# Infusing Questions into the learning process:

1. ***Good questioning starts with good listening!***
2. ***What is the big idea that you want to convey in your subject area?***

Use the engineering design process as the base line for asking focused questions. Select the stage of the activity that you are at and relate it to the design process. Questions can then be focused around that activity.

## Composing powerful questions ( Art Costa www.habit-of-mind.net )

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| Good questions are invitational … "As you reflect on …" |
| Good questions express tentativeness … "What conclusions might you draw?" |
| Good questions invite multiple answers … "What are some of causes of global warming?" |
| Good questions encourage behavior … "As you discuss the topic…" |

Questions can be focused around a system perspective as follows: *From seeing just the parts to seeing the whole:*

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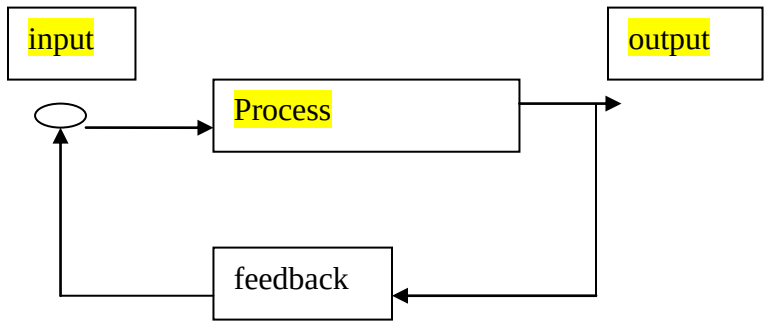
| ***Key words:***<br>**Input:** complete, count, define, describe, identify, list, match, observe, recite<br>**Process:** evaluate, judge, predict, infer, analyze, reason, explain, distinguish<br>**Output:** complete, imagine, predict, speculate,<br>**Feedback:** if/then, forecast, idealize, hypothesize, judge, learn, not quite right, |  |
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**Learning by engagement:**

Use the Infusion process to have the students learn the subject matter by asking questions that focus their thoughts on constructing an understanding of the content. This way they are building a connection to the content matter using their own experiences.

As an example; having the students learn the design process, we can ask them the question of what project they recently did that was like designing something new? They should pair with a fellow student and discuss. Then we can go around the room and using questions and their thoughts & what they did, we can build the design process.

1. The teacher introduces students to the thinking skill or process by demonstrating the importance of doing such thinking well.
2. The teacher uses explicit prompts to guide students through the skillful practice of the thinking as they learn concepts, facts, and skills in the content area.
3. the teacher asks reflective questions that help students distance themselves from what they are thinking and develop a plan for ding it skillfully.
4. The teachers reinforces the thinking strategies by providing additional opportunities for students to engage in the same kind of thinking independently.

Helping students think skillfully about causes in the primary grades can develop more sophisticated versions of this kind of thinking and make it second nature as they progress through upper elementary and secondary school. ***Robert Swartz .. University of Massachusetts***

What do we ask in order to find out what caused something to happen?

- What are some possible causes?
- What clues could you find?
- What real clues do you have?
- What do the clues show about the cause?

## What makes a question good?

- A good question makes you think.
- A good question is one that does not have an immediate answer, because it requires some thinking, feeling and application to previous knowledge.
- A good question opens doors. It demands more than a yes or no answer.

**Model Questions**: … we should be asking our students

Now, what questions do we need to ask of this situation. Whenever we encounter complex situations in our subjects, we pose certain crucial questions:

- What do we know?
- What are the givens?
- What do we need to find out?

The workplace and schools increasingly call for teams of people to work effectively to analyze and resolve issues. It is important not only to ask the right questions but also to ask them in a logical sequence. Without a **sequential questioning strategy**, groups often flounder, go off track, or overlook essential information

**Skillful decision Making**

- What makes a decision necessary?
- What are my options?
- What information is there about the consequences of each opinion?
- How important are the consequences?
- What option is the best in light of the consequences?

## Cues for Effective Questioning

Ways to Engage, Enhance, and Extend Student Thinking

• Ask open-ended questions Reword questions to eliminate yes/no responses.

• Develop questions carefully A few, "higher-order" questions are more productive than a lot of "lower-order" questions.

• Use precise language This enables students to associate specific language with thinking processes and cues student responses.

• Practice "wait-time" …***Provide 3-5 seconds of silence after a question and after a response.***

• Call on students randomly

• Acknowledge all responses … ***Passive (i.e., a nod) and active (i.e., paraphrasing) acceptance demonstrates that a response is valued.***

• Withhold criticism … ***Respond to student answers non-judgmentally.***

• Paraphrase more often than praise … ***This communicates that you've heard and that you understand. Doesn't encourage conformity.***

• Use praise sparingly … ***When used, give criteria.***

• Rephrase rather than repeat. … ***When students don't understand, rephrase own question. Ask students to rephrase response when clarification is needed.***

• Ask students to "think about thinking" …***Provide opportunities for reflection and for "thinking aloud".***

• Plan for productive interaction …***"Think-pair-share" and small group cooperative learning encourage thoughtful student-student interaction.***

• Encourage question-asking *Provide opportunities for students to develop own questions.*

• Thinking skills improve with practice … ***Remember, thinking processes are developmental, so hang in there!***

**The role of the teacher** during the questioning process is to help the student see the shortcomings in his thinking. It is to open his eyes to alternatives, erroneous assumptions, and eventualities he has not considered. It is, most of all, to challenge the student to develop a deeper understanding of his own knowledge. In order for the student to gain such an understanding, he/she must experience expectation failure. A teacher should aim to provide the questions that will lead the student into the understanding cycle.

Asking questions at the right time is a critical role of a good teacher. This statement summarizes what we call the sounding board model of teaching. When teachers adopt the role of sounding boards, they should allow students to speculate, wonder, imagine, and be creative.

**Caution:**

However, it is rather difficult for teachers to be effective sounding boards. Teachers like to tell the correct answers to students. Teachers do not have the time to sit with students, and encourage them to pursue the implications of what they are thinking. Additionally, teachers often fall into the trap of thinking they are asking questions when they are really only delivering answers using the syntactic guise of a question.

## Creating questions: *Follow the engineering design process*

Massachusetts Curriculum Frameworks, Science and Technology/Engineering October, 2006

| Engineer design process* / Thinking skills | Questions |
|---|---|
| **Identify the need or problem**<br>• Compare / Contrast<br>• Decision process<br>• Drawing Conclusions<br>• Analysis | What are we looking to do?<br>How would we judge success?<br>What do we have to design to solve this issue?<br>What is the purpose of this design?<br>What would the goals and objectives be?<br>Can we break the problem/design into parts? |
| **Research the need or problem**<br>• Classification<br>• Sequencing<br>• Critical Thinking / creative Thinking<br>• Compare / Contrast<br>• Root Cause<br>• Synthesis | What do we know?<br>Any similar circumstance from the past that we can build on?<br>Who are the stakeholders and their needs?<br>What outside factors will affect this problem/need/design?<br>What questions do we need to ask?<br>How do we know the facts are true? What evidence do we have? |
| **Develop possible solution (s)**<br>• Brainstorm<br>• Critical Thinking<br>• Root Cause<br>• Evaluation | What concepts, definitions, principles do we need to utilize?<br>Have we taking all assumptions, thoughts into consideration?<br>What facts, data, observations and experiences are available?<br>Can we combine elements into a novel designs? |
| **Select the best possible solution(s)**<br>• Compare / Contract<br>• Classification<br>• Drawing Conclusions<br>• Problem Solving | What interpretation and inferences can we make?<br>How can we select the best solutions?<br>How would we test the solution so we can provide information about the design? |
| **Construct a prototype**<br>• Classification<br>• Drawing Conclusions<br>• Problem Solving | Do we need to build it or can we simulate it?<br>What materials, skills & tools do we need?<br>What plans are necessary to document the design?<br>Can we break of the construction into modules? |
| **Test and evaluate the solution(s)**<br>• Compare / Contract<br>• Classification<br>• Drawing Conclusions<br>• Problem Solving | What test plan do we need to evaluate the design?<br>What tools do we need to test it? |
| **Communicate the solution(s)**<br>• Compare / Contract<br>• Classification<br>• Drawing Conclusions | Who is our audience and what are they expecting to hear?<br>Have we testing all our conclusions and facts?<br>Have we presented it in a way people can understand it? |
| **Redesign**<br>• Brainstorm<br>• Compare / Contract<br>• Classification<br>• Drawing Conclusions | What have we learned & what would I do differently?<br>What was our thought process? |