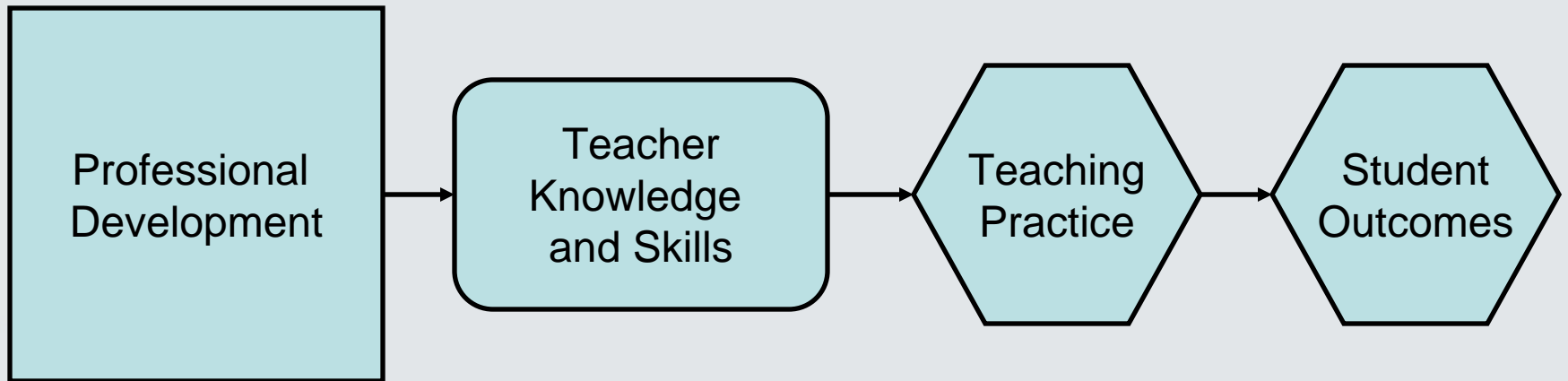


# Simplified Logic Model for Professional Development



- Purposes of PD and the learning experiences planned for teachers have implications for selecting PD providers – STEM faculty, teacher leaders, etc.
- What you need to do to prepare PD providers will depend on what their roles will be, and where the providers start in relation to those roles.

# MSP Example: Preparing STEM Faculty

North Cascades and Olympics Partnership  
(NCOSP)

Pinky Nelson

Director of Science, Mathematics, and Technology  
Education and professor of Physics and  
Astronomy at Western Washington University

# Preparation of STEM Faculty

George Nelson

NCOSP, PI, Director of Science Mathematics and  
Technology Education, Western Washington  
University, Bellingham, WA

# Claim



Today's preservice and inservice teachers **can** become potentially effective teachers of science

# Claim



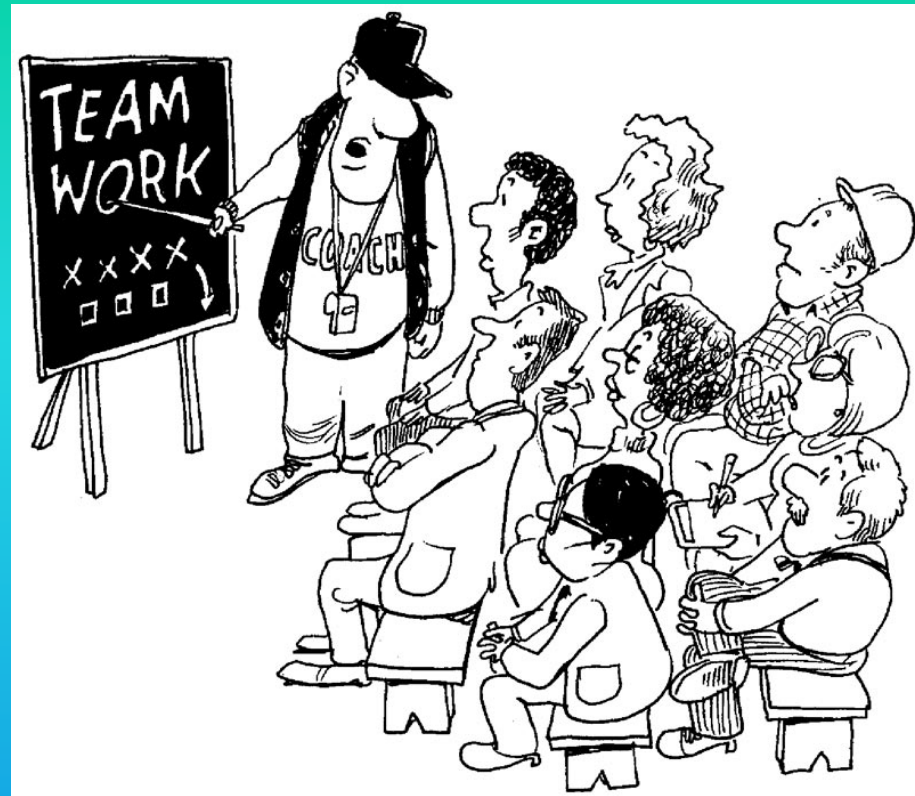
Today's higher education faculty **can** become effective science and science education teachers

# Claim



It is possible to recruit and prepare an adequate number of potentially effective STEM teachers in our current system

# Claim



K-12 Reform and Teacher  
Preparation Reform are  
Inseparable





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## Higher Education Collaborators (GUR Faculty)

**Physics:** Jim Stewart<sup>1</sup>, Andrew Boudreaux<sup>1</sup>, George Nelson<sup>1</sup>, Sara Julin<sup>2</sup>, Ann Zukoski<sup>3</sup>, Linda Zuvich<sup>4</sup>, Ted Williams<sup>5</sup>

**Biology:** Deb Donovan<sup>1</sup>, Carolyn Landel<sup>1</sup>, Alejandro Acevedo<sup>1</sup>, John Rousseau<sup>2</sup>, Val Mullen<sup>3</sup>, Rene Kratz<sup>4</sup>, Pam Pape-Lindstrom<sup>4</sup>, Adib Jamshedi<sup>5</sup>

**Geology:** Scott Linneman<sup>1</sup>, Sue DeBari<sup>1</sup>, Bob Mitchell<sup>1</sup>, Bernie Dugan<sup>2</sup>, Brad Smith<sup>3</sup>, Ben Fackler-Adams<sup>3</sup>, Steve Grupp<sup>4</sup>, Terri Plake<sup>5</sup>

**Chemistry:** Steve Gammon<sup>1</sup>, Emily Borda<sup>1</sup>, Paul Frazey<sup>2,3</sup>

**Science Education:** Chris Ohana<sup>1</sup>, Jacob Blickenstaff<sup>1</sup>(Physics), Liesl Hohenshell<sup>1</sup>(Biology), Don Burgess<sup>1</sup>(Biology), Molly Lawrence<sup>1</sup>

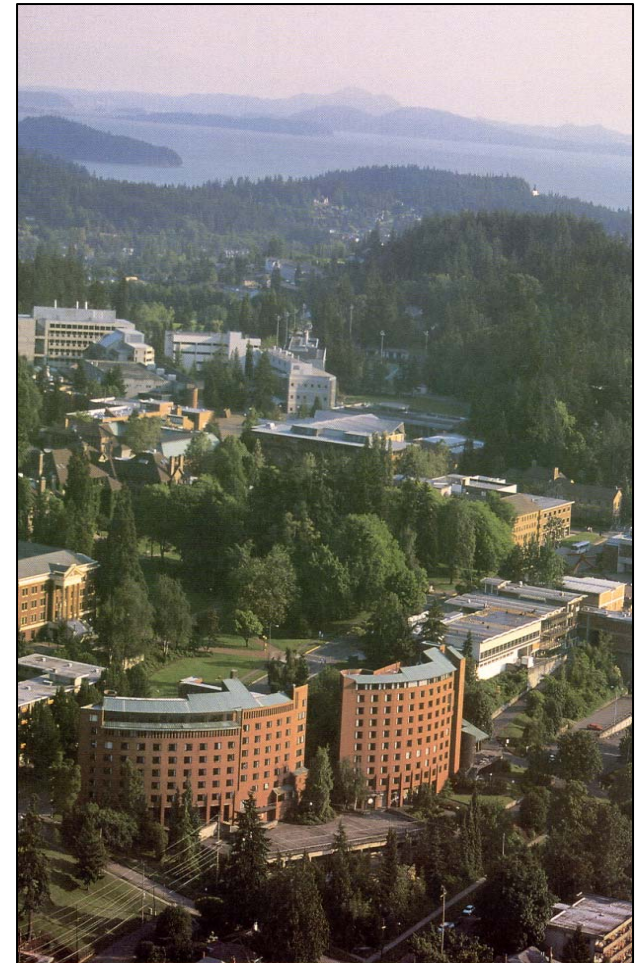
**Evaluation:** Dan Hanley<sup>1</sup>, Jim Minstrell<sup>6</sup>, Ruth Anderson<sup>6</sup>, Phil Buly<sup>1</sup>, Many Graduate Students(MS)<sup>1</sup>

<sup>1</sup> Western Washington U, <sup>2</sup> Whatcom CC, <sup>3</sup> Skagit Valley C, <sup>4</sup> Everett CC, <sup>5</sup> Northwest Indian College, <sup>6</sup> FacetInnovations Inc.

# What do faculty need?

---

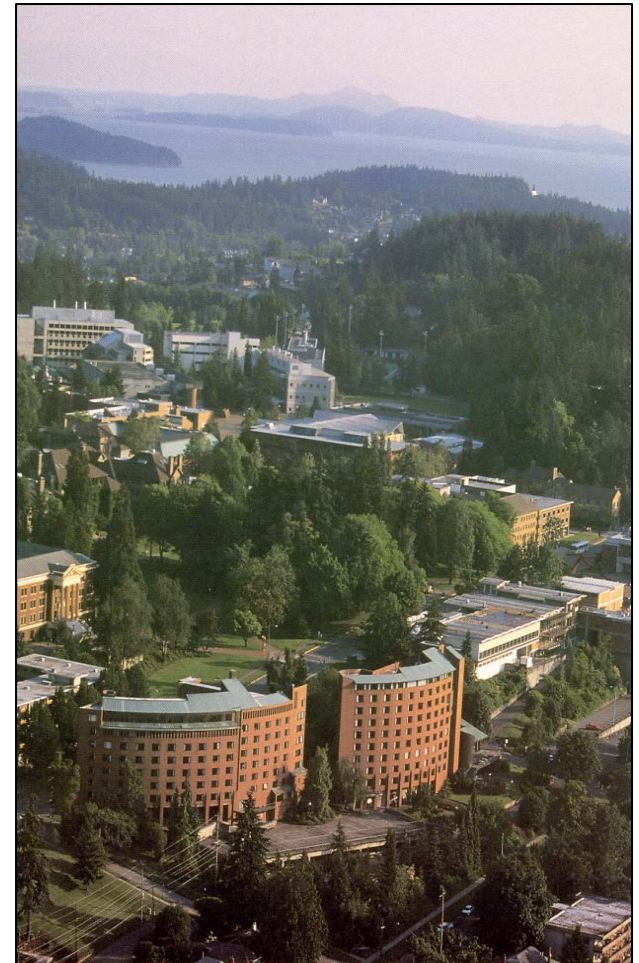
- Strong institutional commitment (time)
- Courageous, relentless leadership
- Shared beliefs
- Norms of behavior
- Integration of sciences and education
- Knowledge of learning research
- P-16 partnerships
- Focus on student learning
- Continuous assessment of results (data)
- Collaboration to improve



# What NCOSP did

---

- Pre-commitment of participants
- Clear goals--develop and deliver
- Release time (1 class/year)
- Offer of participating in research
- HRI training
- Assessment training
- UBD training
- Regular meetings
- Co-facilitation of all content areas
  - With K-12 master teachers
- Data, data, data--visible results



# K12-Higher Education Partnership

*“The Summer Academy was definitely a collaborative effort. I learned as much - if not more - than the teachers who were technically the students.”*

-Higher Ed Faculty

“NCOSP didn’t say ‘here’s what’s wrong with education and here’s how we’re going to fix it’. Rather NCOSP said, ‘here’s what we know about How People Learn, let’s work on this together and see what we find out’. We weren’t just being told something - we were a part of something.”

-Teacher Leader

# Mean rating of HE Science Lessons: Horizon Research Inc. Obs. Protocol

## ***Quantitative Capsule Rating 2008***

Faculty:       **3.7**

### *National K-12 Comparison*

*1-2:     59% Ineffective Instruction/Elements of Effective Instruction*

*3 Low: 17% Beginning Stages of Effective Instruction*

*3 Med: 10% Beginning Stages of Effective Instruction*

*3 High: 5% Beginning Stages of Effective Instruction*

*4-5:     10% Accomplished/Exemplary Instruction*

# Mean rating of Science Methods : Horizon Research Inc. Obs. Protocol

## ***Quantitative Capsule Rating 2008***

Elementary: **3.1**      Secondary: **3.3**

### *National K-12 Comparison*

*1-2:      59%    Ineffective Instruction/Elements of Effective Instruction*

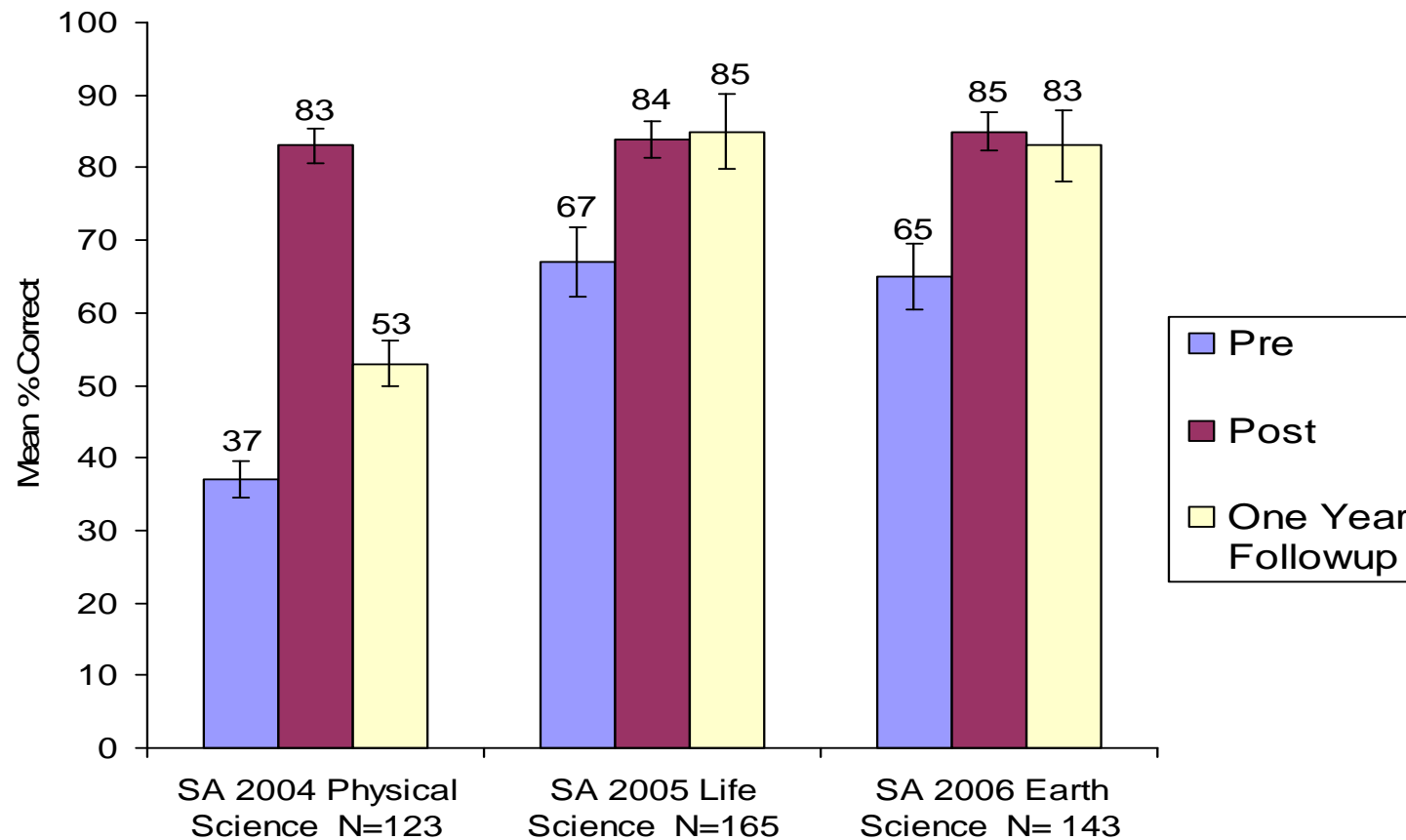
*3 Low: 17%    Beginning Stages of Effective Instruction*

*3 Med: 10%    Beginning Stages of Effective Instruction*

*3 High: 5%    Beginning Stages of Effective Instruction*

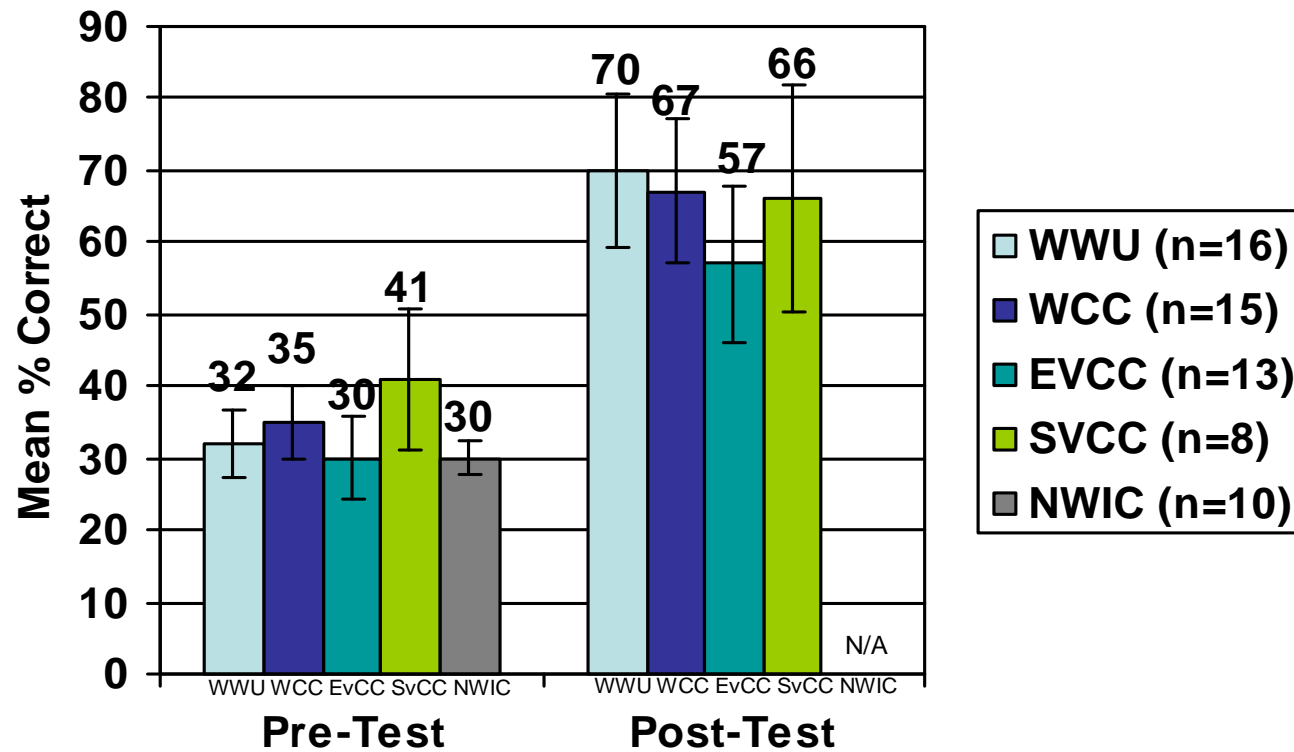
*4-5:      10%    Accomplished/Exemplary Instruction*

# Teacher Leaders: Content Knowledge



# Preservice Students Pre/Post Biology

Figure X: Life Science Content Assessments in Year 5





**Western Washington University Secondary Preservice  
Students  
2006-2007 WEST-E (Praxis II)  
100% Pass Rate**

<b>Discipline</b>	<b>Passing Score</b>	<b>N (69)</b>	<b>Mean</b>
• Biology	152	13	175
• Chemistry	152	9	172
• Earth Science	150	4	185
• Gen. Science	153	14	181
• Mathematics	134	21	167
• MS Math	152	2	190
• MS Science	145	2	168
• Physics	140	4	163

# Products and Tools

www.ncosp.wvu.edu

NORTH CASCADES AND OLYMPIC Science Partnership

## Matter and Energy in Life Systems

SCED 203  
WESTERN WASHINGTON UNIVERSITY  
SPRING 2007

Advancing science learning and teaching

NORTH CASCADES AND OLYMPIC SCIENCE PARTNERSHIP

www.ncosp.wvu.edu

NORTH CASCADES AND OLYMPIC Science Partnership

## Matter and Energy in Earth Systems

WESTERN WASHINGTON UNIVERSITY  
SCED 202  
SPRING 2007

Advancing science learning and teaching for all

NORTH CASCADES AND OLYMPIC SCIENCE PARTNERSHIP

## Science Notebooks in K-12 Classrooms

*Linking science, reading, writing, communication, and mathematics*

INTRODUCTION | NOTEBOOK FEATURES | STUDENT WORK | CLASSROOM TOOLS | TEACHER RESOURCES | FREQUENTLY ASKED QUESTIONS

Site Contents  
Site History

## Introduction

Supported by the National Science Foundation under Grant No. DUE-0315060

### Supporting Student Success Guide

**I. Student Learning is the Highest Priority**

**A. Administrators take personal responsibility for student success.**

- Administrators convey through their day-to-day operations the belief that schools will change in order to ensure that every student in every classroom is succeeding.
- Administrators facilitate school-wide agreement on improvement goals and distribute responsibility for reaching them across all teachers.
- Administrators provide the resources (e.g. space, time, staff, and money) and flexibility teachers need to increase knowledge, improve instruction, and enhance student learning.

**III. Schools Make Improvements Based on Data and Community Context**

**A. Teachers and Administrators acknowledge community context in their school improvement process.**

- Time is used to create and support the shared vision of student success that acknowledges contextual factors, such as poverty, parent ambivalence, large class size, and high teacher turnover, but is not paralyzed by them.
- Resources from internal and external sources are accessed and applied to support school improvement and student success.
- Improvement is achieved through diligence, persistence, and focused hard work that

### Science Classroom Observation Guide

**I. Classroom Culture is Conducive to Learning Science**

**A. Ideas, questions, and contributions are exchanged respectfully.**

- Students interact collegially.
- Students and teachers jointly decide what science related idea will be discussed or investigated.
- Students listen actively and ask for clarification when they don't understand.

**B. Discussions are based on scientific evidence.**

- Students use supporting and refuting evidence to inform reflection and discourse.
- Students rely on their own thinking and logical arguments to evaluate ideas.
- Students make explicit, question, and debate their own understanding.
- Students use observation and evidence to challenge ideas and inferences.
- Students differentiate between personal and scientific ways of knowing.

**C. Science content is made accessible to each student.**

- Content and instruction is adjusted based on the background knowledge and skills of each student.
- Explanations and clarifications are clear, accurate, and accessible to each student.
- Spoken and unspoken messages communicate that each student is capable of learning science.
- Each student actively participates in thinking and learning.
- Each student experiences challenges that ultimately lead to new insights.
- Each student experiences scientifically productive discussions.

**II. Science Content is Intellectually Engaging**

**A. Science content is significant, accurate, and well organized.**

- Science content is explicit and apparent to students.
- Science content is primarily focused on big ideas, support and terms.
- Science content is within the bounds of an agreed upon level of difficulty.
- Science content is developmentally appropriate and useful.
- Science is portrayed as a dynamic body of knowledge that is available evidence.

**B. Science content builds on students' prior ideas.**

- Students reveal their preconceptions about the science concepts, or the nature of science.
- Students reveal their underlying thinking and reasoning or preconceptions.
- Students recognize links between their preconceptions and the activities or experiences in the science content.

**C. Science content is intentionally connected to the experiences.**

- Student actions and interactions focus on understanding content.
- Students generate and explore questions about the science content.
- Students can articulate the intended science content of a

**III. Instruction Fosters and Monitors Student Understanding**

**A. Instruction fosters students' emerging understanding of science content.**

- Students are confronted with evidence that challenges their initial ideas as opportunities for productive dis-equilibrium.
- Questions enhance the development of students' understanding of key concepts connected to the lesson.
- Clear and accurate explanation/clarification are provided at appropriate points.
- Opportunities are provided for students to build on their present understanding as they develop new understandings.
- Student generated questions are pursued based on their relevance to the science content and their potential to deepen student understanding.

**B. Instruction monitors students' emerging understanding of science content.**

- Student ideas are recognized, even when they are vaguely articulated.
- Responses to student questions or comments address the scientific idea expressed in their thinking and relate it to the focus of the lesson.
- Learning experiences are modified or added to ensure students develop the necessary science content knowledge.

**IV. Students Organize, Relate, and Apply Their Scientific Knowledge**

**A. Students make sense of the intended scientific ideas and concepts.**

- Students work on answering scientific questions or problems and objectively communicate their findings.

### Professional Learning Community Observation Protocol

**Introduction**

This observation protocol is structured around three key elements of an effective Professional Learning Community (PLC): Shared Vision and Ways of Working, Collaboration, and Reflective Dialogue. These three elements combine to help foster open communication among group members so that they develop common norms, vision, and goals. The two main purposes of this protocol are to help groups 1) build and deepen a shared understanding of what it means to work effectively as a PLC, and 2) provide a meaningful tool for self-monitoring a PLC's development.

**I. Shared Vision and Ways of Working**

The group has a common vision and applies standards as criteria in its actions, reflections, and planning.

- The focus of the group activities is on students' understanding of science content in order to improve student learning.
- The team has standards or criteria that specify what determines proficiency in student work.
- Team members share ideas based on evidence, and discussions of the pros and cons of ideas are grounded in evidence.
- The group plans for and pursues opportunities to enhance their content knowledge when needed.
- Actions are planned and modified based on available research.

**II. Collaboration**

The group creates an environment that fosters open communication and sharing of ideas. All members have the opportunity to learn from one another and support the group's continuous improvement. The group is organized and managed to achieve its goals.

Collaboration refers to sharing expertise and perspectives on learning and learning processes, examining data about students, and developing a sense of mutual support and shared responsibility for effective instruction. Developing collaborative cultures as the work of leaders who realize that a collection of superior teachers working in isolation cannot produce the same results as interdependent colleagues who share and develop professional practices together (Garnston & Wellman, 1999).

- Members value the contributions of other members of the group and are open to different points of view.
- Criticism is constructive and there is a collegial challenging of diverse ideas.
- Responsibilities are shared amongst all members of the group.
- The group is good at managing their time. The meeting is efficient and effective.

**III. Reflective Dialogue**

The group monitors its actions, decisions, and reflections based on its common norms and goals.

Reflective dialogue helps develop shared understandings of such things as the purpose of and processes for learning. Shared understandings build communities together and build members to shared goals and shared work. Through reflective dialogue, group members gain perspectives on who and how they are to each other and to those they serve. Reflective dialogue is the essential for reflective practice. It helps participants develop self awareness and collective awareness of personal and shared work (Garnston & Wellman, 1999).

- The group monitors its understanding of information that informs its activities.
- The group monitors its progress and adjusts its processes to become more effective when appropriate.
- The group monitors several ways of doing something before deciding what might work best.
- Commitments are made between past learning, current goals, and intended applications.

STEM faculty roles in the design of professional development programs or courses intended to deepen teacher content knowledge:

- Identifying learning goals for teachers;
- Developing the scope and sequence of professional development programs/courses;
- Selecting/adapting/designing learning experiences for teachers;

STEM faculty roles in the design of professional development programs or courses intended to deepen teacher content knowledge:

- Developing instruments to assess teacher content knowledge;
- Preparing professional development/course providers; and
- Providing input on redesign of professional development programs/courses.

## STEM faculty roles in implementing content-deepening experiences for K-12 teachers:

- Facilitating teacher investigations/discussions focused on mathematics/science content;
- Facilitating investigations/discussions focused on mathematics/science pedagogical content knowledge (e.g., considering student thinking);
- Providing lectures/explanations focused on mathematics/science content;

## STEM faculty roles in implementing content-deepening experiences for K-12 teachers:

- Serving as a content resource to address teachers' questions;
- Monitoring teacher understanding of the content; and
- Serving as an on-demand content resource for teachers.

# Developing Teacher Leader Capacity to Work with Other Teachers

**Who are teacher leaders?**

Current or former classroom teachers working with other classroom teachers and other educators in the school or district

# Developing Teacher Leader Capacity to Work with Other Teachers

**When** do they work as teacher leaders?

- Full-time classroom release, so TL works throughout the day
- Part-time classroom release, so TL has some time during the day dedicated to TL work
- No classroom release, so TL work happens outside of teaching responsibilities



# Developing Teacher Leader Capacity to Work with Other Teachers

What might teacher leaders do?

- Lead workshops or other formal pd
- Observe teaching and give feedback
- Model lessons
- Engage in lesson planning
- Lead teacher work groups or teams

# Developing Teacher Leader Capacity to Work with Other Teachers

## Why teacher leaders?

- Credibility with teachers
- Familiarity with school and district practices
- Necessary to reach large numbers of teachers
- Promise for sustainability

# What do we know from research?

- Review of empirical literature on teacher leadership
- Searches yielded 1,127 studies
- Studies screened based on “in/out” criteria
  - Designed as research, not an advocacy piece
  - Included a specific measure or analysis of teacher leadership
- 101 studies, plus 10 completed MSP studies, went through standards of evidence review

# What do we know from research?

- The work of teacher leaders, particularly providing instructional support to teachers, impacts teachers' classroom teaching
- Teacher leaders' practice is associated with positive student outcomes

# What do we know from research?

- The most frequently reported TL activities were leading workshops or professional development, and leading work groups of teachers
- TL practice was influenced by the preparation TLs had for their work

# What do we know from research?

- TL preparation focused on developing teacher leader content knowledge in combination with attention to pedagogical strategies and/or specific leadership abilities
- Importance of TL preparation to include opportunities to engage in the practices that they would employ as TLs

# What do we know from research?

- Information drawn from summaries of empirical research on teacher leadership in the MSP-KMD Knowledge Reviews
- Available at: [www.mspkmd.net](http://www.mspkmd.net)

# Connecting TL Practice to Selection and Preparation

- Preparation of teacher leaders should be tied to their anticipated roles
- Selection of teacher leaders should be related to preparation plan and to the anticipated practice of teacher leaders.

AND

- Roles of teacher leaders working with teachers vary broadly, making strategic selection and preparation challenging



# Team Planning Worksheet #4 (Tab 7, Green)

- Who will implement the professional development you are designing?
- How well prepared do you expect these providers to be initially for the roles you envision them playing?
- You will have 10 minutes to get started on this discussion..

# MSP Example

## NSF Institute: Preparing Virginia's Mathematics Specialists

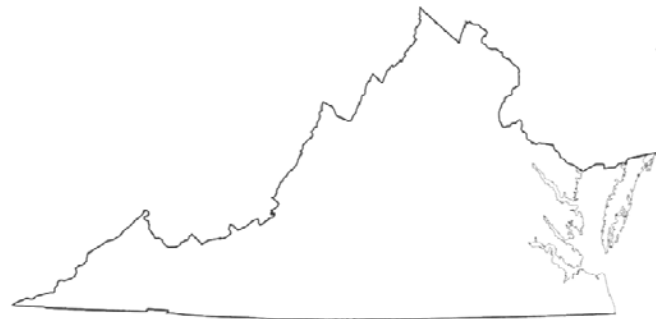
**Bill Haver**

Professor of Mathematics  
Virginia Commonwealth University

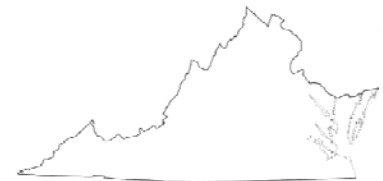
**Vickie Inge**

Director of Mathematics Outreach  
University of Virginia

**MSP Institute:  
Preparing Virginia's  
Mathematics Specialists**



Virginia committed to idea of  
teacher leaders/mathematics  
specialists/coaches in k-5  
schools for past 20 years



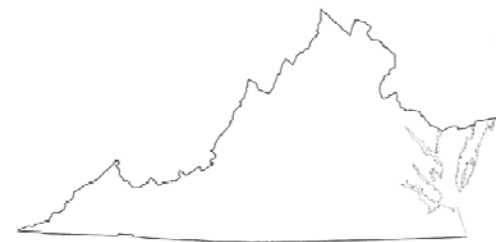
# Firm commitment to this idea from:

- Leaders of k-12 mathematics community
- University math education faculty
- University math faculty
- Mathematics professionals in Virginia Department of Education
- Virginia Mathematics and Science Coalition
- Professional math organizations



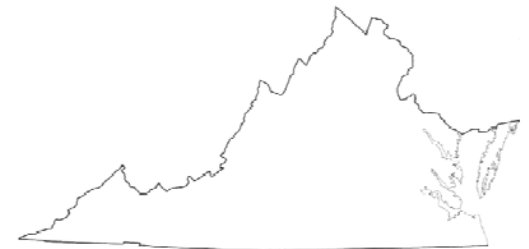
# Consensus has developed on role and preparation of Mathematics Specialists

- Virginia Mathematics and Science Coalition Taskforce chaired by Vickie Inge
- Statement of Role of Mathematics Specialists
- Information can be retrieved at <http://www.vamsc.org/>

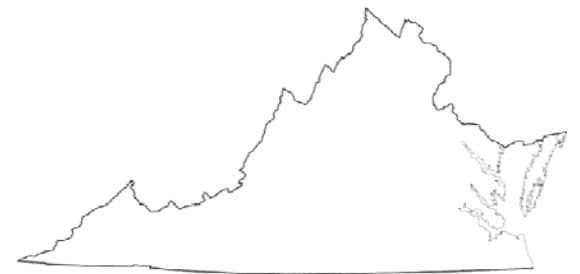


# Support Gained Outside of Mathematics Community:

- Legislature
- Principals/School Administrators
- Board of Education



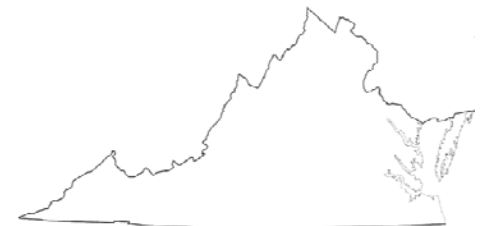
Five year process ended with  
state approval of Mathematics  
Specialist licensure  
endorsement in  
September 2008.





# Masters Program Collaboratively Developed

- Six universities
- Professional development teams
- Math Supervisors, teachers, university mathematics and mathematics education faculty

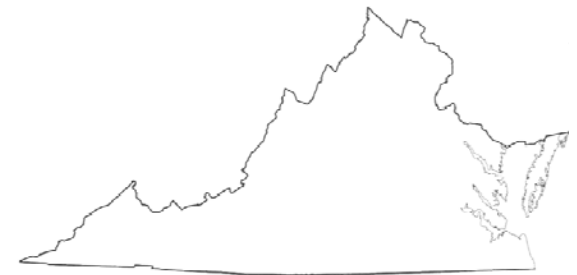


# What Mathematics Specialists Do

- Provide leadership and content expertise for job-embedded professional development
- Collaborate with school-based administrators to provide leadership for the school's mathematics program
- Co-plan and co-teach with classroom teachers
- Coach teachers
- Support novice teachers learning to teach mathematics
- Collaborate to assess student learning and plan for remediation or extension
- Facilitate parent workshops

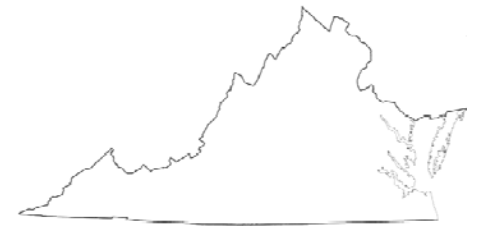
# Mathematics Courses

- Number and Operations
- Geometry and Measurement
- Probability and Statistics
- Algebra and Functions
- Rational Numbers and Proportional Reasoning



# Education/Leadership Courses

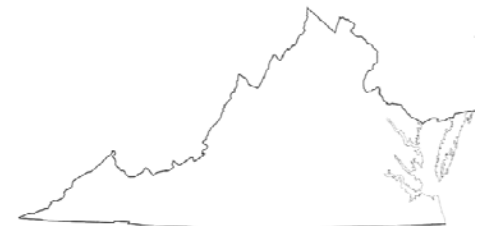
- I. Quality instruction
  - Standards based instruction
  - Reflective professional
- II. School as a learning organization
  - Roles of Mathematics Specialist
  - Coaching
- III. Facilitating a learning community
  - Assessment as a tool
  - Lesson study
- IV. Diverse learners



# Research Findings

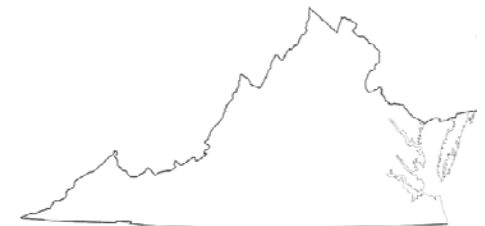
Treatment/Control Schools  
Involving 36 Schools

Case Study Research



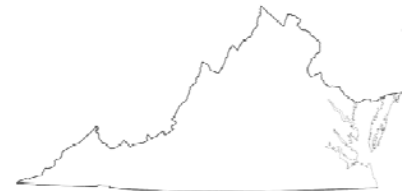
# Statistically significant increase in student SOL scores

- Grades 3, 4, and 5
- Difference in first year, greater difference in second year and more in third year



# Contact Information

- Bill Haver, Virginia Commonwealth University  
[whaver@vcu.edu](mailto:whaver@vcu.edu)
- Vickie Inge, University of Virginia  
[vinge@virginia.edu](mailto:vinge@virginia.edu)
- Information about all of Virginia's Mathematics Specialist Projects is located at <http://www.vamsc.org/>



## When you return from the break at 10:30 am

- Your team should sit together at a table labeled with the grade range and the topic you want to discuss:

Preparing STEM Faculty, Elementary (K-5)

Preparing STEM Faculty, Secondary (6-12)

Preparing Teacher Leaders, Elementary (K-5)

Preparing Teacher Leaders, Secondary (6-12)