Teaching Science as Inquiry (TSI)
Practices of Inquiry Teaching
Plan and guide students through the phases of inquiry via the modes of inquiry

Science as a Discipline
Description of scientific discipline – what science is.

- Recognize and teach science as a multi-directional process, with multiple pathways to knowledge generation.
- Model and require students to exhibit the demeanors of scientists.
- Recognize and teach science as a human endeavor.
- Purposefully use scientific language.
- Encourage the consideration and incorporation of alternative points of view and sources of information.
- Provide opportunities for creativity.
- Design or use a curriculum grounded in the history and content of the scientific discipline.
- Recognize and teach science as a discipline that integrates concepts and skills within a context, rather than as a collection of isolated facts.

Teacher as Research Director
Students as scientists in classroom – application of disciplinary inquiry

- Engage students in the practices of science (as defined by NGSS, TSI PD slides, and EOFE curriculum).
- Have students develop their own hypotheses based on evidence.
- Facilitate learning by analysis; provide time for students to identify, generate, test, and interpret as well as time for students to refine scientific questions, experimental procedures, hypotheses, and explanations.
- Require students to select and evaluate data, reason through the steps of analysis, interpret the findings of investigations to determine scientific explanations, and propose alternative explanations.
- Direct students to assess the quality of procedures, results, and conclusions.
- Allow students to evaluate whether data collection occurred as predicted, recognize discrepancies in data, discuss variations, and identify sources of error.

Metacognition

- Create a meaningful learning environment that fosters self-awareness, reflection, and self-assessment of knowledge and skills.
- Explicitly model your own thought processes and promote intentional learning.
- Guide students in continually monitoring, adjusting, and explaining their approaches to problems.
- Require evidence of student thinking and provide students many, varied opportunities to make their thinking visible.
- Be clear about expectations and performance criteria so that students are able to become aware of their own thinking processes and self-assess.
- Be transparent about the process of teaching and learning through inquiry.

Communication

- Create a classroom community where all students are comfortable contributing to civil discourse about the scientific process, including communicating and defending evidence and conclusions.
- Model and require the communication of both processes and outcomes.

- Facilitate collaboration in large groups, small groups, and pairs.
- Model and require recordkeeping.
- Give students the opportunity to be the authority and to teach each other.
- Use graphs and data tables to represent data and in presenting and interpreting results of investigations.
- Share predictions and hypotheses, and compare and validate methods, procedures, data, and interpretation with the classroom community.
- Share knowledge among the wider student community, the scientific community, and the public.

Assessment and Guidance

- Purposefully use effective questioning strategies to guide classroom discussions.
- Monitor progress during investigations by circulating and interacting with students.
- Incorporate multiple forms of formative assessment and use assessments to modify teaching strategies.
- Provide feedback on early assessments so students have time to develop skills.
- Focus on capturing the reasoning behind student judgments and explanations.
- Align objectives, teaching strategies and assessments.
- Set clear roles and expectations.
- Clarify goals and task understanding, including how students will be assessed.
- Anticipate and explicitly address common misconceptions.
- Discuss errors in thinking or gaps in conceptual understanding.
- Set challenging, yet realistic, expectations for students, and help students set challenging, yet realistic, expectations for themselves.
- Provide quality models or exemplars.

Instructional Strategies

- Utilize a range of inquiry activities, from directed to open-ended.
- Value student perspectives.
- Allow students to design and refine models, and build an understanding of a model's strengths and weaknesses.
- Provide access to multiple sources of information.
- Allow modifications of procedures and hypotheses based on new information.
- Provide time for:
    - cognitive discourse,
    - reviewing and revisiting concepts,
    - and multiple opportunities to practice.
- Develop student interest, and make knowledge relevant through use of place and everyday situations, interests and life experiences, and societal or personal concerns.
- Connect new information to prior knowledge.
- Initiate new concepts and activities.
- Scaffold scientific content, practices, and skills.
- Allow for student choice and student-driven instruction.
- Explicitly discuss ethics and safety.
- Discuss the context of definitions, and point out exceptions.
- Emphasize the importance of careful observations, predictions, and hypotheses prior to beginning an investigation.
- Avoid front-loading too much content.