

Differentiation in IQWST

Diverse Student Learners

Strategies built into IQWST lessons acknowledge students' differing capabilities, expectations, experiences in school and at home, language proficiency, reading strategy use, and science background knowledge, among others. English learners and students with learning disabilities require supports that not only help them but help other learners as well, thus support strategies are threaded throughout the fabric of IQWST. Materials address diverse needs in multiple ways, the most significant of which is connecting classroom science to students' everyday, real-world interests and experiences, and providing extensive opportunities to use both oral and written language. By providing opportunities for teacher guidance, for independent work as well as small-group and whole-group interaction, for investigation, for discussion, and for reading, writing, and talking science, opportunities for differentiation abound in each of these areas and in each lesson, so all students are able to work at their appropriate level of challenge.

Phenomenon-based lessons enable students to share common experiences from which to build understanding. That is, all students begin with the same experience of the lesson—typically an anchoring phenomenon.

Students with kinesthetic preferences can use their strengths as doers and problem solvers. Those with verbal strengths excel when they can talk and write about processes and practices and can contribute ideas from readings to the discussion. Those with tactile preferences can manipulate materials. Those with visual preferences observe rather than only read about science. IQWST does not require memorizing definitions, writing paragraphs using vocabulary, or writing lab reports. Students with a range of learning preferences, language abilities, and other strong and weak areas as learners can contribute to, engage in, and learn from each investigation— independently and collaboratively.

To enable you to plan, specific differentiation opportunities are described in the Preparation section that precede each lesson and are often indicated within lessons as well. The following general strategies apply across IQWST.

- When students are given procedures for an investigation, it will be helpful for you to read through the procedure with them, perhaps demonstrate the equipment without actually doing the experiment, highlight key components and safety issues, and summarize briefly (or have a student do so) so that all students conceptualize the big picture of what they are going to do. Such an introduction frames the activity for all students but is especially important for students who need to hear and not just read the procedure, who are helped by the visual representation, or who need support in understanding the big picture before they proceed with individual steps.
- Two follow-up questions that can always be asked of students and that they cannot get wrong, simply by virtue of having read one of their reading assignments, are (1) What did you find most interesting in the reading?, and (2) What is one new thing you learned as you read for today? Some variation of either of these questions can be used for accountability purposes (i.e., Did the student read?) and for encouragement purposes (i.e., There are no

wrong answers, giving a measure of “success” for even the weakest readers). In addition, these types of questions can generate good discussion in which you tie in-class activities and readings in a way that illustrates the value of reading for information in science.

- Students’ original questions: Each module begins with an activity—typically an anchoring phenomenon—designed to generate students’ original questions. Those questions get posted on the Driving Question Board (DQB) to be used (and many of them answered) throughout the module. It is likely that some questions will not be addressed in the module. Such questions may be assigned (or suggested and encouraged) for individual, pair, or group pursuit, requiring students to use school library or media center resources or to access online resources independently.
 - Pursuit of a question students asked (and are obviously interested in learning the answer to) can enable students who benefit from “going beyond” the material to do so independently. If desired, projects for advanced students might require the use of multiple resources of varied text complexity, and they could require a written and/or oral presentation of findings or a written claim-evidence-reasoning formatted explanation that answers the question.
 - However, extremely important—and perhaps counterintuitive—is that passionate interest has been shown to motivate students who struggle with reading to *read texts well beyond their Lexile level or presumed “ability”* in a quest to learn more about a topic in which they are interested. English learners, students with learning disabilities, and struggling readers should thus be encouraged to investigate topics in which they are keenly interested. Some students may need support with resources (e.g., Internet search terms or suggested websites), but it is important to encourage all *students* to pursue areas of interest and to ensure that *reading level is never used to discourage* students from pursuing interests deemed “too difficult” for them to investigate.
 - Finally, at the end of 8th grade, students will engage in a capstone project in which they pursue an area of interest in depth, including exploring pros and cons or arguments for or against an issue related to sustainability, for example. It may be that a student in 6th or 7th grade begins pursuit of a topic that arises in a reading or discussion or one that is generated by an activity or investigation, and that topic becomes a project much later. If your school keeps portfolios of student work, or if you have another way to pass along ideas in which students showed passionate interest along the way in middle school, that would go a long way toward students viewing their middle school science experience as a connected whole, in which their teachers show genuine interest in supporting them as learners.

Language Supports: Focus on ELs

- Discussion is important to allow the exchange of ideas and examination of one’s own ideas. However, many students, especially some English learners (EL), students with some forms of learning disabilities, or students with auditory processing difficulties, struggle to make sense of a question asked aloud and then to formulate a response in time to raise their hands and articulate their ideas orally. A think-pair-share activity is one useful strategy. Pose a question and provide students with time to *think* about their response (or to write their ideas). Then, *pair* students with partners to *share* ideas. The teacher can then call on a pair,

who can give a response they have had time to rehearse. This activity can be taken a step further to *square* the response by having two pairs talk together.

- Allowing EL students to talk with one another—in their native language—has been shown to be a positive strategy for supporting their classroom success. Consider how challenging some science ideas are for native English speakers in an English-speaking setting! For example, how difficult is it for students to understand that even though their desks aren't moving, the molecules of which their desks are made are, indeed, in constant motion? Or how difficult is it to understand that the reason a book stays sitting (still) on the desk is that not only is gravity pulling it toward the Earth, but the table is exerting an upward force at the same time (along with forces pushing and pulling on the other surfaces). Middle school students are going to encounter many incredibly challenging ideas, often ideas that are counterintuitive. If EL students can work with peers to “make sense” in the native language in which they are comfortable and fluent, they are more likely to then be able to share their ideas with classmates and to participate in whole-class discussions in which they have an opportunity to use English with more confidence as the entire class works through challenging content.
- Oral language opportunities are a strong component of the IQWST curriculum. Use the Word Wall frequently, pointing directly to words being used in discussion. Perhaps use a version of the Word Wall that does not simply provide words but also provides photographs, drawings, or other representations that enable students to associate printed and spoken words with those things that they represent. All students need to speak, hear, and read the language of science. For English learners, the need is even greater as they must learn English and the specific language of science at the same time. This is also at the same time that they are learning science content and engaging in scientific practices.
- Remember that for English learners, and often for students with particular learning disabilities, much more is going on for them than they are able to express verbally—either orally or in writing.
- Some students would be able to participate more fluently and comfortably if they were told ahead of time what it is that they are going to be asked to share their ideas about. Preparation time allows students to jot notes, practice orally, or reread a written response and be confident about sharing aloud. While planning a lesson, you might write a sticky note such as: “Be ready to talk about your answer to Question 3,” which you can place on a student's book or desk in the course of teaching a lesson. This strategy can enable students with a range of language proficiencies, background knowledge, memory/recall issues, or ability to process information the time to think through their ideas and thus to be more confident and successful sharing in whole-class contexts. The “Question 3” tip could, of course, also be delivered orally rather than on a sticky note. Providing students with a heads-up can enable them to find success in science as they have an opportunity to prepare, to think, and to rehearse.

Reading Supports: Focus on Low-Performing Readers

- Reading in science requires organizing both main ideas and important details. Some IQWST readings employ built-in prereading strategies and advance organizers to help students with both text structure and content. Teachers may create additional advance organizers, as desired, for particular readings. Resources that offer such reading strategies are ubiquitous. However, more important than forced organizational strategies is that students learn how to address any text that they encounter and that they know simple fix-up strategies such as:
 - rereading a word, sentence, or passage
 - reading a word, sentence, passage, or entire lengthy text aloud
 - moving their lips when they read, even without vocalizing
 - plugging their ears (or using headphones) to block out extraneous noise
 - using white noise or other background sounds if it helps concentration
 - running a finger under words if it helps with fluency and keeping one's place
- Hearing good, fluent oral reading is important for all learners. Often, the adults in a students' life stop reading aloud to them once students are able to read independently. Two strategies can improve student fluency (and comprehension): one that the teacher does and one that the student does.
 - Auditory Readings are provided on the student portal. Students should be encouraged to (rather than discouraged from) using those readings. Just hearing material read aloud will be helpful. However, listening while following along with the text helps to connect spoken and written language, and this supports both English learners and low-performing readers. Listening while following along and reading along with the text involves another sensory experience (moving the lips) and will support learners in yet another way. Even good readers may enjoy and benefit from the auditory readings, as well.
 - If you use any of the readings during class time, whole-class choral reading (in which everyone reads along with you or with the auditory reading played at a volume that everyone can hear) singles out no one, does not stifle high-performing readers in any way, and allows you to stop the audio for discussion purposes. You can stop either to ask questions, call attention to something in the text, do a think-aloud in which you connect content to your own experience, "wonder" about something, or express confusion over a point that doesn't make sense immediately and then model a rereading strategy. Without using the auditory reading, hearing you read aloud in a fluent manner provides students, again, with an opportunity to listen or to listen and follow along, letting them hear what good reading sounds like.
- Encourage students to read all of the written material, as it is designed to support learning of key concepts and to extend the application of core ideas into the real world, thus generating interest in science. However, many options enable the teacher to support struggling readers, students with learning disabilities, English learners, and advanced students.
 - If students find an assignment overwhelming, let them know what to focus on as they read, perhaps indicating (and having them mark) two or three sections of the reading that they should read most carefully. Doing so gives students freedom to read all of the material but focuses their reading. Then they are more likely to experience success when they participate in follow-up class discussion because they focused on the "right" section of the reading. Avoid having students need to guess what is in your head by

quizzing them on goals you had for the reading but did not share with them. They may have focused on different details that were interesting to them and not what seem to be the “main ideas.” In fact, a body of main-idea research indicates that when a group of teachers is given the same reading and asked to determine its main idea, they disagree on what constitutes the main idea depending on experiences they bring to bear, prior knowledge, and other factors that have to do with the person not the text. So, unless main idea is obvious in a sentence that begins, “Here is the most important thing to remember,” tell students what you want them to be prepared to talk about rather than expecting them to land on the same key ideas that you do when you read.

- When a reading has multiple examples (e.g., a reading about how the eyes of three types of animals work), invite students to prepare to talk about any one of the three. Doing so does not erase the opportunity to read all of the passage, but it enables students to make choices and to focus their reading, providing encouragement and small steps toward success.
- Many opportunities exist for students to conduct Internet searches and read more complex texts as they either pursue areas of interest or as you assign such work. Although advanced students may be expected to gravitate toward independent research pursuits, other students often surprise themselves (and their teachers) by delving into an area of particular interest and becoming experts. Rather than assuming that only advanced students “get” physics, for example, have all students apply physics principles to sports, music, or any other activity. Chemistry principles are readily applicable to cooking. Encourage students to go beyond the class content to investigate areas of interest and, perhaps, to present to their classmates in some manner.
- Support readers by pre-identifying challenging language in the readings. On the board, write 2–3 words likely to be stumbling blocks, pronounce them, and provide connections (if possible) to everyday use of such words or to cognates for English learners. IQWST is built on a strong research base showing that the best way to learn vocabulary is to encounter and use words in context. Use an interactive Word Wall to display words so that they may be referred to often in reading, writing, and discussion. Pre-identifying and pronouncing words that might cause difficulty is not meant as a strategy for pre-teaching vocabulary but only as a way to ensure that when students encounter Leonardo da Vinci’s name or see *photosynthesis* in print, they will not experience such unfamiliar words as roadblocks.
- Readings should be previewed and followed up in class, and soon most students, even low-performing readers, will attempt at least portions of the reading. Even if they do not read an entire assignment, or do not read well, students will make sense of whatever they do accomplish in ways that will help them learn. IQWST is not a textbook-driven curriculum, so using class time to read all of the materials does not align with a project- and inquiry-based philosophy in which students experience phenomena and then think about, write about, talk about, and read about science to learn content in meaningful ways. Encourage reluctant readers by asking follow-up questions that draw on examples from the reading, making the focus not on details but on sense making, so that all can feel successful and encouraged to read independently. If your school uses homework, the readings provide an opportunity to meet several literacy-in-science standards related to independent reading, and enable students to apply and extend their in-class learning.

Writing Supports

- For students with motor skills challenges who are using the print materials, provide ample writing space by using the margins, the back of the page in the student book, or additional paper. Students can also compose on a computer, print, and insert the page into their student book.
- To support students with learning disabilities, who may omit words in writing, suggest that they read their own writing aloud, as they can often “hear” omissions when they do so. Alternatively, a peer or family member can read a written response aloud so that students can self-correct as they hear errors in their own writing.
- Because several languages have different writing conventions and grammar than those in English, English learners are also helped by reading aloud or having their own writing read aloud to them. First languages that do not have prepositions or articles (e.g., a, an, the), for example, pose a challenge when precision in science matters and finding the correct way to represent an idea is difficult.
- Having another person scribe, while students who struggle with writing or with written expression provide oral responses, allows students to express their understanding unencumbered by their challenges with representing the ideas in their heads in writing.
- Sentence starters are a simple way to support students who need a way to get going in moving ideas from their heads to written form. Sentence starters do not give away answers; they simply help students get over the hurdle. For example, if you ask, “What was the most interesting thing you read for today?” the sentence starter, “The most interesting thing...” or “I thought...” may be all that some students need. If students are supposed to write an explanation that answers the question, “Why do some things sink and some things float?” a sentence starter might be, “We observed”
- For any writing task that is more than a very short response, you may choose to use the Word Wall in one of four ways.
 - Do nothing. Students have the WW to consult as they write.
 - Remind students that they are able to consult the WW as they write.
 - Look at the WW with students, and decide together which words are likely candidates to go into the explanation about why some things sink and others float.
 - Pre-identify words that you expect to be included, telling students: Your explanations can include any of these words, but I will be looking to see that you understand and include the words *property/properties* and *density/densities*.
- Summarizing can be a valuable way to use writing as a tool for sense making. To support students in summarizing key ideas, provide practice for them to verbalize their thinking before writing or time to write about their ideas before sharing orally. For instance, before writing a summary of a reading, students could be asked: *How would you summarize what we did and what we learned yesterday (or what we read) for a new student who just joined our class (or for someone who was absent yesterday)? What did they miss that they need to know?* After discussing, students will be better prepared to write summaries. However, summarizing orally is also a useful skill that helps students to meet several literacy in science standards.

Mathematics-Focused Strategies

- Measurements in science are precise, and measuring using science equipment can be difficult. Collaborative investigations enable students with varied strengths to work together. Although all students should learn how to use the tools of science, students who have difficulties with motor skills or vision impairments, for example, do not need to physically measure or be the person solely responsible for reading a thermometer or graduated cylinder. Instead, students work in teams or groups to carry out investigations and are able to support one another. All students should know *how* to measure using the tools of science, but all students do not need to make the measurements themselves.
- Procedures in science require a sequencing of steps can be difficult for some students, particularly if instructions are given only orally or in print. To support all students, review written instructions orally, step-by-step, as needed. Have students reread procedures even after they have been reviewed. Demonstrate procedures for investigations that are anticipated to cause confusion or frustration. Many students are more successful if they check off steps as each is completed. Thus the procedure section of activities in the IQWST students materials have checkboxes to support students with this aspect of carrying out an investigation.
- Reading graphs and tables is a skill important to both mathematics and science, and that provides a layer of challenge for many students. Take the time to practice these skills. Sometimes, the materials suggest walking through the details of a graph (e.g., What is the title of this graph? What relationship is it showing—between what and what? What is represented on the *x*-axis? The *y*-axis? How were the data points collected? What does the line that connects them tell us?). Whether suggested in the materials or not, take the time to do this if any students in your class are likely to need practice with analyzing and interpreting data presented graphically. Doing so addresses the SEP “Analyzing and Interpreting Data,” and may address “Using Mathematics and Computational Thinking,” depending on the nature of the data.
- Much of the mathematics in IQWST may require you to do an example with students, and then have them proceed. Locating a city via latitude and longitude, calculating averages, developing models to scale, using proportional reasoning, and many others may require an example first—which either you or an advanced student can provide. Consulting the math teacher(s) for grade-level support may also be useful.

Wrapping Up

These and other strategies support students as readers, writers, speakers, listeners, and budding scientists. Most of the recommended strategies apply to learning outside of science class as well, thus they prepare students not only for your class, but also prepare them with College and Career Readiness skills, behaviors, and habits of mind that prepare them to be lifelong learners. Equity standards are addressed in these strategies for using IQWST, as well as in the materials themselves. Diverse learners, as well as diverse ways of learning, are addressed in the design principles that undergird IQWST, and via their representation throughout the readings in the SE and in the scientists' biographies on the Student Portal. Every element of IQWST is designed to invite *all students* into the scientific enterprise.