ABSTRACT: Realizing the vision of Next Generation Science Standards (NGSS Lead States, 2013) requires curriculum materials that integrate disciplinary core ideas, crosscutting concepts, and designing collaborations to help students make sense of phenomena; are logically sequenced and pedagogically sound; and support teachers in guiding students’ sense making and monitoring their progress. The Evaluating the Quality of Instructional Products (EQuIP) Rubric (Achieve, 2014) provides criteria for estimating the likely success of curriculum materials in helping to achieve this vision of NGSS. This poster describes an 8th grade curriculum unit, Toward High School Biology, provides evidence (shown in the far right-hand column of the table) that this unit satisfies criteria in each of the three EQuIP Rubric categories, and provides preliminary findings to support that impact of the unit on teaching and learning.

INTRODUCTION: The Toward High School Biology (THSB) unit was funded to address students’ low achievement on state-level science tests that are essential for science literacy and further study of biology. Today’s middle school students must be better prepared if they are going to succeed in high-school and college-level biology courses, which demand a solid understanding of chemistry. The National Research Council has called attention to the increased dependency of biology on chemistry, noting that “this trend will continue, as more and more biological phenomena are explained in fundamental chemical terms” (2003, p. 138).

We developed the THSB unit with the goal of providing the most common and persistent misconceptions students have about biology and biochemistry to integrate into their molecular-level explanations. The five years of formative research used a case study approach to gain insight into the vision of the Framework for K-12 Science Education (NRC, 2012) and NGSS (NGSS Lead States, 2013) for three-dimensional learning.

The (a) physics and life science core ideas, (b) phenomena about atom rearrangement and conservation, and (c) students’ initial ideas and skills and monitor their progress; and (d) supports teacher learning through print and online teacher resources and professional development. The EQuIP Rubric identifies a set of criteria that specify the high-level characteristics of materials that are well-aligned to NGSS and support achievement of NGSS goals through high-quality instructional assessment. The rubric has three criteria of categories that can be used to examine (1) the overall alignment of a material to NGSS core ideas, and crosscutting concepts; (2) the quality of instructional designs and instructional support provided in a material; and (3) the extent to which the material supports professional development.

TABLE 1a: Effect of increased explanation scaffolding

<table>
<thead>
<tr>
<th>Condition</th>
<th>Mean Pre-test</th>
<th>Mean Post-test</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>No scaffolding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scaffolding</td>
<td></td>
<td></td>
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</tbody>
</table>

The equation for the linear trend line and R² = 0.7554

FIGURE 1: Key phenomena for each THSB chapter. Each phenomenon listed in the right-hand column is observed, modeled, and explained using the core ideas of crosscutting concepts in the left-hand column on the left. The unit includes additional phenomena that are asked to make sense of as they use disciplinary core ideas to engage with scientific phenomena.

METHODS: Teachers and students who participated were from a Mid-Atlantic suburban school district in Year 4, the unit increased support for explanation writing as described in the left-hand column. In order to evaluate the effect of this increased support, we compared the scores for three explanation items that appeared on the pre- and post-test in both 3rd and Year 4.

Table 1a shows the results for each of these items by comparing the maximum possible score to the post-test score. Effect sizes were calculated by dividing the difference of the means by the standard deviation of the differences. To determine the extent to which students actually experienced these supports, we analyzed student-level data to track student responses by activities that activities they completed modified, or omitted and we checked their survey responses against written work in student notebooks.

FINDINGS: Table 1a shows that the post-test explanation scores were significantly higher than the pre-test explanation scores for both years. Additionally, the effect sizes were larger for both years with the effect size for Year 4 being significantly larger than for Year 3. An analysis of this study, however, is that in Year 3 some classes did not complete the entire unit. Table 1b shows the results of a case study of one teacher who completed the unit with the gifted and talented classes in both years with effect sizes of 1.57 for Year 3 and 2.39 for Year 4.

METHODS: In Year 5, teachers from the above described school district participate in professional development specifically designed for teaching. The unit included scaffolding for students to explain the rubric. The unit included scaffolding for students to explain the rubric. The unit included scaffolding for students to explain the rubric. The unit included scaffolding for students to explain the rubric. The unit included scaffolding for students to explain the rubric.

FINDINGS: Teachers varied in their ability to appreciate the scores of experts on students’ explanations on the embedded tasks. Note: The expert calibration process identified problems with some of the rubric, leading to more stringent rubrics than were initially shared with teachers. The agreement between teacher and expert student explanations on the expert scoring rubric was higher than the experienced teachers who taught the unit (Chart 1). Other potential factors include teachers’ role in the science content, their identification of explanation as an important practice, and the extent to which their school focused on argument writing in Common Core ELA.

The equation for the linear trend line is: y = 0.112x + 0.25 and the value of R² is shown on the chart.