessment;	EDCI 675, 676 Lesson plans Case studies
Analyzing student thinking, discussing possible responses, and providing constructive feedback based on case studies presented by colleagues	EDCI 676 On-line (Blackboard) discussions of case studies

**B. Include a general assessment plan for the learning outcomes.**

The criteria for assessing each of these assignments is described below.

1.) Argument/counterargument papers

Papers will be evaluated against the outcomes articulated above. The specific outcome will be dependent on the specific prompt and response. Please see Appendix A for further clarification and illustration of these assessment criteria.

2.) Exams

Exams will target key scientific concepts discussed in class. Evaluation of student responses will lie with the professional judgment of the teaching faculty responsible for the course. All instructors will have strong backgrounds in the science being taught.

### 3.) Curriculum analyses

In evaluating students' curriculum analysis projects, we look for students to support their claims with evidence from the material or reference to course readings and student interviews. In particular, we focus on candidates' (1) attention to science content; (2) attention to inquiry, and the abilities to engage in scientific inquiry; (3) attention to the nature of science, and when relevant; (4) attention to relevant local and societal issues related to the desired content.

#### *Science content*

To be considered adequate, a candidate's analysis must involve attention to the science concepts addressed in the curriculum material. The form this attention may come in will vary depending on the material selected for analysis, however, evidence of attention to content could lie in their statements about the accuracy of content, the coherence across lessons or activities, and the relevance to key ideas within the discipline. All candidates must address whether the curriculum material provides opportunities for students to develop the conceptual understandings and knowledge reflected in the curriculum goals or objectives. This includes attention to both the teaching and learning activities. Some candidates may challenge the goals articulated by the material. While we may encourage this type of critique, we do not expect this of all candidates at this point in the program. For those that do, they must ground their challenge in the subject matter, understandings or conceptual understandings, and/or externally developed standards documents such as the National Research Council's National Science Education Standards.

#### *Abilities for scientific inquiry*

We expect candidates to critically consider the types of activities students will engage in with respect to the material. Specifically, we expect them to consider opportunities the students have to engage in scientific inquiry, and also consider the curriculum's support of the development of such abilities. We do not want candidates to look for evidence of inquiry out of the context of the scientific concept being taught. In fact, we expect them to address the relationship between the nature of the scientific inquiry presented and its alignment with the conceptual development targeted by the materials.

#### *Epistemologies and understandings of the nature of science*

Adequate analyses consider the nature of science set forth in the curriculum materials as well as the more traditional views of scientific content. Candidates' analyses are expected to examine assumptions of science learning underlying the material and speak to the views of science that are advanced by the curriculum material. When contradictions occur -- among the nature of science, epistemological underpinnings, and/or activity structures -- student are expected to uncover and address these as well.

#### *Contexts*

Candidates are specifically asked to look for connections made to societal or local issues. When explicit, candidates should comment on how they add to or complement existing material. Where they are not available, candidates should consider possible openings for extension activities that could meaningfully connect the existing curriculum material to social issues. The connections should be purposeful, serving to support the development of student conceptual development rather than serving as an end to itself (connection for connections sake) or even detract from the lesson or activity.

#### *Support claims with evidence*

A major criterion for evaluating candidate work will be on how well students support their major points and claims with evidence – from curricular materials, external readings, and what they've learned through student interviews.

### 4.) Lesson plans

Assessing and responding to lesson plans, we attend to three basic requirements: (1) clarity, (2) reasonability of objectives, and (3) opportunity for students to express their thinking. In the assignment and in discussion we emphasize a fourth that connects to the first three: (4) how well the plans anticipate possible student responses.

### *Clarity*

This is the most basic need for the plans: We cannot think about whether a plan is realistic or sensible for the students if we do not know what it is. By the same token, the candidate cannot implement a plan if it is too vague.

For example, a candidate might write,

“The class will talk about why people look the way they do.”

“The students will explore buoyancy in small groups.”

“Talk about plant structure.”

None of these are specific enough to give a reader a clear sense of what the candidate intends, and perhaps the candidate is not clear either. What precisely is the focus of the activity? And how will the candidate introduce the activity to the students?

In contrast, the plan might say:

“I’ll ask the students ‘What makes people’s hair come out the color it does?’ and have them talk about it in small groups.”

“The students will work in pairs trying different objects in list A to see which float and which do not. I’ll ask them to try to come up with explanations for what they observe, and then I’ll ask them to use their explanations to predict whether each of the items in list B will float or sink.”

“I will give a lecture on plant structure, with a diagram [attached] to show the root and shoot systems, focusing on flowering plants, monocots and dicots. Here’s a draft of what I will say...”

These are more specific with respect to what the candidate intends to do, and they allow for detailed questions and comments from readers. (E.g. “I don’t think students will know exactly what you’re asking — can you make the question more specific? They might not be sure whether you mean what gives it that pigment, as it forms in the scalp, or whether you’re talking about heredity.”)

### *Reasonable, appropriate objectives*

The lesson plans should have objectives that make sense given what we expect the students know and are able to do, including with respect to time, substance, and approach. There should also be a basic alignment between the objectives and the approach. By the time students construct these lesson plans, they have spent a semester studying research on student learning as well as conducting their own interviews of students on questions in science. Many will be inclined to set aside the ideas they had discussed in that reading, as they formulate their lesson plans (often in part because they are working from materials in the school that do not reflect research on learning). The lesson planning assignment is one of many opportunities in the program to make that connection. So students should come to see that a plan built primarily around lectures and demonstrations of conceptually difficult material is unlikely to help students achieve good understanding. It would not be reasonable, based on extensive findings from research, to expect that most students will be able to learn the laws of motion, of segregation, or of ideal gases based entirely on presentations and readings. Nor would it be reasonable to have students engage in a word-search activity, or crossword puzzle, to the purpose of developing conceptual understanding. Moreover, such lessons would present or reinforce misleading ideas about the nature of science, as a body of knowledge to be received on the authority of the teacher or text. Rather, students will need opportunities to wrestle with the ideas, to consider alternative ways of thinking, to study evidence for and

against different points of view, in the interest of their understanding both the concepts and what it means to engage in scientific thought.

#### *Opportunities for students to express their reasoning*

The lesson plans should include appropriate opportunities for students to express their reasoning, both because those opportunities are essential for their learning and because teachers need to see and hear from students in order to assess their progress and needs. Lesson plans that do not provide such opportunities are inadequate: Enacted as planned, they are likely to fail, and, worse, the teacher can remain unaware. It is important to note that planning in this way depends critically on the candidates' assessment of the students' current knowledge and abilities. In some classes, students have progressed to the point that lesson plans based on lectures and teacher presentations are perfectly appropriate; in those classes, the students pepper the teacher with questions and comments, and what is planned as a presentation is understood on all sides as interactive. In other words, the students have become sufficiently sophisticated as learners that they can create their own opportunities to express their thinking, for themselves and for the teacher to be aware. Of course, that is not typical, and for this assignment it would seldom be appropriate for a candidate to plan a purely presentation-based lesson. A somewhat more subtle difficulty with lesson plans are those that incorporate student "hands-on" activities that do not genuinely provide opportunities for them to express their thinking. For example, a teacher might design a lesson plan that has students move about the room to enact the process of mitosis, follow a prescribed experimental procedure to measure the dependence of solubility with temperature, or spend time at an amusement park to explore circular motion. All of these would have students active but not necessarily expressing their reasoning in such a way that the teacher could attend to it. An adequate lesson plan provides clear opportunity for student thinking, and for the teacher to gain a sense of it. For example, a plan might have students writing in journals the teacher can collect and read; working in groups as the teacher circulates around the room listening in or visiting with questions; engaging in a whole-class debate; and so on.

#### *Insightful anticipations*

A perennial challenge of lesson planning is to keep the attention focused on the students. For years the accepted means of doing this was (and in many places still is) to require that objectives be expressed in a form that explicitly denotes observable student performances. A liability of this approach is that it can be inauthentic: The form takes the foreground away from the substance. We have been using a different approach, in isolated courses; with our program redesign we are making it the local standard. Rather than require a particular form for lesson plans, we require that the plans include explicit discussion of anticipations: What are the ways students are likely to respond, to the instructions or questions or explanations set before them in the plan? What are some plausible ways they could respond? Anticipating possible responses, as opposed to only those responses the teacher intends, she or he can consider how to address them. As well, it may help the teacher be more perceptive in noticing what does happen, when it differs from those anticipations. To meet this requirement, the candidates must step back from the plan and imagine it from a student's perspective, and they must formulate reasonable expectations. For example, it would be reasonable to expect students to have some early ideas about children's hair color being related in some way to their parents', and that some students would speak of hair color as "genetic." But in general it would not be reasonable to expect students would already have in mind specific ideas about the mechanisms of inheritance.

#### 5.) Case studies

Assessing and responding to case studies, we attend to (1) evidence of student knowledge and reasoning; (2) the candidate's interpretations of that evidence, at the time of the class and reflecting back on it; (3) the candidates' interactions with students; and (4) the candidate's reflections on the lesson.

### *Evidence of student knowledge and reasoning*

To be considered adequate, a case study must present evidence sufficient to give readers and viewers insight into the student's knowledge and reasoning and sufficient to support the candidate's claims. That evidence is in the form of students' statements and behavior, as recorded on videotape and as recounted in the candidate's written report. The requirement of sufficient evidence, of course, has implications for what takes place during the class. In particular, consistent with the requirement of the lesson plan assignment, students need to be given opportunities to express themselves. Sufficient evidence means student generated explanations of ideas, student questions, and student actions. Statements such as "Yes, I understand" or "I don't know how to do number 6" are not sufficient evidence of student knowledge and reasoning. For many candidates, it takes a round and sometimes two of case studies before they produce one that shows sufficient evidence of student thinking. The requirement of this assessment is that, by the end of the course, every candidate must present an adequate case study.

### *Interpretations of evidence*

The candidate should offer reasonable interpretations of the evidence available. We do not require that candidates catch everything that takes place; that is not possible. We require that they show evidence of attending to what does take place, both during the class and in reflecting on it later, and of recognizing ambiguities and alternative possibilities. We expect it to happen often that candidates change their interpretations of student thinking, on reflection later—the criterion is not that candidates' interpretations are correct. When candidates fail in this criterion, it is because they make judgments about student thinking they cannot support with data, or because they regularly ignore evidence of student thinking when it is available. It would not be reasonable, for example, to assess that students understand a concept based on their not asking questions, or their nodding during a lecture, or because they repeat back an explanation of the concept using the teacher's same words. Nor would it be adequate performance if the candidate generally misses signs of students' alternative understandings. Success by this criterion means a candidate regularly notices evidence of student thinking and giving plausible interpretations of it, and regularly supports assessments of student thinking with specific data. Our evidence of a candidate's success here would require us to identify examples of supported interpretations in the case study.

### *Interactions with students*

There are several criteria by which we assess candidates' interactions with students. First, most basically, they should be respectful of the students as human beings, promoting their well-being, including treating them with dignity and integrity. Second, the interactions should reflect the candidate's understanding both of the concepts and of scientific practice. At the most basic level, the candidate should understand the concepts and practices involved in the lesson. At a more demanding level, the candidate should be able to assess the validity of students' arguments and reasoning, including and especially when expressed in the students' own words, and the candidate should be able to engage in scientific discussion about ideas s/he had not yet encountered. It would not be appropriate, for example, if the candidate were to communicate tacitly or explicitly that knowledge in science comes from authority, that they should refrain from asking questions or arguing alternative points of view.

### *Perceptive reflections on the lesson*

We do not expect candidates (or teachers in general) to show "optimum" performance during class. Teaching, we recognize and want candidates to recognize, is full of uncertainties. Part of skilled, professional practice in teaching is to look back on lessons and reflect on how it went and on how it might have gone differently. What we expect in these case studies is that candidates engage in honest, perceptive reflections on what took place, to consider how their actions in class may have helped students make progress but may also have had unintended effects. An adequate response would show insight into specific interactions and decisions, and it would reflect on alternative possibilities. It would not be adequate, on the other hand, for the

case study simply to provide a rating — “I think I did a good job,” or “That went badly.” Candidates may revise a case study after presenting the video during class, which provides an opportunity for them to gain insight from others’ reactions. This would be another way to succeed with the assignment, to incorporate ideas that come up in interactions with colleagues. We do not require that the reflection in a case study be entirely independent; to the contrary, we expect and hope candidates will benefit from discussions.

6.) Online discussions of case studies

#### **IV. Faculty and Organization**

##### **A. Who will provide academic direction and oversight for the program?**

Oversight for this program will be with faculty members in the EDCI Science Teaching Center. Dr. Janet Coffey will serve as the primary point person. Dr. Coffey will be advised by a steering committee, which will include herself, one representative from the College of Mathematics, Computers and Physical Sciences (David Hammer, who is also on the faculty in the Department of Curriculum & Instruction), and two representatives from the College of Chemical and Life Sciences (Spencer Benson and Joelle Presson). For the initial cohort, the steering committee will also include two representatives from the MCPS science instructional unit (Anita O’Neill, K-12 Science Supervisor; Mary Doran Brown, Elementary Science Coordinator) and one representative from MCPS central office (Russ Fazio, Staff Professional Development Specialist). (This is the type of steering group we propose to develop for each partner district.) Formal staffing assignments will be made by the respective Department Chairs based upon recommendations from the steering committee.

During the initial cohort’s program, the steering committee will meet at least once per year to review progress, make policy and procedures recommendations, and guide program evaluation data collection for this initiative. They will communicate as needed by email.

If the program is not to be housed and administered within a single academic unit, provide details of its administrative structure. **NOT APPLICABLE**

#### **V. Off Campus Programs**

- A. If the program is to be offered to students at an off-campus location, with instructors in classrooms and/or via distance education modalities, indicate how student access to the full range of services (including advising, financial aid, and career services) and facilities (including library and information facilities, and computer and laboratory facilities if needed) will be assured.

The Universities at Shady Grove will provide classroom facilities and other technical assistance for the program. The director of outreach programs for the Universities at Shady Grove will work closely with the University of Maryland and Montgomery County Public Schools to support the programs objectives and to insure that the proper resources are available for the programs’ staff, faculty and participants. For classes where laboratory equipment is necessary, we will seek space on campus or at local MCPS schools.

- B. If the program is to be offered mostly or completely via distance education, you must describe in detail how the concerns in Principles and Guidelines for Online Programs are to be addressed.  
**NOT APPLICABLE**

## VI. Other Issues

- A. Describe any cooperative arrangements with other institutions or organizations that will be important for the success of the program.

We negotiated letters of agreement with the participating school district (Montgomery County Public Schools) to ensure understanding and communicate responsibilities. They will take primary responsibility for the recruitment of teachers.

- B. Will the program require or seek accreditation? Is it intended to provide certification or licensure for its graduates? Are there academic or administrative constraints as a consequence?

The program is subject to review by NCATE. We are not seeking certification or licensure at this time.

## VII. Required Physical Resources

- A. Additional library and other information recourse required to support the proposed program. You must include a formal evaluation by library staff.
- B. Additional facilities, facility modifications, and equipment that will be required. This is to include faculty and staff office space, laboratories, special classrooms, computers, etc.
- C. Impact, if any, on the use of existing facilities and equipment. Examples are laboratories, computer labs, specially equipped classrooms, and access to computer servers.

Existing resources are adequate to support the proposed program. The program will have minimal impact on the use of existing facilities and equipment because the size of this proposed science certification program is quite small relative to the size of existing programs administered by the Science Teaching Center. For the initial cohort, we have obtained state funds that will cover costs for teaching, course and program design, and partial tuition for participating teachers.

## IX. Resource Needs and Sources

Describe the resources that are required to offer this program, and the sources of these resources. Project this for 5 years. In particular:

- A. List new courses to be taught, and needed additional sections of existing courses. Describe the anticipated advising and administrative loads. Indicate the personnel resources (faculty, staff, and teaching assistants) that will be needed to cover all these responsibilities.**

New courses include: EDCI 604, EDCI 605, EDCI 606, and EDCI 607. These four courses were approved by the College of Education and have been submitted to VPAC for approval. The other two required courses, EDCI 675 and EDCI 676, are fully approved. We anticipate cohorts of 20 students, which would require one section of each course.

Staffing for the courses described above is aligned with department goals. Grant support was received to provide sufficient resources to cover faculty salary for the first cohort, as well as pay for course and program design. Clinical teaching faculty are being supported to teach these courses (Andy Elby and Dan Levin).

The initial grant will also cover program administration. We anticipate that much of this work will be turned over to the Amy Berman in the COE outreach office. We will continue to seek funding for subsequent years. We also plan to work in partnership with local districts to ensure enrollment numbers.

**B. List new faculty, staff, and teaching assistants needed for the responsibilities in A. and indicate the source of new resources for hiring them.**

Classes will be taught by clinical faculty (currently, Andy Ely and Dan Levin) whose job description involves courses of this nature.

**C. Some of these teaching, advising and administrative duties may be covered by existing faculty and staff. Describe your expectations for this, and indicate how the current duties of these individuals will be covered, and the sources of any needed resources.**

Outside funds have been obtained to support teaching for clinical faculty and graduate assistants who will oversee coursework. We will continue to seek funds, and maintain enrollment numbers to adequately cover teaching costs.

**D. Identify the source to pay for the required physical resources identified in this section.**

The main funding source for this program is an Improving Teacher Quality Grant (MHEC).

**E. List any other required resources and the anticipated source for them.**

We will see continuation funds from MHEC for a second cohort (probably with Prince Georges County Schools). Whether or not we receive funds, we will continue to work in partnership with local districts to maintain adequate enrollment numbers.



## Appendix A: Illustrating Assessment Criteria for Argument/Counterargument Assignment

In this appendix, we use three hypothetical examples of student argument/counterargument papers to illustrate how we assess students' progress with respect to four of the Science Content Knowledge Learning Outcomes. We rate each student as showing poor, fair, good, very good, or excellent progress toward each learning outcomes and explain our reasoning.

The argument/counterargument papers respond to a classroom discussion about this question:

*A small bowl sits on the floor. With your keys in your hand, and your hand held motionless in front of you, you run toward the bowl. To make the keys land in the bowl, should you drop them (i) before your hand reaches the bowl, (ii) when your hand is directly over the bowl, or (iii) after your hand has passed the bowl? Why?*

As in all argument/counterargument papers, students express their answer and the reasoning behind it; give a plausible counterargument in support of a different answer; and try to achieve a synthesis that addresses the argument and counterargument.

1 Alina

2

3 **1. Make an argument about when you should drop the keys.**

4

5 I should drop the keys from directly over the pot. Gravity pulls things straight down when  
6 they're dropped instead of thrown. It doesn't matter if I'm moving when I drop it. For instance,  
7 when I ride in a car, if I drop my keys from directly above my feet, they fall down onto my feet,  
8 proving that they fell straight down. Gravity doesn't "know" that I was moving, and that's  
9 equally true whether I'm running toward the pot or riding in my car.

10

11 **2. Give a counterargument.**

12

13 Some people in the class think you should drop the keys before you reach the pot because the  
14 keys will leave your hand with forward motion because you were moving when you dropped  
15 them. By that argument, if you drop the keys from directly over the pot, they'll fly forward while  
16 falling and land in front of the pot. So you've got to drop them earlier. An example Katie gave to  
17 support this argument is that when you move your hand forward while throwing something, the  
18 thing keeps moving forward even after the thrower lets go.

19

20 **3. Address the counterargument.**

21

22 I still think the keys should be dropped from right over the pot. If you *throw* something, then  
23 sure, it goes forward. But holding your hand still while running or riding forward is different  
24 from throwing something forward, because in the first case you're holding your hand still, while  
25 in the second case you're *moving* your hand forward. If holding your hand still while running or  
26 riding forward were the same thing as moving your hand forward while throwing, then when I  
27 drop something in a car moving at 30 mph, it would be the same as if I threw it forward at 30  
28 mph, in which case it would land way in front of my feet. But it doesn't.

**Desired Outcome 1: *Deep conceptual understanding of fundamental areas of physical science: especially the nature of matter, basic kinematics and dynamics, buoyancy, and electric circuits.***

Although she gives the wrong answer to part 1, Alina shows evidence of a **good** understanding of the targeted kinematic concept. She knows that keys thrown forward continue moving forward while falling (lines 24-25) and that the relevant issue here is whether dropping keys while moving forward is equivalent to throwing keys forward. What's missing is a realization that, from the keys' perspective, those two scenarios are indeed equivalent. As discussed below, her understanding of the correct physics, spelled out in her part (2) response, is good,

**Desired outcome 4: *The ability and propensity to engage in scientific argumentation, which includes engaging with other people's ideas, defending claims with evidence, and seeking coherence between different ideas.***

Alina displays **very good** argumentation here, despite her incorrectness. In defending her claim in part (1), she cites both empirical evidence, about dropping keys in a moving car (lines 7-8), and a theoretical argument, about what gravity can "know" about an object it's pulling down (lines 8-9). She articulately expresses the main counterargument to her position (lines 14-18), even citing empirical evidence to support it (lines 18-20). In part (3), she goes on to explain why she favors her part (1) over her part (2) response; a *reductio ad absurdum* hinging on a piece of empirical evidence about what happens when you drop keys in a moving car (lines 27-31).

**Desired outcome 5: *The ability and propensity to engage in scientific coherence-seeking, by which we mean trying to explain a large range of phenomena in terms of a small number of basic concepts and models.***

Although the evidence pertaining to this indicator is thin, Alina appears to show **very good** progress. Instead of accepting (i) *throwing*, (ii) *dropping while motionless*, and (iii) *dropping while moving* as three separate phenomenon governed by three separate sets of laws/explanation, she argues coherently (see desired outcome 4 above) that *dropping while motionless* and *dropping while moving* are the same thing (lines 6-9; 27-31), inviting a unified explanation. Although a Newtonian would collapse (i) and (iii) instead of (ii) and (iii), Alina and the Newtonian are playing versions of the same coherence-seeking game.

**Desired outcome 6: *Understanding of the difference between sense-making and other common approaches to learning physical and biological sciences (such as rote memorization, focus on vocabulary, etc.)***

Alina is showing **at least good** progress here; she is consistent in trying to make sense of what's going on, based on evidence and everyday experiences (lines 7-8; 27-31) and appeals to the plausibility of different mechanisms (lines 8-10; 26-27). Nowhere does she revert to vocabulary-spewing or authority citing. What we cannot tell from this paper is how conscious and articulate she is about the differences between what she's doing and other, more authority-based approaches.

1 Bob

2  
3 **1. Make an argument about when you should drop the keys.**

4  
5 The key should be dropped before the person reaches the pot. According to Newton’s 1<sup>st</sup> law, an  
6 object in motion stays in motion unless acted upon by an outside force. So, the key keeps moving  
7 forward after you drop it because it was moving forward when you dropped it. Newton’s 2<sup>nd</sup> law  
8 says that force is mass times acceleration.

9  
10 **2. Give a counterargument.**

11  
12 Arnold says the key should be dropped from directly over the pot because gravity pulls things  
13 down.

14  
15 **3. Address the counterargument.**

16  
17 I disagree with Arnold because that answer disagrees with Newton’s 1<sup>st</sup> law. The 1<sup>st</sup> law says you  
18 have to drop the key *before* getting to the pot, since the key’s forward motion will make sure it  
19 keeps going forward to land in the pot.

**Desired Outcome 1: *Deep conceptual understanding of fundamental areas of physical science: especially the nature of matter, basic kinematics and dynamics, buoyancy, and electric circuits.***

Despite giving the correct answer in part (1), Bob displays a merely **good** understanding. He shows evidence of understanding how Newton’s 1<sup>st</sup> law applies to this scenario (line 7; 18-19). What’s missing is evidence that he has connected this understanding to his intuitions and everyday experiences. (He may well have made such connections; but the evidence here is lacking.)

**Desired outcome 4: *The ability and propensity to engage in scientific argumentation, which includes engaging with other people’s ideas, defending claims with evidence, and seeking coherence between different ideas.***

Bob displays **fair** argumentation here, despite his correctness. In part (2), he states Arnold’s idea, and briefly gives the reason as “gravity pulls things down,” but doesn’t go into more detail about the common-sense ideas and everyday experiences underlying this answer. And in part (3), he doesn’t take on Arnold’s argument; his reason for rejecting it is simply that it disagrees with the law he cites in favor of his answer -- though Bob does discuss what would happen to the keys if dropped in the way Arnold suggests. In his part (3) response, Bob doesn’t write anything that would convince Arnold, if Arnold weren’t already convinced by Bob’s assertion back in part (1).

**Desired outcome 5: *The ability and propensity to engage in scientific coherence-seeking, by which we mean trying to explain a large range of phenomena in terms of a small number of basic concepts and models.***

There is **insufficient evidence** to reach a conclusion about this. All we know is that Bob thinks Newton’s 1<sup>st</sup> law applies to this scenario. We don’t know if he would seek to apply that law to other situations.

**Desired outcome 6:** *Understanding of the difference between sense-making and other common approaches to learning physical and biological sciences (such as rote memorization, focus on vocabulary, etc.)*

Bob shows **poor** progress here; in this work, he enacts the view that explanations should consist of appeals to authority (specifically, authoritative physical laws) with at most incidental connections to sense-making.

1 Christina

2  
3 **1. Make an argument about when you should drop the keys.**

4  
5 I should drop the key before reaching the pot, because it will continue to move forward while  
6 falling. So if you drop it from over the pot, or even from not far enough in front of the pot, it will  
7 overshoot and miss the pot. The key keeps moving forward when you drop it because your hand  
8 was in motion while you were carrying it, and the key acquires that motion, just as if you threw  
9 the key forward. So for instance, if your hand was moving at 5 mph, then the “dropped” key was  
10 also moving forward at 5 mph and therefore keeps going forward at 5 mph as it falls.

11  
12  
13 **2. Give a counterargument.**

14  
15 The main counterargument to this was that the key is just “dropped” rather than thrown, and  
16 dropped objects fall straight down. It’s dropped rather than thrown because although the person  
17 is running, her hand is being held still. And it’s true; when you just drop something it falls  
18 straight down. To illustrate this argument, someone talked about dropping keys in a car. The key  
19 lands directly under the place from which it was dropped, and this allegedly goes to show that  
20 throwing something (your *hand* is moving) leads to different results from just dropping  
21 something (your hand not moving) even if your body as a whole is moving.

22  
23 **3. Address the counterargument.**

24  
25 The distinction between throwing something and dropping it while your body is in motion just  
26 doesn’t hold up. The key can’t “know” whether your hand is moving because you’re thrusting it  
27 forward of because it’s attached to your body which is moving. All the key “knows” is how fast  
28 your hand is moving, for whatever reason. If your hand is moving forward at 10 mph when you  
29 release the key, the key inherits that 10 mph of forward motion; and it doesn’t matter whether  
30 your hand had that speed because you “threw” it forward at 10 mph or because you held your  
31 hand still while riding I a car going 10 mph. To the key, it’s all the same. Now sure, the key  
32 “dropped” in a moving car lands directly under the dropping point. But that actually support my  
33 argument, not the counterargument. While the key is falling, the car itself — include its floor —  
34 is moving forward. By the time the key lands on the car’s floor, that floor has moved forward;  
35 it’s now in front of where the key was dropped from. So, in reality, when the key lands on the  
36 floor “right under” the place it was dropped from, it’s really landing far *in front of* the place it was  
37 dropped from. Someone standing on the road watching through the car window would correctly  
38 see the key as moving forward while it falls and while the car also moves forward. The person in  
39 the car sees the key as falling straight down only because she’s *also* moving forward, keeping up  
40 with the forward motion of the car floor and falling key.

**Desired Outcome 1: Deep conceptual understanding of fundamental areas of physical science: especially the nature of matter, basic kinematics and dynamics, buoyancy, and electric circuits.**

Christina displays **excellent** progress here not simply because she is correct but because she deals with difficult conceptual issues such as the common perception that “passively” dropping something while running or riding is different from “actively” throwing something (lines 7-11). She reconciles her correct understanding of inertia with seemingly contrary intuitions (lines 28-33) and evidence (lines 34-44), relying on productive ideas about what the key can and can’t

“know” (lines 28-30) and on a good analysis of how a given motion appears from two different frames of references (lines 40-44). Note that Christina’s progress is excellent even though she doesn’t use “inertia” or “Newton’s 1<sup>st</sup> law” to name her ideas. Given what she understands, it will be quick and easy for her to learn those terms and apply them correctly.

**Desired outcome 4:** *The ability and propensity to engage in scientific argumentation, which includes engaging with other people’s ideas, defending claims with evidence, and seeking coherence between different ideas.*

Christina displays **excellent** argumentation here. She clearly expresses the main counterargument to her position (lines 16-19), including compelling evidence for it (lines 20-23). In refuting those counterarguments, she seeks and achieves coherence among theoretical ideas about what the keys “know” and empirical evidence about the keys dropped in the car, even incorporating the fact that the person riding in the car sees the keys fall straight down (34-40).

**Desired outcome 5:** *The ability and propensity to engage in scientific coherence-seeking, by which we mean trying to explain a large range of phenomena in terms of a small number of basic concepts and models.*

The thin evidence here suggests Christina is making **very good or excellent** progress; she seeks to apply her inertia ideas to situations in which different observers perceive different motions (lines 34-44).

**Desired outcome 6:** *Understanding of the difference between sense-making and other common approaches to learning physical and biological sciences (such as rote memorization, focus on vocabulary, etc.)*

Christina is making **at least very good** progress here; she shows evidence of being solid and robust in her sense-making. We don’t know, however, if she is conscious and articulate about the difference between what she’s doing and what Bob is doing.

**TABLE 1: RESOURCES**

Resources Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1.Reallocated Funds <sup>1</sup>	0	0	0	0	0
2. Tuition/Fee Revenue <sup>2</sup> (c+g below)	79,920	139,860	119,880	119,880	119,800
b. Annual Tuition/Fee Rate	0	0	0	0	0
c. Annual Full Time Revenue (a x b)	0	0	0	0	0
d. # Part Time Students	20	35 <sup>1</sup>	30	30	30
e. Credit Hour Rate	444	444	444	444	444
f. Annual Credit Hours	9	9	9	9	9
g. Total Part Time Revenue (d x e x f)	79,920	139,860	119,880 239,760	239,760	239,760
3. Grants, Contracts, & Other External Sources <sup>23</sup>	59,400	59,400	0	0	0
4. Other Sources	0	0	0	0	0
<b>TOTAL (Add 1 - 4)<sup>3</sup></b>	<b>139,320</b>	<b>199,260</b>	<b>119,880</b>	<b>119,880</b>	<b>119,880</b>

<sup>1</sup> Subsequent cohorts will target 20 students, and will not run if the number is less than 15. Numbers here are calculated based on this minimum number.

<sup>2</sup> MHEC ITQ funds were received for the initial cohort. This number reflects non-participant monies awarded for program. We will continue to seek additional monies in future years.

<sup>3</sup> Per College of Education agreement with campus, the outreach revenue to the Department is based on 70% of tuition.

*JV. 12-8-04*

<sup>1</sup> Whenever reallocated funds are included among the resources available to new programs, the following information must be provided in a footnote: origin(s) of reallocated funds, impact of the reallocation on the existing academic program(s), and manner in which the reallocation is consistent with the institution's strategic plan.

<sup>2</sup> This figure should be a realistic percentage of tuition and fees which will be used to support the new program. Factors such as indirect costs linked to new students and the impact of enrolling continuing students in the new program should be considered when determining the percentage.

<sup>3</sup> Whenever external funds are included among the resources, the following information must be provided in a footnote: source of the funding and alternative methods of funding the program after the cessation of external funding.

*J.D. 12-8-08*



**TABLE 2: EXPENDITURES**

Expenditure Categories	(Year 1)	(Year 2)	(Year 3)	(Year 4)	(Year 5)
1. Total Faculty Expenses (b + c below)	22,000	44,000	44,000	44,000	44,000
a. # FTE	.5	1	1	1	1
b. Total Salary <sup>4</sup>	22,000	44,000	44,000	44,000	44,000
c. Total Benefits	0	0	0	0	0
2. Total Administrative Staff Expenses (b + c below)	25,700	20,560	20,560	20,560	20,560
a. # FTE	.6	.5	.5	.5	.5
b. Total Salary	20,000	16,000	16,000	16,000	16,000
c. Total Benefits <sup>5</sup>	5,700	4,560	4,560	4,560	4,560
3. Total Support Staff Expenses (b + c below)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Equipment	2000	4000	4000	4000	4000
5. Library	0	0	0	0	0
6. New or Renovated Space <sup>6</sup>	2,100	4,200	4,200	4,200	4,200
7. Other Expenses <sup>7</sup>	1,000	1,000	1,000	1,000	1,000
<b>TOTAL (Add 1 - 7)</b>	<b>78,500</b>	<b>99,460</b>	<b>99,460</b>	<b>99,460</b>	<b>99,460</b>

<sup>4</sup> Calculated at 12.5% of faculty academic year salary, and 10% for summer courses.

<sup>5</sup> Benefits calculated at 28.5% of salary.

<sup>6</sup> Costs at Shady Grove facility calculated at a rate of \$650/course, and \$50/course for program facility fees, totaling \$700/course.

<sup>7</sup> Includes costs such as copies and relevant office supplies.

*J.D. 12-8-08*



**DATE:** February 17, 2009

**TO:** Dr. Anna O. Graeber  
Interim Associate Chair for Teacher Education

**FROM:** Karen Patterson *KP*  
Education Librarian

Gerri Foudy *GF*  
Interim Budget Manager, Collection Management & Special Collections Division

Sue Baughman *SB*  
Interim Director, Collection Management & Special Collections Division

**RE:** Library Resources to Support Science Education Certificate for Elementary and Middle School Teachers in the Department of Curriculum and Instructions, College of Education

The University of Maryland (UM) Libraries currently support the undergraduate and graduate students of the Department of Curriculum and Instruction in the area of science education. With this new proposal, the University of Maryland Libraries collections can adequately support the instruction and research needs of the newly proposed Science Education Certificate for Elementary and Middle School Teachers.

### **The Collection: Monographs and Serials**

McKeldin Library houses the education collection of monographs and serials relevant to science education. Since science education is an interdisciplinary area of study, the library resources in Science [i.e. physics, life sciences, chemistry] and the Government Documents Collection will supplement the science education holdings.

Because this program will initially begin in partnership with teachers from Montgomery County Public Schools (MCPS), the Shady Grove Library will be the immediate library facility. With science education drawing from the sciences and education, it is difficult to provide precise figures on the number of library materials that support this program. A spot check of the University of Maryland, College Park catalog and the USMAI [University Systems of Maryland and Affiliated Institutions, which is a consortium of sixteen institutions] catalog was done for the following subject headings: "science—study & teaching-- elementary", "science – study & teaching – primary", and "science – study & teaching – middle school" was done. The "science – study & teaching – elementary" search retrieves: 5 titles from the Shady Grove library as its holding site, 210 titles from the University of Maryland, College Park catalog; and 687 titles from the USMAI catalog. The "science – study & teaching – middle school" search retrieves: 3 titles from Shady Grove library as its holding site, 48 titles from the University of Maryland, College Park catalog, and 71 from the USMAI catalog. Students at the Shady Grove campus can borrow books located at any USMAI library, which helps alleviate the concern of Shady Grove Library's limited collection on science education.

To further analyze the strength of our holdings, a spot check of the holdings of peer institutions was done. The search results for “science – study and teaching – elementary” from peer institutions are as follows: University of Wisconsin-Madison: 353 titles; University of North Carolina at Chapel Hill: 562 titles; Teacher’s College of Columbia: 383 titles; Michigan State University: 242 titles; Stanford University [Cubberley Education Library]: 125 and University of Michigan: 248 titles. When reviewing all of the catalog searches, our monographic holdings in UM libraries is lower than other university holdings in science education [elementary and middle school], but when you consider the USMAI consortium, the holdings are more than adequate. This catalog search does not consider specifics such as formats of materials (e.g. books, journals, multimedia, theses) and the rate of english to non-english language publications.

A search was performed in *Journal Citation Reports 2007*, a database that uses citation data to rank and determine the impact factor of journals in an academic field. To support the proposed courses, at the present time the Libraries provide access to the following top-ranked journals:

*Journal of the Learning Sciences*  
*International Journal of Science Education*  
*Journal of Research in Science Teaching*  
*Science Education*  
*Learning and Instruction*  
*Cognition and Instruction*

Other academic journals to support the classes are *Science & Children*, *Science Teacher*, and *Elementary School Journal*. With the libraries moving toward electronic serials, the majority of these titles have holdings that are remotely accessible.

In the area of serials, our collection is strong in comparison with the other universities as revealed by the catalog check, but a few relevant titles could be added to the collection. A journal title to consider for purchase would be *Journal of Science Education and Technology* [Springer Netherlands] \$969. In order to provide support for the proposed classes, the Libraries would require \$969 per annum to purchase this journal.

### **The Collection: Government Documents**

As a regional depository library, University of Maryland Libraries has a collection of over two million documents. This will provide historic and current relevant government documents for the Science Education program. Some of the agencies that publish documents include: from U.S. Department of Education; National Center for Education Statistics, U.S. Department of Education; the United States. Congress. House. Committee on Science and Technology.

### **The Collection: Electronic Resources**

UM Libraries subscribes to the following significant databases that will support the certificate program. *Education Research Complete*, *ERIC*, *JSTOR*, and *Web of Science*. *Education Research Complete* is the definitive online resource for education research. The database covers all areas of curriculum instruction.

### **Staff Resources**

All library personnel provide support to the curricular and research needs of academic departments at the University of Maryland. Library specialists will provide in-depth research consultations with the EDCI students, faculty and administration.

### **Interlibrary Loan**

When resources are not part of our holdings within the sixteen University System of Maryland and Affiliated Institutions [USMAI] libraries, the Interlibrary Loan Office can obtain monographs, journal articles,

dissertations, government documents and technical reports at no charge to the student or faculty. This service will support the instruction and research needs of the EDCI faculty and students. Shady Grove students can request Interlibrary Loan items be shipped to the Shady Grove Library.

### **Conclusions**

At the present time, library holdings are at least adequate to support the proposed set of courses, even without the purchase of the suggested journal title. Journal collections, however, remain particularly vulnerable. As a result, the level of future support is dependent upon ongoing funding and other circumstances affecting journal subscriptions.