

Curriculum Topic Study (CTS) Summary

Select a key lesson that allows you to see your students' thinking or stands at an important intersection for further learning. Use the Curriculum Topic Study Topic list to identify the topic most relevant to this lesson. This topic will be the basis of your CTS summary.

CTS Topic Guide: Controlling Variables Page: 231

Curriculum: FOSS Variables Grade: 5

Accessing Prior Knowledge	<ol style="list-style-type: none"> 1. What important ideas or skills make up this topic? <ul style="list-style-type: none"> • <i>Any element of an investigation that can vary is a variable. For example a string used in an investigation might be long or short, thick or thin. The length or width of the string can vary.</i> 2. What is important for students to know and be able to do about this topic? <ul style="list-style-type: none"> • <i>In order to control an investigation, only one element in the investigation should vary. All other elements should remain the same. For instance if the thickness of a string is to be changed during an investigation, then the length of the string should remain the same throughout the investigation.</i> 3. What learning opportunities or teaching strategies are most effective with this topic? <ul style="list-style-type: none"> • <i>Students need to experience both controlled investigations and uncontrolled investigations. Follow-up discussions should lead the students to recognize that uncontrolled investigations cannot lead to evidence-based conclusions.</i> 4. What difficulties or misconceptions are associated with his topic? <ul style="list-style-type: none"> • <i>Young students do not recognize the need to control the variables in an investigation.</i>
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Using CTS: Choose a CTS study guide that best describes the topic covered in this set of lessons. You will use this study guide to complete your CTS summary.

I. Identify Adult Content Knowledge	<p>IA: Science for All Americans</p> <p>▶ Chapter 12, <i>Critical Response Skills</i>, pp. 193-194</p> <p>IB: Science Matters- Achieving Scientific Literacy</p> <p>▶ NA</p>
Examine the resources indicated in Section I of the CTS study guide.	<ol style="list-style-type: none"> 1. What big ideas and major concepts make up this topic? <ul style="list-style-type: none"> • <i>When I answered the questions to access prior knowledge, I was thinking of a variable as some part of a scientific investigation. The reading in Science for All Americans has very little information about developing experiments and controlling variables; it mostly addresses critical thinking about assertions and arguments.</i> 2. What examples or contexts were used to explain the ideas? <ul style="list-style-type: none"> • <i>Students should be taught to notice signs of weak assertions and arguments. Of the fifteen examples given to demonstrate signs of weak arguments, only one specifically related to controlling variables:</i> <ul style="list-style-type: none"> ○ <i>No mention is made, in evidence said to come from an experiment, of control groups very much like the experimental group.</i>

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| | <p>3. What insights about the topic did you gain from this reading and how might these insights inform your classroom practice?</p> <ul style="list-style-type: none"> • <i>Critical thinking is a skill students need to be taught. Awareness of weak arguments will not only help them determine the validity of assertions others make, but will also help them think critically about their own assertions. In terms of controlling variables, it is important to conduct experiments that have both experimental and control groups. Students need to recognize the difference, and importance, of controlled vs. experimental variables.</i> |
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Check with your facilitator before going on to the next section.

II. Consider Instructional Implications	<p>IIA: Benchmarks for Science Literacy</p> <ul style="list-style-type: none"> ▶ 1B <i>Scientific Inquiry</i> general essay, p. 9; a grade span essay is not available for below 6th grade. <p>IIB: National Science Education Standards</p> <ul style="list-style-type: none"> ▶ Grades 5-8, Standard A essay, pp. 143-145, Vignette <i>Pendulums</i>, pp. 146-147
Examine the resources indicated in section two of the CTS study guide.	<p>1. What suggestions are provided for effective instruction at your grade level?</p> <ul style="list-style-type: none"> • <i>5th grade students will center on evidence that supports their current beliefs and fail to process evidence that does not support their current beliefs. Teachers need to challenge their students' current beliefs with scientific explanations.</i> • <i>Students at the 5th grade level may have trouble identifying variables in an investigation.</i> • <i>Students at the 5th grade level may have trouble controlling more than one variable in an investigation.</i> • <i>Students at the 5th grade level may not understand the influence of different variables in the experiment.</i> <p>2. What insights about the topic did you gain from this reading and how might these insights inform your classroom practice?</p> <ul style="list-style-type: none"> • <i>5th graders have a difficult time understanding variables in an investigation. I now know to use thoughtful scaffolding when teaching the concept of variables. For instance, students will need practice identifying different types of variables in experiments and constructing experiments with manipulated and controlled variables. They will also need opportunities to use the language of science in their own explanations and receive feedback on the accuracy of their explanations. Through the process of giving a scientific explanation, students may increase their understanding of variables.</i>

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<p>III. Identify Concepts and Specific Ideas</p>	<p>IIIA: Benchmarks for Science Literacy ▶ Grade level essays—NA; 12E <i>Critical Response Skills</i>, p.299</p> <p>IIIB: National Science Education Standards ▶ Grades 5-8, Standard A, <i>Design and Conduct a Scientific Investigation</i>, p. 145</p>
<p>Examine the resources indicated in section three of the CTS study guide.</p>	<ol style="list-style-type: none"> 1. What learning goals align well with this topic? <ul style="list-style-type: none"> • <i>By the end of 5th grade, students should be able to recognize when comparisons might not be fair because conditions were not kept the same.</i> 2. How do these goals help you clarify what is important to teach in this topic? <ul style="list-style-type: none"> • <i>This goal helps me see how I might approach the idea of variables with 5th graders. Fairness is important to 5th grade students. Relating fairness to controlling variables in a “fair” investigation may help students understand why control of variables is important in investigations.</i> 3. How does the learning goal change from one grade span to the next? <ul style="list-style-type: none"> • <i>In the K-2 grade span students are expected to be able to answer the question, “How do you know?” with a reasonable answer.</i> • <i>In the 3-5 grade span students should buttress their statements with facts and seek better reasons for believing something than, “Everybody knows that,” or, “I just know.”</i> • <i>In the 6-8 grade span students should be skeptical of investigations that do not have a control sample.</i> • <i>In the 9-12 grade span students should insist that the critical assumptions behind any line of reasoning be made explicit so that the validity of the position being taken – whether one’s own or that of others – can be judged.</i> 4. What insights about the topic did you gain from this reading and how might these insights inform your classroom practice? <ul style="list-style-type: none"> • <i>Critical thinking in examining the claims of others and honesty in our own investigations (keeping them “fair”) are the themes I see running through the reading. Being honest in our own work and thinking critically about our own work, as well as the assertions and arguments of others, need to be modeled and expected in the classroom.</i>

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IV. Examine Research on Student Learning	IVA: Benchmarks for Science Literacy Readings1B, <i>Experimentation</i> , p. 332 IVB: Making Sense of Secondary Science- Research Into Children's Ideas NA
Examine the resources indicated in section four of the CTS study guide.	<ol style="list-style-type: none"> 1. What specific misconceptions or alternative ideas might a student have about this topic? <ul style="list-style-type: none"> • <i>Students will simply overlook the need to keep all but one variable constant.</i> • <i>It is difficult for students to make the distinction between a variable that has no effect on a system and a variable that does have an effect.</i> 2. Which ideas might be more resistant to change? <ul style="list-style-type: none"> • <i>Students don't necessarily see a need to control variables in an investigation, nor do they understand why that's important. This lack of understanding tends to be mitigated over time and with experience.</i> 3. Are there examples of questions or tasks that could be used to find out what students know about this topic? <ul style="list-style-type: none"> • <i>NA</i> 4. What insights about the topic did you gain from this reading and how might these insights inform your classroom practice. <ul style="list-style-type: none"> • <i>Students are unaware of variables in investigations and have a difficult time understanding the effect of variables in an investigation. This awareness and lack of understanding changes with time and exposure. It appears that providing students with multiple experiences in controlling variables is a sound approach. Teachers need to be persistent and patient as students progress in this area.</i>
V. Examine Coherency and Articulation	V: Atlas of Science Literacy <ul style="list-style-type: none"> ▶ Scientific Investigations, pp. 18-19 ▶ Correlation, pp. 124-125; note the conceptual strand Control and Conditions
Examine the resources indicated in section five of the CTS study guide.	<ol style="list-style-type: none"> 1. What connections can you identify among concepts or skills in the topic? <ul style="list-style-type: none"> • <i>The idea of fairness in comparisons is key to students eventually coming to understand the concept of variables and the need to control variables in an investigation.</i>

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	<p>2. What prerequisite ideas can you identify for learning the topic at your grade level?</p> <ul style="list-style-type: none"> • <i>Before reaching the 5th grade, students should understand that people are not always sure what will happen in an investigation because they don't know what might have an effect on the outcome.</i> • <i>When we do scientific investigations the way we did them before, we should get very similar results.</i> • <i>We can learn about things by observing them, but sometimes we can learn more by doing something to the things and recording what happens.</i> • <i>We can think of questions about our world and look for answers by observing and trying different things to find the answer.</i> <p>3. What insights about the topic did you gain from this reading and how might these insights inform your classroom practice.</p> <ul style="list-style-type: none"> • <i>Students in the eighth grade are able to recognize a lack of controlled variables in an investigation after receiving specially designed instruction.</i> • <i>Fifth graders can understand the idea of 'fairness' but may have difficulty identifying all of the variables in an investigation. They will attend consciously to controlling the variables they think will affect the result, but may ignore other important variables.</i> <p style="text-align: center;"><i>We are back to the claim here that the concept of variables is a difficult one for 5th graders. However, fairness in comparisons is an idea they can understand. This idea is a science benchmark for students in grades 3-5, and all students should have an understanding of fairness in comparisons before the end of their 5th grade year.</i></p>
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VI. Clarify State Standards and District Curriculum	<p>VIA: State Standards- Link Sections I-V to learning goals and information from your state standards or frameworks that are informed by the results of the topic study.</p> <p>VIB: District Curriculum Guide- Link Sections I-V to learning goals and information from your district curriculum guide that are informed by the results of the topic study.</p>
Examine the state standards document and your district curriculum guide.	<p>1. What learning goals and information from the state standards are informed by the results of your topic study?</p> <p><i>EALR 2 INQUIRY: The student knows and applies the skills, processes, and nature of scientific inquiry.</i></p> <ul style="list-style-type: none"> • <i>Component 2.1 Investigating Systems: Develop the knowledge and skills necessary to do scientific inquiry.</i> <ul style="list-style-type: none"> ○ <i>Generate a logical plan for, and conduct, a simple controlled investigation with the following attributes:</i> <ul style="list-style-type: none"> ▪ <i>Variables kept the same (controlled)</i> ▪ <i>One changed variable (manipulated)</i> ▪ <i>Measured (responding) variable</i> ○ <i>Generate a logical plan for a simple field investigation with the following attributes:</i> <ul style="list-style-type: none"> ▪ <i>Identify multiple variables</i> ▪ <i>Select observable or measurable variables related to the investigative question</i>

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2. What learning goals and information from your district curriculum are informed by your curriculum topic study?

- *Gain experience with the concept of variable.*

- *Design and conduct controlled experiments.*

- *Acquire the vocabulary associated with controlled experimentation.*

Visit www.curriculumtopicstudy.org for updates or supplementary readings, web sites, and videos.