

# INQUIRY-BASED LEARNING

Inquiry-based learning is a youth-centered, active learning approach that involves questioning, critical thinking, and problem solving.



*Stages of Inquiry adapted from Scientific and Engineering Practices in K12 Classrooms.*

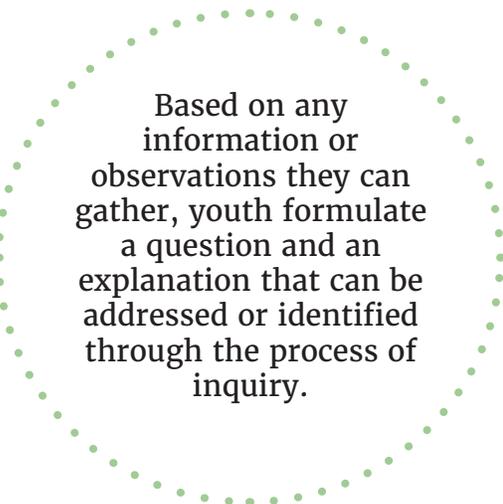
## STEP 1: ASK

The inquiry process begins by asking questions tied to real-world problems, questions, or challenges. During this stage youth create an open-ended question about a phenomenon or a problem. Once youth have a question, they develop a working hypothesis – a prediction.

### TIPS FOR SUPPORTING YOUTH DURING THIS STAGE

**Twenty Questions** is a strategy to help youth brainstorm questions they may have about a topic and focus their questions on a specific project. You can start by having youth select a topic they're interested in learning more about. To help them get started try questions like:

- What do you want to know more about?
- What is a problem or challenge you see that you'd really like to work on?
- Where do you see opportunity to make changes in your community?



Based on any information or observations they can gather, youth formulate a question and an explanation that can be addressed or identified through the process of inquiry.

**Post-it notes** can be a helpful tool to elicit youth engagement. Ask youth to write one question or topic per post-it and brainstorm multiple topics, or questions they'd like to know more about –the more ideas the better.

- After some time youth should have a wide range of issues that they're interested in learning about with some overlap.
- Try re-grouping post-its in themes or patterns with the support of youth, and then ask youth to sticker vote on areas they're most interested in. Continue until a specific topic is identified.
- Once youth have focused on a topic have them brainstorm twenty questions they have about the topic.
- Use fist to five, sticker voting, or group dialogue to support youth in narrowing down their questions to the five most important.
- Depending on the topic and question you might support youth to hone in on one question or divide the group to focus on different aspects of the project.

Once there's consensus on a specific, problem, issue or topic youth will need support to fine tune their question. What specifically do they want to learn, identify, or answer?

Encourage youth to create an open-ended question, that can't be answered with yes or no. Have them brainstorm who, what, when, where, and why questions related to their topic of interest.

**Mapping** is another great way to support youth to think through specific questions they have about a given topic.

- Using a poster paper or white board draw a small target circle in the center where youth can focus the project purpose.
- Outside of that circle draw another circle where youth will brainstorm a list of ideas.
- Outside of that circle draw a larger circle where youth can refine or advance their ideas.

Example: Suppose that youth have decided to focus on a garden project but they can't decide on the project emphasis.

- The goal in this case is to help the group decide what kind of garden project they're most interested in.
- As the facilitator write garden project in the center and circle it. The center of the map always shows the project focus or purpose to help the group focus.
- Using a different color of marker ask the group open-ended questions designed to help youth further brainstorm areas of interest in relationship to this topic:

**What can we do in the garden?**

**What are different steps to gardening?**

- Ask group members to shout out their ideas as you write them on the board/poster around the outside of the bull's eye. You'll draw a circle around these ideas too so try not to let the responses stray too far around the page.
- Prepare more open-ended questions expanding on the ideas listed in the previous circle. Direct the question first to one of the inner ideas

**What can we learn about in the garden?**

**What can we research about soil preparation?**



## STEP 2: PLAN



The second stage of inquiry involves creating a plan to test the hypothesis. This often involves creating models to develop explanations. Participants should consider the influence of multiple variables when developing a plan to test hypothetical explanations. When planning an engineering project various models can test the strength and limitations of a design.

During this stage youth identify a list of all the steps necessary to conduct a project and then outline a chronological order.

### Post-it Planning

- After youth have decided on a question and hypothesis, support them to take turns identifying all the tasks or steps necessary to undertake this project.
- As a group place sticky notes on a piece of poster paper to create a timeline of the steps they'll need to take (brainstorm every step first then arrange chronologically).
- Make any additions or changes
- Document the final list

### Backwards Planning

- Have youth identify the final outcome of the project.
- Ask youth to start writing (or stating aloud) the steps to get this done, starting with the one right before the final product or outcome and continuing until they reach what would be the first step.
- Use questioning to help the group get “unstuck” or for conflict management if disagreements occur.
- When finished, with index cards or sticky notes, have youth agree on an order and rearrange the steps as needed –see Post-it planning above.
- Have youth share their plans with a partner to ensure the group understands the plan.

## STEP 3: OBSERVE

During the third stage of inquiry participants organize and interpret information, carry out a plan, analyze and interpret data, and look for patterns to derive meaning. At minimum this stage includes some form of measurement. In an engineering project this includes analysis of data collected in the application of models –examining the effectiveness, efficiency, and durability of designs.

Tips to supporting youth during this stage of inquiry: Planning & Observation Reflection Handouts

- Readymade handouts that allow for efficient and effective data collection can be helpful for youth.
- Consider creating an observation handout that allows youth space to write down their question, hypothesis, plan and observations.

## STEP 4: RECORD

After posing a question, enacting a plan, and making observations –during the fourth stage of inquiry youth utilize math and computational thinking to record and visually represent the relationships observed between the interactions of variables. This step can be as simple as rudimentary graphs or scales, or as complex as mathematical equations and statistical analysis.

Tips to supporting youth during this stage of inquiry:

- When using a handout like that described above consider incorporating helpful tools for recording information like graph paper, charts or other diagrams to help youth create relevant records. See sample Tallest Tower Activity.

## STEP 5: REFLECT



After observing and recording findings, during the reflection stage youth get to examine the strengths and weaknesses of the evidence and develop the best available explanation or theory for their results. During this stage youth develop logical arguments to defend their findings based on the data.

Tips to supporting youth during this stage of inquiry

### Learned So Far Reflection Activity

- In this reflection activity youth write down what they have learned so far about a given topic or skill.
- Give youth two different color index cards or scrap pieces of paper.
- On one card ask them to write one thing they've learned.
- On the other card ask them to write a question they still have.
- Collect the cards and redistribute them to the group and review aloud.

### Green, Yellow, Red Light Reflection

- During this activity youth collectively reflect on things they would like to continue doing, stop doing, and start doing.
- Post a piece of large paper or use a whiteboard and draw 3 columns.
- In column one; "green light," participants list the things they would like to start doing.
- In column two; "yellow light" participants list the things they would like to continue doing.
- In column three; "red light," participants list the things they would like to stop doing.
- Distribute sticky-notes and have participants write their reflections on 3 different notes for each column and then place their reflections in the appropriate column.
- This reflection activity can lead to a helpful group discussion about decisions and a plan based on ideas generated.

## STEP 6: PRESENT

In the final stage of inquiry youth communicate their ideas and the results of inquiry. Through clear and persuasive dialogue youth share orally, in writing (with documentation of the evidence: graphs, charts, tables etc.), and in conversation with peers. In this process youth derive meaning from the process itself and gain feedback to apply in the future.

Tips to supporting youth during this stage of inquiry

### Postcards

- Support youth to mentally review their project and create a postcard for someone who was not there.
- Ask youth to reflect on the activities and experiences of the project. It may be helpful to lead them through a brief mental walk-through of all the project activities.
- Ask youth to take a mental snapshot of some experience they had during the project that they would like to send as a postcard to someone who was not there.
- Have each participant draw and briefly describe their postcards to the rest of the group.

This activity can be used as a way to prepare youth for presentations as they reflect on:

- What stood out to them
- What do they want others to know
- What questions remain

### Practice Presentations

- After youth have shared their reflections support members of the group to identify elements of the project they're most interested in sharing with their peers.
- Support each youth to identify a role within the presentation and help them practice independently and as a group.

# APPLYING INQUIRY-BASED LEARNING

Name:

Date:

Materials:

- 20 sticks of spaghetti
- 1 yard of masking tape
- 1 yard of string
- 1 marshmallow



## TALLEST TOWER DESIGN ACTIVITY INITIAL INQUIRY

1. What variables might affect the height and stability of your tower?
2. What variable is your group testing? Independent Variable (IV) =
3. What do you think is going to happen when you change this variable?
4. Dependent Variable (DV) = Height (cm)
5. Controlled Variables =

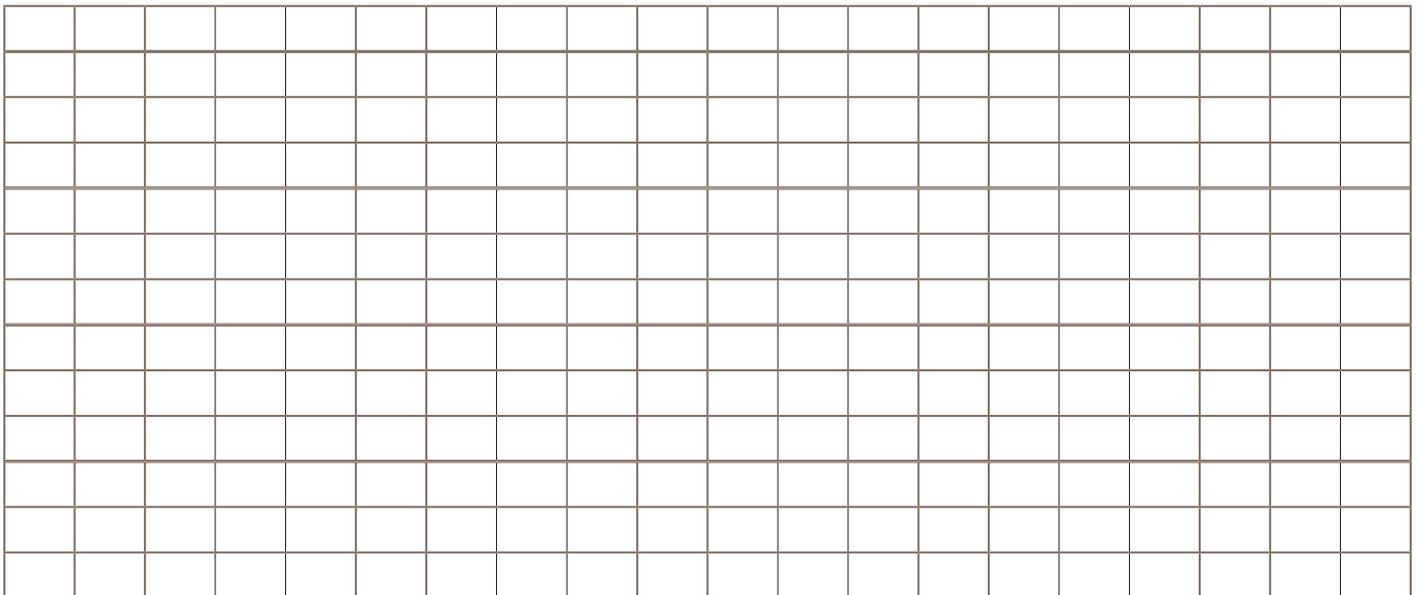
**PICTURE OF YOUR SET-UP**



**DATA TABLE FOR THE INQUIRY**

IV =	DV= Height (cm)

**GRAPH OF VARIABLES**



## DATA-INFORMED PLANNING

What variables have the greatest effect on tower height?

**SCENARIO:** Your group's task is to determine the combination of factors that will create the tallest tower.

**PROBLEM:** Identify the problem(s) your tower should address.

**CRITERIA:** What should your tower be able to do? Be specific.

**PRIORITIES:** Rank the criteria you identified above in order of importance. Be sure to explain your rankings.

**CONSTRAINTS:** What might limit your ability to build a tower? What might limit the effectiveness of the tower you build?

**SOLUTIONS:** Using what you learned from your first attempt sketch two different design ideas for your own tower. Be sure to label all the parts and include important measurements. Below are some questions to consider as you brainstorm ideas.

- What shape will you use?
- Where will you utilize the marshmallows?

SOLUTION 1	SOLUTION 2

**BUILD:** Choose one of your solutions to build first and then gather the materials you need and start building your solution. If you make changes as you build, be sure to update your original sketch as well (so you have an accurate record for future reference).

**TEST:** Test your design

Tower Design	Trial 1 Height (cm)	Trial 2 Height (cm)	Trial 3 Height (cm)	Average	Observations
1					
2					

**EVALUATION:** Evaluate the effectiveness of your solutions and explain the engineering behind your tower. Which of your designs was the most effective in terms of criteria, priorities and constraints?

How could you improve your tower? Think beyond the constraints that restricted you in this activity.