

STEAM

Discourse and Reflection

RESOURCE KIT



DISCOURSE, QUESTIONING, AND REFLECTION IN STEAM

One of the most vital aspects of a vibrant STEAM-centered classroom is student-led discourse, rich with purposeful questioning and self-reflection. Discourse is a key component to a STEAM classroom for many reasons, including...

- ✓ Ensuring students are actively involved in the learning process
- ✓ Allowing educators and students to get the most out of STEAM lessons
- ✓ Creating an environment that develops two vital 21st-century skills: collaboration and communication
- ✓ Deepening students' understanding of content by requiring them to use and apply the information during higher order thinking tasks, such as questioning, synthesizing, debating, explaining, etc.

Discourse Vs. Scientific (STEAM) Discourse

To cultivate the next generation of scientists, engineers, mathematicians, and innovators of all kinds, educators must teach students how to think, question, evaluate, and argue like them. One of the most critical steps in doing so is to prioritize discourse. But not just any discourse will do! Teachers must show students how to differentiate between typical classroom discourse and scientific discourse.

Standard Classroom Discourse	Scientific Classroom Discourse
<ul style="list-style-type: none">• People may just be exchanging ideas• People may rely on power, persuasiveness, and emotional appeals (think ethos and pathos)• Usually, the goal of the conversation is to "win" by developing the most convincing argument	<ul style="list-style-type: none">• Facilitates listening, argumentation, comparison, and evaluation• Is a form of argumentation in which ideas are evaluated based on merit and evidence rather than persuasiveness or emotional appeals• Moves away from the traditional model wherein the instructor provides the information and students try to determine the one correct answer and towards a model in which students discover multiple answers on their own and decide on the one with the most merit.• Has a very different end goal than standard discourse. The aim of these collaborative conversations is to come to a mutual understanding as to the best path forward based on empirical data.

If you're a STEAM educator wondering how to facilitate scientific discourse in your classroom, take some time to ask yourself...

How often do students really talk deeply through their ideas during STEAM projects?

Are you employing any discourse strategies to enrich academic conversations?

When was the last time you refreshed your discourse practices with current, research-based strategies?

Do current district staff and PD providers offer teachers the resources and opportunities to develop more STEAM discourse strategies?

Does school leadership have protocols to measure how well discourse is being promoted during STEAM education?

To what extent does current STEAM instruction prioritize student understanding and sensemaking through collaborative conversations?

In what ways does discourse in STEAM education attend to equity? Are underserved students being supported and engaged in discourse as well as others?

How to Orchestrate Productive STEAM Discourse

- Make sure you fully understand the components of scientific discourse
- Set clear expectations for students
- Model, establish, and mediate STEAM-centered discourse practices
- Maintain collaborative patterns of communication that foster productive STEAM discourse
- Keep discourse rigorous
- Gauge the success of your discourse strategies and modify them if necessary

Promoting Discourse with Purposeful Questioning

By far the most valuable tool to promote classroom discourse is purposeful questioning. Throughout the duration of STEAM projects, purposeful questions should be employed to help get kids to think deeply and connect with the material. Purposeful questions should be open-ended, deep-thinking questions with multiple possible answers, all of which require research and time to compose a response.

Questions to Use During Each Phase of the Engineer Design Process

THINK

- What is the problem you need to solve?

ASK

- What is needed to solve the problem?
- Do you have any constraints? What are they?
- What will success look like for you in this project?

IMAGINE

- What are some possible solutions for his problem?
- Does this remind you of another problem you have seen or solved? How?
- What materials do you have and how can you use them?

CREATE

- For each part of our design, what materials will you need to collect?
- Given the constraints, which of these projects could you realistically finish?
- What jobs will you assign to the people in your group?
- What could go wrong when you start building?
- Who will complete each part of the design?
- What challenges do you anticipate, and what can you do to plan for them?

ASSESS

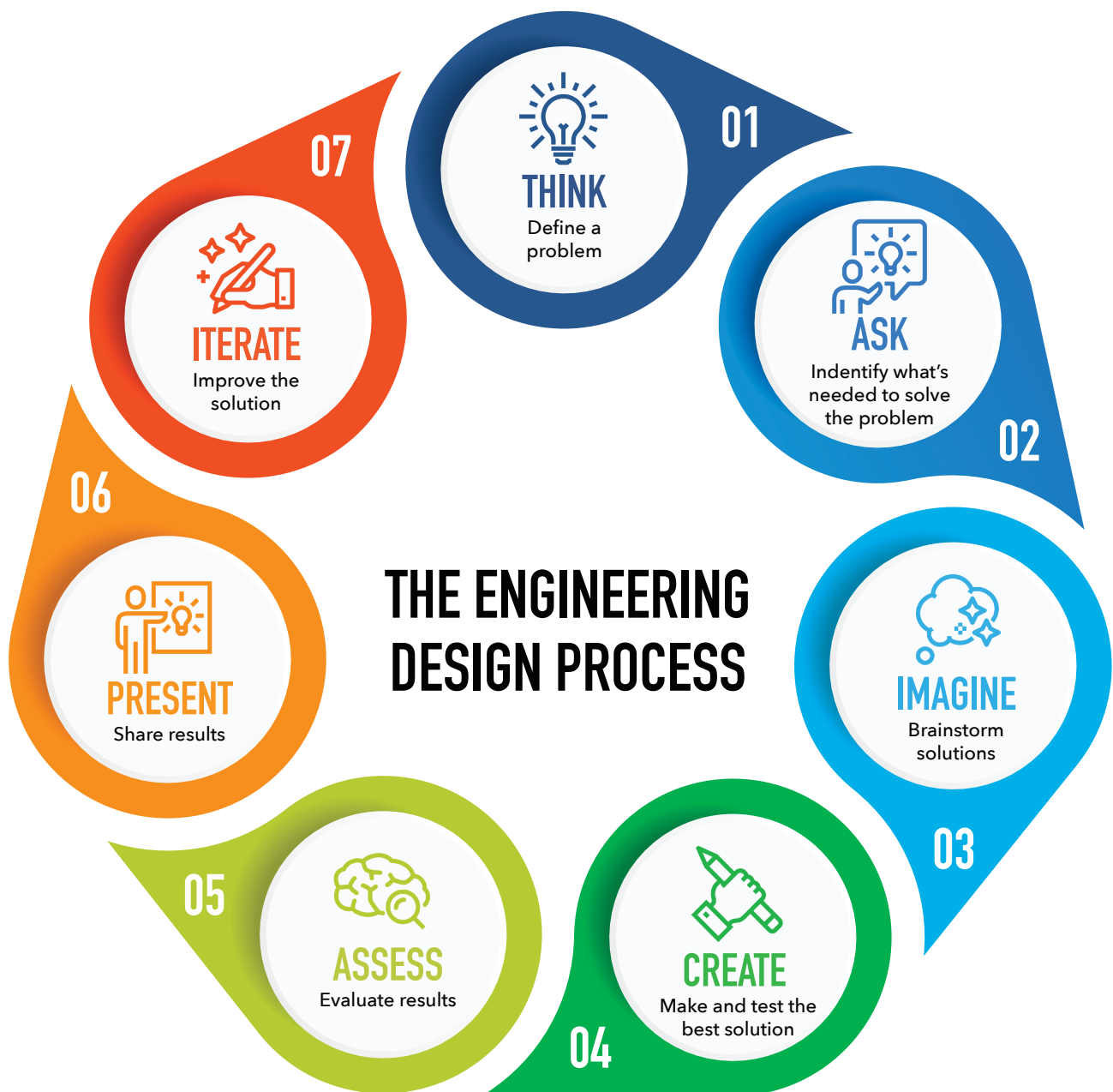
- Did you hit all the necessary requirements with your design?
- What did you notice while you were designing and testing?
- What went well? What didn't go well?

PRESENT

- Does your design work? Does it solve the problem?
- Does anything need to be improved?
- If you had to start the design process all over again, what would you do differently?
- How can this help you fix a problem in the real world?
- What other designs in the class went well and why?

IMPROVE

- How does your design need to be improved?
- What do you need to change?
- Who will perform the changes in your group?



Open Ended-Question Sentence Starters to Facilitate Discourse & Reflection

- What would happen if _____?
- What is the connection between _____ and _____?
- Why did you decide to _____?
- What do you think?
- How could you improve/change _____?
- What would be a different way to _____?
- Does this make you think differently about _____? Why?
- How can _____ improve _____?
- How can _____ be applied to _____?
- How can _____ change _____?
- How would you design a new _____?
- How could you design or create a new _____? Explain your thinking.
- How does _____ affect _____?
- What impact did/does _____ have on _____?
- What makes a good/effective _____?
- What is possible?
- What are the steps that need to be taken to accomplish _____?
- What evidence supports _____?
- What is the relationship between _____ and _____?
- What details are most important and why?
- Can you explain how you came to that conclusion?
- Can you explain to your classmate how you came to that conclusion?
- Is there anything you would like to add?
- Can you restate what you said in a different way?

Structured Reflection Strategy Ideas

- Journaling
- Students respond to an open-ended question by writing a journal entry.
- Fist-to-Five
- Students use fingers (fist = zero, 5 fingers = 5) to answer reflection questions. Questions might be, "How well did your project go?", "How did your group work together today?"
- Partner Sharing
- Students answer reflection questions with partners and share answers with the whole group
- Group Sharing
- Students sit in a circle and share what went well and what they would improve with the whole group.

STEAM

DISCUSSION PROMPTS

Ask a Question & Clarification

- Why...?
- What is...?
- Why did...?
- What happens if...?
- I have a question about...
- Can you explain that again?
- What do you mean by...?
- I'm confused about...
- Could you tell me more about...?
- I don't understand...
- What do you think about...?
- Will you tell me more?
- Now I understand...

Make an Inference

- I notice...
- I think that...
- I predict...
- I wonder...
- It seems like...
- Based on the evidence...
- The data shows...
- This could mean...
- I can see that...

Agree/ Disagree

- I agree because...
- I disagree because...
- I'm not sure about...
- I have a different idea...
- I see it another way...
- I understand... but I think...
- That's a good point, but...
- I agree with your reasoning...
- I disagree with your idea...

Reasoning

- Why do you think that?
- What data led you to that?
- What's your evidence?
- How did you get that answer?
- How did you come to that conclusion?
- Why is it important?
- Can you show me the data you analyzed...
- What's your source?

PROJECT

REFLECTION

“ We do not learn from experience...
we learn from reflecting on experience. ”

— JOHN DEWEY

Think back on the STEAM project you just completed and respond to each prompt in detail.
Be as specific as possible.

Student Name

STEAM Project Name

Driving Question

ABOUT THE STEAM PROJECT

What part of the project did you find most difficult? Why?

What was your favorite part of the project? Why?

What actions did you take to solve the Driving Question?

ABOUT YOUR WORK

Who did you work with? What ways did you work well together? Where did your group struggle to work together?

Is there a part of the project you would have done differently?

What part of the project did you do your best work? What solution are you most proud of?

Daily Project Planner & Reflection

Name: _____

Date: _____

Complete the planner to document today's progress and to identify what you plan to accomplish moving forward.

Ideas I Agree or Disagree With		Questions I Asked
Agree		
Disagree		
New Ideas I Had While Working		Questions I Answered

	PROGRESS <small>Describe specific accomplishments you achieved today and their outcomes.</small>	PLANS <small>Describe what needs to happen tomorrow in order to reach goals.</small>	NEXT CLASS <small>Describe specific steps and strategies.</small>
ACTIONS: — What actions did you take? — What steps were successful?			
COLLABORATIONS: — Who did you work with? — What went well, and what might need to change in order to meet goals? — What resources did you use?			
SELF DISCOVERIES: — What strengths did I bring to the project today? — Where do I need to improve and give more effort?			

PROJECT

REFLECTION

“ We do not learn from experience...
we learn from reflecting on experience. ”

— JOHN DEWEY

Think back on the STEAM project you just completed and answer the questions below.
Be as specific as possible.

Student Name

STEAM Project Name

Overall, how do you feel about the STEAM project? Answer by coloring a face.



ABOUT THE PROJECT

What was your favorite part of the STEAM project? Why?

What was your least favorite part of the STEAM project? Why?

Describe how you solved the problem during the STEAM project.

ABOUT YOUR WORK

Who did you work with?

Is there a part of the project you could have done better?

What part of the project did you do your best work? What are you most proud of?

Daily Project Planner & Reflection

Name: _____

Date: _____

To be an inquisitive innovator, it is important to reflect on your work! Think about the tasks you worked on today and then fill out the planner below.

Ideas I Agree or Disagree With		Questions I Asked
Agree		
Disagree		
New Ideas I Had While Working		Questions I Answered

	PROGRESS List three tasks accomplished today.	PLANS Color the number of stars that you think reflects the quality of your work.	NEXT CLASS What work needs to be done?
ACTION Reflect on the work you did today. Then, fill out the related columns.	1. 2. 3.	★ ★ ★ ★ ★	
	PROGRESS List two ways your group worked well together.	PLANS Color the number of stars that you think reflects the quality of your group's work.	NEXT CLASS Share one way you can be a better teammate next time you work on a STEAM project.
COLLABORATION Reflect on the work your group did today. Then, fill out the related columns.	1. 2.	★ ★ ★ ★ ★	