STR 1: Anchoring Phenomenon

Why this routine?	An Anchoring Phenomenon routine lays a strong foundation for learning and thinking in the science classroom by sparking students' curiosity with a compelling real-world situation, driving all subsequent lessons toward explaining it through firsthand and secondhand investigations, and requiring students to iteratively construct and revise explanations over time as their understanding deepens. This authentic process engages students in three-dimensional learning by integrating core science concepts, crosscutting concepts, and science practices. By centering the entire experience around making sense of the Anchoring Phenomenon, it provides coherence and models how science actually progresses. This supports the Portrait of a Graduate durable skills of critical thinking, communication, and learner's mindset.

What is an Anchoring Phenomenon?	An Anchoring Phenomenon[1] is an interesting, observable event from the natural or built world that piques students' curiosity. It serves as the core focus that frames the learning experience, where students work to explain the phenomenon by gathering evidence through investigations and applying scientific concepts and practices. Effective Anchoring Phenomena are puzzling, relatable, developmentally appropriate, and culturally relevant, ensuring all students find meaning in them. They are broad enough to encompass multiple scientific ideas yet specific enough to focus the unit.
How does the use of an Anchoring Phenomenon support an equitable science classroom?	An Anchoring Phenomenon supports an equitable science classroom by providing a common, real-world context that engages all students, regardless of background or prior knowledge. By selecting culturally relevant and age-appropriate phenomena, educators ensure the content is meaningful and accessible to everyone. This approach fosters inclusive discussions and investigations, promoting equity through student-driven inquiry. As students collaboratively explain the phenomenon, they bring diverse perspectives and experiences, leading to deeper, more personalized learning and breaking down barriers to engagement.
What does an Anchoring Phenomenon look like in the classroom?	In the science classroom, an Anchoring Phenomenon serves as a central focus around which the entire unit is structured. Students begin by observing and describing the phenomenon through a Notice and Wonder (STR 2), generating questions that drive their investigation. They then make their thinking visible by writing, drawing and sharing their initial models, explanations or design solutions. The DQB (STR 4) acts as the shared classroom representation of the Anchoring Phenomenon. As the unit progresses, lessons and activities are designed to build the knowledge and skills necessary to understand the phenomenon more deeply. Students repeatedly revisit the Anchoring Phenomenon through the DQB (STR 4), using their growing understanding to refine their explanations and identify new questions.

[1] Zieminski, C. (2020, June 6). *What is an Anchoring Phenomenon? — Phenomena for NGSS*. Phenomena for NGSS. https://www.ngssphenomena.com/ourvoice/2020/2/19/phenomenainfocus-anchoringphenomenon

STR 2: Notice & Wonder

Why this routine?	The Notice and Wonder routine encourages students to make careful observations and generate questions about a phenomenon or image while providing a space for sense-making. It also allows students' prior knowledge and preconceptions about a scientific concept or phenomenon to surface and become a resource that builds onto further learning and potentially questions for the Driving Question Board (STR 4). This supports the Portrait of a Graduate durable skills of critical thinking, personal responsibility, learner's mindset, and communication.

What is a Notice & Wonder?	Notice and Wonder[2] is an instructional strategy that prompts students to make observations ("Notices") and ask questions ("Wonders") about a phenomenon, image, or data set. This approach encourages curiosity and critical thinking, laying the foundation for deeper exploration and understanding. The Notice and Wonder routine facilitates the creation of the Driving Question Board (STR 4).
How does a Notice & Wonder support an equitable science classroom?	Notice and Wonder activities promote engagement by encouraging students to share their observations and questions, actively involving all learners. They foster a culture of inquiry where students feel comfortable asking questions and seeking answers. These activities develop critical thinking as students analyze their observations and formulate thoughtful questions. The open-ended nature supports diverse learners, allowing meaningful participation from students with different backgrounds and abilities. These routines align with scientific practices of observing phenomena, asking questions, and seeking explanations. Additionally, they facilitate scaffolded learning by helping teachers identify students' understanding and providing appropriate support.
What does a Notice & Wonder look like in the classroom?	A Notice and Wonder activity is effective in various classroom scenarios. When analyzing and interpreting data, students first observe patterns, trends, or anomalies in graphs, charts, or tables, and then generate questions about their observations. This method makes data more approachable and engaging. In demonstrations and hands-on activities, prompting students to Notice and Wonder before explanations harnesses their natural curiosity, allowing them to form their own observations and questions, which sets the stage for deeper understanding. When introducing anchoring phenomena or new concepts, teachers present relevant images, videos, or real-world examples, and students record their notices and wonders. These questions drive subsequent investigations and lessons, ensuring that learning is guided by student curiosity and interests. This approach promotes student engagement, uncovers preconceptions, and allows for a more dynamic and inquiry-based learning experience. The wonders can be shared as a class with the teacher facilitating a discussion to refine questions and identify areas for further investigation.

[2] Sadler, E. (2023, September 15). *3 easy ways to use 'Notice and Wonder' in science*. Sadler Science - Transforming Science Education. https://sadlerscience.com/notice-and-wonder/

STR 3: Scientists Circle

Why this routine?	To facilitate creating the conditions of a thinking classroom, teachers should establish routines that will work with and on students' ideas. This routine supports building a culture of scientific identities and equity by allowing all students' ideas to be shared and valued. This supports the Portrait of a Graduate durable skills of collaboration, communication, critical thinking, learner's mindset and personal responsibility.

What is a Scientists Circle?	A Scientists Circle[3] reconfigures the learning space so that students sit in a circle and can see and speak directly to each other. While it can be convened at any point in a lesson, it is most often used at moments in which the class needs to work towards consensus on ideas they have figured out. This video from Edutopia shows an example.[4]
How does a Scientists Circle support an equitable science classroom?	A Scientists Circle supports equitable discussions by valuing all voices and ideas. When students collaborate in a circle, they can engage more meaningfully with each other and share authority, using techniques like Talk Moves. This setup enhances listening, idea-building, and group accountability, fostering a culture where students are recognized as 'knowers' and 'thinkers,' working together with the teacher to explore ideas. This collaborative approach provides more opportunities for all students to contribute and make meaning together.
What does a Scientists Circle look like in the classroom?	In the classroom, a Scientists Circle transforms the traditional learning environment into an interactive, collaborative space. Begin by arranging the desks and chairs in a circle so that all students can see and engage with each other. This setup fosters open communication and equal participation. To implement a Scientists Circle, start with a guiding question or phenomenon that is relevant and thought-provoking. Facilitate the discussion by encouraging students to share their observations, ask questions, and build on each other's ideas, using Talk Moves to guide the conversation. Document key points on a whiteboard or chart paper, ensuring that students can see the collective thinking process. Opportunities to use a Scientists Circle include building the Driving Question Board (STR 4), discussing a complex concept, or reaching a consensus on scientific ideas. This approach not only enhances students' understanding but also promotes a culture of collaboration and mutual respect in the classroom .[5],[6]

[3] OpenSciEd. (2022). OpenSCIED Teacher Handbook. In *OpenSciEd Teacher Handbook* (Version 4.0). https://htmlsimulations.s3.us-west-1.amazonaws.com/2022_+OpenSciEd+Teacher+Handbook.pdf

[4] Edutopia. (2023, September 27). *Encouraging collaboration with a scientists circle* [Video]. YouTube. https://www.youtube.com/watch?v=f___Jg6_Xo7o

[5] *Encouraging collaboration with a scientists circle*. (2023, September 27). Edutopia. https://www.edutopia.org/video/scientists-circle-encouraging-collaboration/

[6] *Some of you are smiling now*. (n.d.). NSTA. https://www.nsta.org/science-scope/science-scope-mayjune-2022/some-you-are-smiling-now

STR 4: Driving Question Board (DQB)

Why this routine?	A Driving Question Board (DQB) is essential in science classrooms for fostering inquiry and student-centered learning, allowing students to anchor their curiosity and guide investigations. It connects with the Notice and Wonder routine by capturing students' initial observations and questions and can be built through a Scientists Circle routine. By valuing students' knowledge and ideas, the DQB empowers them to build on their insights and drive their own learning. This supports the Portrait of a Graduate durable skills of adaptability, critical thinking, empathy, and communication.

What is a Driving Question Board (DQB)?	A Driving Question Board (DQB)[7,8] is a tool used in science classrooms to collect and organize students' questions about a phenomenon or problem. It serves as a central place for student inquiries, guiding the learning process and promoting scientific investigation. The DQB becomes a roadmap for all of the stages of sensemaking rather than just an activity at the beginning of a new unit.
How does a Driving Question Board support an equitable science classroom?	A DQB supports an equitable science classroom by making student thinking visible, validating all questions, and creating a collaborative environment where every student's ideas are valued. It encourages active participation and helps address diverse learning needs by allowing students to explore their curiosities. Teachers work with students' ideas, eliciting their initial understandings of a phenomenon. These initial explanations, often fragmented and influenced by outside experiences or cultural knowledge, are considered **valuable resources**. The DQB helps create a classroom environment where every student's questions and ideas are valued and visible, fostering respect for diverse perspectives. It encourages students to listen to and consider their peers' thoughts, promoting an understanding of different viewpoints and collaborative problem-solving.
What does a Driving Question Board look like in the classroom?	In the classroom, a Driving Question Board (DQB) is an interactive display that evolves with students' learning. Teachers start by introducing a phenomenon and using a Notice and Wonder activity to spark curiosity. Students' questions from this activity form the basis of the DQB. The board, prominently displayed, organizes questions into categories and tracks ongoing inquiries. Unlike the Notice and Wonder routine, which captures initial observations and questions, the DQB continuously guides learning by integrating new questions and discoveries, fostering a culture of inquiry and collaboration. Throughout and after the unit, teachers revisit the DQB to update it with new insights, track answered questions, and encourage students to refine their inquiries. This ongoing reflection and tracking make the DQB a living document of the learning journey, ensuring that students see the value of their questions and the progress of their understanding. While the approach to creating the DQB can vary by teacher and classroom, one easy way is to introduce a phenomenon using a Notice & Wonder and have students write questions on post-it notes, then place them on the board during a Scientists Circle discussion. Watch an example video here for more details. This video also has further explanations of connections between other routines.

[7] OpenSciEd. (2023, December 6). *Driving Question Board - OPeNSCIED*. https://www.openscied.org/professional-learning/on-demand-teacher-support/driving-question-board/

[8] *Driving Question Boards | National Center for Science Education*. (n.d.). https://ncse.ngo/driving-question-boards

STR 5: Compare & Connect

Why this routine?	The Compare and Connect routine allows student thinking to be made visible and open to classroom discussion. This continues to strengthen the scientists community and connects to the foundations laid out in the Scientists Circle routine. This supports the Portrait of a Graduate durable skills of empathy, communication, adaptability, collaboration, critical thinking, learner's mindset and personal responsibility.

What is Compare & Connect?	Compare and Connect[9] is an instructional routine designed to promote rich scientific discourse by encouraging students to observe, discuss, and analyze different scientific ideas, methods, and results. This routine, adapted from a math language routine, involves students comparing their own work with that of their peers and connecting various scientific concepts to deepen their understanding. By examining multiple approaches to the same scientific problem or concept, students gain insights into different ways of thinking and problem-solving. This is the structure for ongoing student discourse.[10]
How does Compare & Connect support an equitable science classroom?	The Compare and Connect routine supports equity in the science classroom by providing all students with opportunities to share their ideas and learn from one another. This routine values diverse approaches and perspectives, encouraging students from different backgrounds to contribute their unique insights. By displaying student work and facilitating discussions that include multiple viewpoints, teachers create an inclusive environment where every student's voice is heard and respected. This approach not only helps students develop a deeper understanding of scientific concepts but also fosters a sense of belonging and confidence in their ability to participate in scientific discourse.
What does Compare & Connect look like in the classroom?	To compare, students investigate each other's work by taking a tour of the visual displays. Tours can be self-guided or teacher-guided, with the teacher providing guiding questions for students to ask each other. These questions should highlight key scientific features and facilitate comparisons. Comparisons focus on the typical structures and purposes of the different approaches or representations: what worked well in this or that approach, or what is especially clear in this or that representation. While students are discussing, listen for and note any comments about what might make this or that approach or representation more complete or easier to understand. To connect, the whole class discussion then turns to identifying correspondences between different scientific representations. Guide students to refer to each other's thinking by asking them to make connections between specific features of diagrams, models, graphs, tables, descriptions, and other representations of the same scientific phenomenon. During the discussion, amplify language students use to communicate about scientific features that are important for understanding the phenomenon or solving the problem. This STEM teaching tool can provide more information about the student discussions.

[9] *Mathematical routines*. (n.d.). https://achievethecore.org/content/upload/Mathematical%20Routines.pdf

[10] Windschitl, M., Thompson, J., & Braaten, M. (2018). *Ambitious Science Teaching: A Discourse primer for science teachers*. https://ambitiousscienceteaching.org/wp-content/uploads/2014/09/Discourse-Primer.pdf

STR 6: Developing & Using Models

Why this routine?	The Developing & Using Models routine (one of the eight Science and Engineering practices) is essential for connecting the learning and allowing sense making. This routine allows students to iteratively develop and refine their understanding of scientific concepts, mirroring the process scientists use and integrating well with other sense-making practices. This supports the Portrait of a Graduate durable skills of adaptability, collaboration, communication, critical thinking, empathy, learner's mindset and personal responsibility.

What is Developing & Using Models?	Developing & Using Models[11] is an instructional routine that engages students deeply with scientific phenomena through iterative model development and collaborative refinement. It starts with students creating initial models to represent their current understanding and uncover misconceptions. As they gather more evidence, they revise these models, emphasizing evidence-based reasoning and iterative refinement. The process culminates in a consensus model, where students synthesize their individual and group insights into a cohesive class representation, fostering collaboration, communication, and a shared understanding of the phenomenon.
How does Developing & Using Models support an equitable science classroom?	The Developing & Using Models approach supports an equitable science classroom by valuing all students' ideas, regardless of their background or prior knowledge.[12] This process begins with initial models that allow each student to contribute their unique perspectives, fostering a diverse learning environment. By driving investigations through student-generated questions and revising ideas based on collaborative discourse and evidence, students are positioned as active participants in their learning journey. This method surfaces preconceptions, ensuring they are addressed and used as learning foundations. Additionally, strategies like using different colors and handwriting on models promote equal participation and ownership, which enhances engagement, particularly for students who might feel marginalized in traditional settings. Overall, this modeling routine nurtures a classroom culture of collective problem-solving and shared learning.
What does Developing & Using Models look like in the classroom?	The Developing & Using Models routine is implemented throughout an entire unit, starting with students creating initial models using paper and pencil to capture their understanding of a phenomenon. These initial models are simple representations based on their current knowledge. As the unit progresses, students gather new information through lessons, experiments, and discussions. They use this evidence to continuously revise their models, refining their understanding and addressing misconceptions. At the end of the unit, students work collaboratively to combine their ideas into a consensus model, which serves as a comprehensive representation that helps them make sense of the anchoring phenomenon. This final model reflects the collective learning and provides a visual summary of the scientific concepts explored during the unit.

[11] *Doing Science to Learn Science, Part 2 - modeling*. (n.d.). Phenomenal Science K-5 Curriculum. https://phenomscience.weebly.com/blog/modeling

[12] *Tools | Face to face*. (n.d.). https://ambitiousscienceteaching.org/tools-face-to-face/