No Child Left Behind Act of 2001
Public Law 107-110
Title II, Part B

Arkansas Mathematics and Science Partnership Program

Science Lead Teacher Institute

Arkansas Center for Mathematics and Science Education (ACMSE) of
University of Central Arkansas (UCA)
June 7 – June 18, 2010
June 14 – June 25, 2010

PROJECT DIRECTOR
Dr. Umadevi Garimella

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Conway, AR 72035

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About the Institute

Science Lead Teacher Institute (SLTI) is a content-intensive professional development program to guide 30 Science Lead Teachers in Grades 7-10 through the process of crafting tailored strategic plans for initiating and implementing effective inquiry science programs. These teachers will be instrumental in assisting school districts to implement hands-on, inquiry-centered science programs and to bring about systemic reform of science education. Training activities will include a two-week summer science session that is content-intensive, classroom focused and aligned with state standards and science curricula and three one-day sessions during the academic year. Additionally, each participant will have on-site visits from the project staff and will network with UCA faculty members to establish a sustained partnership.

This institute is a three-year partnership project funded to the University of Central Arkansas (UCA) through the Arkansas Department of Education, under No Child Left Behind Act of 2001, Public Law 107-110, Title II, Part B. The main focus of this institute is to integrate concepts of physical science with biology and create a vertical alignment of the curriculum from 7th – 10th grades. Since science knowledge is cumulative, the foundations for the biology content will be created by looking back to earlier grades. Grades 7-9 grade science will be integrated with 10th grade Biology. The content knowledge the (primary focus) will be delivered by UCA faculty from College of Natural Sciences and Mathematics and the pedagogy part (secondary focus) by faculty from College of Education.

Year 1 - Physics in Biology: STLI 2009 summer institute is the first year of the three years program dealing with physics of physical science. The curriculum used in this summer session has been especially designed to strengthen the subject matter background of teachers in topics typically covered in 7-9 grade physical sciences using a hands-on, inquiry-oriented method of instruction. The concepts will then be related to the biological concepts. The materials emphasize the development of fundamental concepts and reasoning skills through laboratory experience.

Year II – Chemistry in Biology: STLI 2010 summer institute is the second year of the three years program dealing with chemistry of physical science. The curriculum used in this summer session has been especially designed to strengthen the subject matter background of teachers in topics typically covered in 7-9 grade physical sciences using a hands-on, inquiry-oriented method of instruction. The concepts will then be related to the biological concepts. The materials emphasize the development of fundamental concepts and reasoning skills through laboratory experience.
**Project Goals and Professional Development Plans:**

**Goal #1:** To increase teacher content knowledge in physical science (year 1), chemistry (Year 2) and biological science (year 3) at a rate of 5% each year over the three year period as measured by DTAMS assessment from University of Louisville.

The byproduct of this goal is to improve student achievement at the rate of 5% in the sciences as measured by Mozart test. The participating teachers will administer pre/post test to their students.

**Objective #1:** Create a vertical alignment of SLE's for the grades 7-10 to increase academic achievement of all students as demonstrated by a 5% increase in the number of students scoring above proficient levels in the EOC Biology exam.

**Objective #2:** 30% improvement in teachers' content knowledge in physical science and development of an ability to integrate physical science with biology, as measured by pre/post testing.

**Goal #2:** Through the SLTI establish a Science Lead Teacher (SLT) team, composed of one middle school teacher and one high school science teacher, for each school district. **Objective #3:** The Science Lead Teacher team will be trained to use content enhancement routines that will improve their teaching skills. Teachers will increase by 75% the frequency of using these routines in their classrooms and administering the assessment tools that they have developed, as measured by pre/post teacher surveys.

**Objective #4:** Develop assessment tools for science proficiency for 8th and 9th grades. The validity of these tests will be validated by the UCA faculty/co-op staff/state science specialists.
## Instructors

<table>
<thead>
<tr>
<th>Dr. Umadevi Garimella</th>
<th>Director, ACMSE</th>
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<tbody>
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<td><strong>Research Interest:</strong></td>
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<td>Plant chemistry</td>
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<td>Science Education</td>
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<tr>
<th>Dr. Faith Yarberry</th>
<th>Visiting Assistant Professor, Department of Chemistry</th>
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<td>Research interests: Chemical education and analytical chemistry.</td>
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<tr>
<th>Dr. Marc Hirrel</th>
<th>Lecturer II, Department of Biology</th>
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<td>Plant Pathology and Mycology</td>
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<td>Research Specialty: Conservation Education</td>
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<td>State Coordinator for the Leopold Education Project</td>
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Tentative SLTI Year II Schedule 2010-2011
Science Lead Teacher Institute
Mathematics and Science Partnership Grant

Daily Schedule: Week one

8:30 am – 11:30 am  Morning session
11:30 am – 12:30 pm  Lunch, Christian Cafeteria, UCA
12:30 pm – 4:30 pm  Afternoon session

June 7, 2010

8:30 am – 11:30 am  Introduction
Overview and Pretest
Dr. Garimella
12:30 am – 4:30 pm  Discussions
Overall aim and requirements of the project
Dr. Garimella

June 8, 2010

8:30 am – 11:30 am  Water – Physical Science
Structure, Physical properties and “like dissolves like.”
concept
Dr. Yarberry
12:30 am – 4:30 pm  Water – Biology
Unique properties of water, Adhesion, cohesion, and
transpiration
Dr. Hirrel and Mr. Mimms

June 9 & 10, 2010

8:30 am – 11:30 am  Concentrations – Physical Science
Preparing solutions, electrolytes
Dr. Yarberry
12:30 am – 4:30 pm  Concentrations – Biology
Diffusion - agar, cell size, conductivity probe
Dr. Hirrel and Mr. Mimms

June 11, 2010

8:30 am – 11:30 am  Acid/base chemistry – Physical Science
Strong and weak acid/base, Household, Buffer and pH
Dr. Yarberry
12:30 am – 4:30 pm  Acid/base chemistry – Biology
Photosynthesis/respiration, graphing, chl spec.
Dr. Hirrel
Daily Schedule: Week Two

June 14 & 15, 2010

8:30 am – 11:30 am  Chemical Reactions – Physical Science
Types of reactions, Esterification, saponification and redox reactions
Dr. Yarberry

12:30 am – 4:30 pm  Chemical reactions – Biology
Respiration, Buffer and yeast, seed germination and open ended lab
Dr. Hirrel

June 16 & 17, 2010

8:30 am – 11:30 am  Polymers – Physical Science
Polymer activities, slime, gloop, and demonstrations
Dr. Yarberry

12:30 am – 4:30 pm  Polymers – Biology
DNA run, Food Chemistry, structure and solubility
Mr. Hirrel and Dr. Garimella

June 18, 2010

8:30 am – 11:30 am  Content Enhancement Routines
Dr. Kohler-Evans and Mr. Floyd

12:30 am – 4:30 pm  Post-test Physical Science
Dr. Garimella
Daily Schedule: Week Three

Monday June 21, 2010

8:30 am – 11:30 am  Water – Physical Science
Structure, Physical properties and “like dissolves like.”
concept
  Dr. Yarberry

12:30 am – 4:30 pm  Water – Biology
Unique properties of water, Adhesion, cohesion, and
transpiration
  Dr. Hirrel and Mr. Mimms

Tuesday and Wednesday June 22 & 23, 2010

8:30 am – 11:30 am  Concentrations – Physical Science
Preparing solutions, electrolytes
  Dr. Yarberry

12:30 am – 4:30 pm  Concentrations – Biology
Diffusion - agar, cell size
  Dr. Hirrel and Mr. Mimms

Thursday June 24, 2010

8:30 am – 11:30 am  Acid/base chemistry – Physical Science
Strong and weak acid/base, Household, Buffer and pH
  Dr. Yarberry

12:30 am – 4:30 pm  Acid/base chemistry – Biology
Photosynthesis/respiration, graphing, chl spec.
  Dr. Hirrel

Friday, June 25, 2009

8:30 am – 12:30 pm  Post-test Physical Science
Evaluations
  Dr. Garimella

12:30 am – 4:30 pm  Discussions
Overall aim and requirements of the project
  Dr. Garimella
Monday, June 7, 2010

I. Goals and Objectives for Teachers

8:30 am – 11:30 am

Pretest
Introduction and Overview
Dr. Garimella

12:30 pm – 4:30 pm

Discussions
Overall aim and requirements of the project
Dr. Garimella and Dr. Williams
Tuesday, June 8, 2010

I. Goals and Objectives for Teachers

Goal
Participants will study how the shape and intermolecular forces influence the physical properties of water and hydrocarbons. In addition, we will look at the difference between a polar and a non-polar molecule and how they interact in living systems.

Objectives and Activities
- Become familiar with the structure of water and methane.
- Understand how the structure influences the polarity of water and methane.
- Be able to identify the intermolecular force associated with each substance.
- Understand how the intermolecular force relates to the properties associated with each substance.
- Understand how the intermolecular force influences the solubility of a solute in a given solvent.

II. Description of the Activities for Teachers
1) Participants will prepare models of water and methane molecule
2) Participants will prepare a model of hydrogen bonding and London forces
3) Participants will several activities to demonstrate cohesion and adhesion properties
4) Participants will do an experiment on transpiration
5) Participants will do calculations on the boiling point of water using periodic table

III. Instructional Materials and References
1. Marshmallows and toothpicks, Ribbon and pipe cleaners, Drinking glasses, cork, 2 beakers, string, 3-4 capillary tubes, food coloring, small bottles of different size openings, and screen or cheese cloth, Styrofoam, acetone, and 2 beakers and Set for transpiration

IV. Arkansas State Curriculum framework
Standard 1: Students shall demonstrate an understanding of matter’s composition and structure.
C.1.PS.1 Compare and contrast chemical and physical properties of matter, including but not limited to flammability, reactivity, density, buoyancy, viscosity, melting point and boiling point
C.1.PS.2 Compare and contrast chemical and physical changes, including but not limited to rusting, burning, evaporation, boiling and dehydration
MC.1.B.3 Investigate the properties and importance of water and its significance for life: surface tension; adhesion; cohesion; polarity; pH
Wednesday and Thursday, June 9 and 10, 2010

I. Goals and Objectives for Teachers

Goal
Participants will explore solutions and concentrations

Objectives
- Be able to use the terms solute, solvent, and solution correctly.
- Understand the concept “Like Dissolves Like.”
- Obtain an understanding of the solution process for compounds in water.
- Be able to identify a solute as a strong electrolyte or weak electrolyte.
- Be able to identify the amount of solute present in a solution given the concentration for that solution.
- Realize how concentration differences influence osmosis.
- Understand how soap allows hydrogen bonding water to link with oil that contains London Forces to remove grease from dirty dishes.

II. Description of Project-Based Activities for Teachers
1) In this session participants will learn how to use make solutions of different concentrations
2) Participants will prepare saturated and supersaturated solutions
3) Participants will use egg and vinegar to remove the outer shell and do an osmosis experiment.
4) Participants will explore ell size and diffusion rate by using jello or agar blocks and phenolphthalein and perform calculations on surface area/volume ratio
5) Participants will perform diffusion experiments using conductivity probe, artificial membrane and agar petridishes.

III. Instructional Materials and References
Table salt, balance, volumetric flask, scoop and weigh paper, 6 M HCl, 10 mL graduated pipet, pipet bulb, 3-100 mL volumetric flasks, labels, eggs, 3-400 mL beakers, sting, vinegar, measuring tape, Karo syrup, balance, food flavoring, balloon, shoe box, masking tape, KMnO₄, agar plates, and dye.

IV. Arkansas State Curriculum framework
PS.5.7.5 Demonstrate techniques for forming and separating mixtures: mixing; magnetic attraction; evaporation; filtration; chromatography; settling
PS.5.7.6 Classify substances as elements; compounds; mixtures
PS.5.7.7 Distinguish among solvent, solute, and solution,
PS.5.7.8 Investigate the effect of variables on solubility rates
PS.5.7.9 Interpret solubility graphs
MC.2.B.7 Compare and contrast active transport and passive transport mechanisms: diffusion, osmosis, endocytosis, exocytosis, phagocytosis,
B.9.c.1: Standard 9: Students shall understand the process of covalent bonding.
Friday, June 11, 2010

I. Goals and Objectives for Teachers
   Goals:
   Participants will explore acid/base chemistry
   Participants will use acid/base chemistry and its effect on photosynthesis and respiration
   Objectives
   • Understand the concept of an Acid.
   • Discover the differences between strong acids and weak acids.
   • Learn the meaning of the term pH with respect to acid / base strength.
   • Uncover what an indicator is and how it works.
   • Identify the strength of an acid and a base in various household products.
   • Be able to define, prepare and understand a buffer
   • Predict the effect of pH change on the photosynthesis and respiration

II. Description of Project-Based Activities for Teachers
   a. In this experiment teachers will perform an experiment with acid and metal to measure the amount of hydrogen gas released or absorbed during the chemical reactions.
   b. Study the role of indicators by using different indicators and red cabbage juice
   c. Teachers will perform photosynthesis using Lab proquest and CO2 sensors.

III. Instructional Materials and References
   10 mL graduated cylinder, Large test tube, Small test tube, Large Erlenmeyer flask, Rubber tubing with stopper and glass tubing, 100 mL graduated cylinder, 600 mL beaker, Thermometer, small test tubes and indicators, cabbage juice and house hold items, Lab proquest, CO2 sensor, and photosynthesis setup

IV. Arkansas State Curriculum framework
   PS.5.6.3 Conduct investigations using acid/base indicators
   B. 19. Students shall understand the historical development of the acid/base theories.
   B. 20. Students shall apply rules of nomenclature to acids, bases and salts.
   B. 21. Students shall understand the general properties of acids, bases and salts.
   B. 24. Students shall apply rules of nomenclature to acids, bases, and salts.
   MC.3.B.5 Compare and contrast cellular respiration and photosynthesis as energy conversion pathways
Monday and Tuesday, June 14 and 15, 2010

1. **Goals and Objectives for Teachers**

   **Goals:**
   Participants will learn various types of chemical reactions
   Participants will explore photosynthesis and respiration as special types of biological reactions

   **Objectives:**
   - Learn to identify a chemical reaction as a single displacement, double displacement, synthesis, or decomposition reaction.
   - Learn to identify precipitation reactions and be able to utilize the solubility rules to determine the state of matter associated with each species in the reaction.
   - Learn how to identify acid / base neutralization reactions, including esterification and amide formation, and how to identify their products.
   - Understand Oxidation-Reduction reactions.

2. **Description of Project-Based Activities for Teachers**

   Participants will perform different types of reactions
   Participants will use Lab Proquest to do photosynthesis and respiration

3. **Instructional Materials**

   Test tubes, test tube racks, various chemicals for different types of reactions, yeast, and respiration, and photosynthesis.

4. **Arkansas State Curriculum Framework**

   PS.5.6.8 Conduct investigations comparing and contrasting physical and chemical changes
   PS.5.6.9 Demonstrate the law of the conservation of matter
   C.3.PS.1 Identify and write balanced chemical equations:
     - decomposition reaction, synthesis reaction, single displacement reaction, double displacement reaction, combustion reaction
   C.3.PS.2 Predict the product(s) of a chemical reaction when given the reactants using chemical symbols and words
   C.3.PS.3 Balance chemical equations using the Law of Conservation of Mass
   C.3.PS.4 Determine mole ratio from a balanced reaction equation
   C.3.PS.5 Compare and contrast the properties of reactants and products of a chemical reaction
   C.3.PS.8 Identify the observable evidence of a chemical reaction:
     - formation of a precipitate, production of a gas, color change, changes in heat and light
Wednesday and Thursday, June 16 and 17, 2010

I. Goals and Objectives for Teachers

Goals
Participants will polymers and different types of polymers in living system

Objectives
- Learn the basic terminology associated with polymers and be able to identify
  the monomers within a polymer chain.
- Learn how the linkage within the polymer affects the properties of the polymer.
- Identify polymers within their everyday life.
  Discover how polymers are synthesized.

II. Description of Project-Based Activities for Teachers

1) Polymer properties will be demonstrated by using pencils
2) Demonstrate the difference in flexibility between straight-chain polymers and cross-linked polymers.
3) Discover if a polymer can be torn more easily in one direction or another.
4) Explore the strength of a crosslinked polymer.
5) Do a DNA run using Edvotech apparatus
6) Identify various macromolecules of food

III. Instructional Materials and References

Pop beads (approximately 80 per group)
Cheap trash bags, cut into 4 inch squares
6 index cards labeled with the names of the polymers,
Lots of recyclable materials, 4% Polyvinyl Alcohol solution, 4%
Sodium Tetraborate, 1 – 25 mL graduated cylinder, 1 – 10 mL graduated cylinder,
Ziploc bags – do buy the Ziploc brand because the seal will be much better than
generic brands, Food Coloring, Borax, White glue or clear school glue , (Elmer’s
glue – makes an opaque ball, the clear glue will make a transparent ball), Corn
starch, Water, Beakers – 3 per group, Tablespoons , Graduated cylinder
Meter Stick, Benedict’s reagent, biuret’s reagent, iodine, food, test tubes and test tube racks

IV. Arkansas State Curriculum framework

C.4.PS.2 Identify organic compounds by their: formula, structure, properties,
functional groups
C.4.PS.3 Distinguish between saturated and unsaturated hydrocarbons
C.4.PS.4 Describe organic compounds and their functions in the human body:
carbohydrates, lipids, proteins, nucleic acids
MC.1.B.1 Describe the structure and function of the major organic molecules
found in living systems: carbohydrates, proteins, enzymes, lipids, nucleic acids
Friday, June 18, 2009

I. 8:30 am – 11:30 am  
Content Enhancement Routines  
Developing lesson Plans  
Dr. Kohler-Evans

II. 12:30 am – 4:30 pm  
Post-test Physical Science  
Evaluations  
Dr. Garimella
Monday, June 21, 2010

II. Goals and Objectives for Teachers

Goal
Participants will study how the shape and intermolecular forces influence the physical properties of water and hydrocarbons. In addition, we will look at the difference between a polar and a non-polar molecule and how they interact in living systems.

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MC.1.B.3 Investigate the properties and importance of water and its significance for life: surface tension; adhesion; cohesion; polarity; pH
Tuesday and Wednesday, June 22 and 23, 2010

II. Goals and Objectives for Teachers

Goal
Participants will explore solutions and concentrations

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V. Goals and Objectives for Teachers

Goals:
Participants will explore acid/base chemistry
Participants will use acid/base chemistry and its effect on photosynthesis and respiration

Objectives
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II Description of Project-Based Activities for Teachers

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e. Study the role of indicators by using different indicators and red cabbage juice.

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IV. Instructional Materials and References

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B. 21. Students shall understand the general properties of acids, bases and salts.
B. 24. Students shall apply rules of nomenclature to acids, bases, and salts.
MC.3.B.5 Compare and contrast cellular respiration and photosynthesis as energy conversion pathways.
Friday, June 25, 2009
8:30 am – 12:30 pm

Post-test Physical Science Evaluations
Dr. Garimella

12:30 am – 4:30 pm

Discussions
Overall aim and requirements of the project
Dr. Garimella and Dr. Williams