Collaborative Development of Biology and Geology Content Courses for Future Elementary and Inservice Teachers

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John Rousseau
Whatcom Community College, Bellingham, WA
Higher Education Collaborators

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**Science Education:** Chris Ohana¹, Jacob Blickenstaff¹ (Physics), Liesl Hohenshell¹ (Biology), Don Burgess¹ (Biology), Molly Lawrence¹

**Evaluation:** Dan Hanley¹, Jim Minstrell⁶, Ruth Anderson⁶, Phil Buly¹, Many Graduate Students¹

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Noyce Master Teachers

- Steve Ruthford, Sehome High School
- Allison Porter, Ferndale High School
- Shawn Doan, Sehome High School
- Randy Holmes, Whatcom Middle School
- Miguel Borres, Fairhaven Middle School
- John Chesborough, Sedro Woolley High School
History Pt 1

• NCOSP funded fall 2003
  – 26 districts, 4 two-year colleges, WWU, dogs and cats
• Summer Academies 2004-2008 (170 teachers, 70 principals)
  – Physics for Elementary Teachers, Biology, Geology, Chemistry (NSF CCLI funded),
  – 50% science content, 50% pedagogy, PLCs/leadership, equity
• Monthly Learning Symposia
  – Leadership, Science Notebooks, Curriculum Topic Study, PLCs
• Monthly Higher Education Partners Meetings
  – Curriculum Development
  – How People Learn, Understanding by Design
  – Effective Science Instruction—Horizon Research, Facet Innovations
History Pt II

• 6 NCOSP Noyce Master Teachers funded 2009-2011 (One of three groups)
  – Expand/Refine/Complete biology and geology curricula

• NCOSP Teacher Leaders plus Masters in Science Education (WWU, UOregon, Harvard)

• Monthly meetings, two-week summer work sessions with faculty

• NSF CCLI grant with Chico State to refine/expand biology curriculum
New Courses

• Biology and Geology (Chemistry funded separately)
  – Modeled after PET (BET, GET)
  – Part of 4-course sequence for future elementary teachers
  – Used in content professional development for K-12 teacher leaders
• Content aligns with NSES/Benchmarks
• Pedagogy aligns with findings of How People Learn and Formative Assessment Research
• Taught @ WWU, Cal St Chico, Northwest Indian College, Skagit Valley College, Whatcom Community College, Everett Community College
• Used for K-8 teacher professional development in many regional districts—taught by NCOSP faculty
• Biology course modified for use in Bellevue and Bellingham High Schools
Biology Table of Contents

• Cycle 1: How do we study connections among living and non-living things
• Cycle 2: What is the function of food for animals?
• Cycle 3: What is food for plants?
• Cycle 4: How do living things grow?
• Cycle 5: How do matter and energy cycle in living systems?
• Cycle 6: Effects of cycling of matter and flow of energy on ecosystems
• Cycle 7: Why are offspring similar to their parents?
• Cycle 8: What are the consequences over time of natural selection?
Geology Table of Contents

• Cycle 1: How do we know about something if we can’t see, hear or feel it?
• Cycle 2: How do rocks tell us about Earth processes?
• Cycle 3: Why does Earth have such varied topography?
• Cycle 4: How do we know about Earth’s tectonic plates?
• Cycle 5: How does heat from inside Earth affect Earth’s surface?
• Cycle 6: How does energy and matter flow in Earth’s Systems?
• Cycle 7: How do we know the age of the Earth and its features?
Selected Results
Teacher Leaders: Content Knowledge

SA 2004 Physical Science  N=123
SA 2005 Life Science  N=165
SA 2006 Earth Science  N= 143
Creating Value Added

Based on Science Scale Score controlled for Student Performance factors

5th Grade

8th Grade

10th Grade

Effect Size

Year (2007 + 2008)

Year (2007 + 2008)

Year (2007 + 2008)
Impact of Teacher Leaders on Students with the Greatest Needs

* Significant difference (t-test, p<.05)
**SPECK-8 8th Grade Science Score Improvement 2010**

<table>
<thead>
<tr>
<th>Category</th>
<th>State %</th>
<th>SPECK-8 %</th>
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<tr>
<td>Males</td>
<td>49%</td>
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<tr>
<td>Females</td>
<td>51%</td>
<td>49%</td>
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<tr>
<td>FRL</td>
<td>41%</td>
<td>59%</td>
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<tr>
<td>Non-FRL</td>
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<td>41%</td>
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<tr>
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<tr>
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<td>2%</td>
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<tr>
<td>ALL</td>
<td>4%</td>
<td>16%</td>
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</table>

**Percentage Point Gain**

- **SPECK-8 %**
  - Males: 21%
  - Females: 11%
  - FRL: 22%
  - Non-FRL: 14%
  - SPED: 17%
  - Non-SPED: 18%
  - White: 18%
  - Hispanic: 27%
  - Am Indian: 8%
  - ALL: 16%

**State %**

- Males: 21%
- Females: 11%
- FRL: 22%
- Non-FRL: 14%
- SPED: 17%
- Non-SPED: 18%
- White: 18%
- Hispanic: 27%
- Am Indian: 8%
- ALL: 16%
<table>
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<tr>
<th>Year</th>
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<th>Washington State</th>
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<td>55.6%</td>
<td>44.7%</td>
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Nooksack Elementary School

**Enrollment**

October 2007 Student Count 272

**Gender (October 2007)**

- Male 55.5%
- Female 44.5%

**Ethnicity (October 2007)**

- American Indian/Alaskan Native 3.7%
- Asian 1.5%
- Pacific Islander 1.1%
- Asian/Pacific Islander 2.6%
- Black 2.2%
- Hispanic 23.9%
- White 67.3%

**Special Programs**

- Free or Reduced-Price Meals (May 2008) 55.1%
- Special Education (May 2008) 15.2%
- Transitional Bilingual (May 2008) 17.4%
- Migrant (May 2008) 6.2%
2009-2010 WWU Graduates WEST E Mean Scores
Points Above Passing Compared with Statewide 2010 WEST E

Points above passing where N is 10 or greater
1. What is the percentage of offspring that have CF?

2. Do both parents need to have the CF gene to have an offspring with CF?

3. What is recessive mean?

4. Do all people have the CFTR gene?

5. When is there enough variation in an allele that it becomes a new gene?

6. What does it mean to be a carrier?

7. Do both parents need to have the CFTR gene?
Preservice Students Pre/Post Biology

Figure X: Life Science Content Assessments in Year 5
Figure 29: Earth Science Content Assessments in Year 5

<table>
<thead>
<tr>
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<th>WWU (n=27)</th>
<th>WCC (n=23)</th>
<th>EVCC (n=22)</th>
<th>SVCC (NA)</th>
<th>NWIC (NA)</th>
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<td>Post-Test</td>
<td>72</td>
<td>68</td>
<td>66</td>
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</table>
Mean rating of HE science lessons: Horizon Research Inc. Obs. Protocol

Quantitative Capsule Rating

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
Current Work

• Complete and publish the biology and geology curricula, including instructors’ resources and additional assessment materials

• DRK-12 funded research to assess impact of content courses and revised science methods and practicum courses on new elementary teacher’s attitudes and capacity to effectively teach science