# Action-Consequence-Reflection

- Students perform a mathematical action
- Observe a mathematical consequence

  *What did you observe?*

  *What changes?*

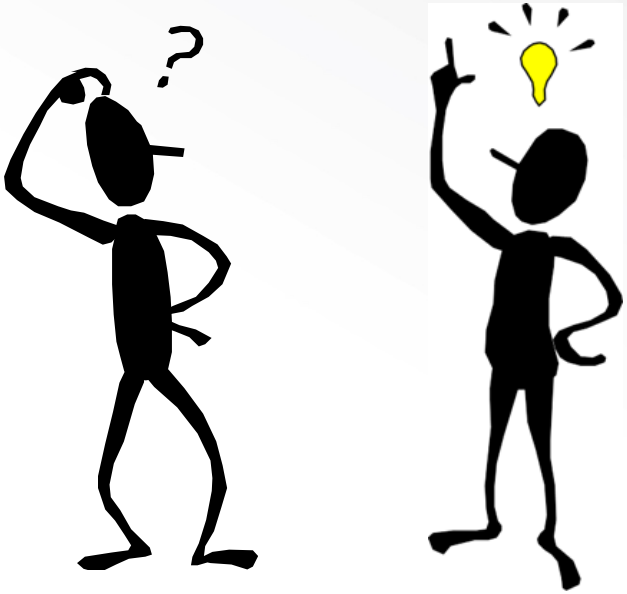
  *What stays the same?*
- Reflect on result and reason about underlying mathematical concepts

Standard Disclosure– No Restrictions

Campe, 2011; Dick & Hollebrands, 2011

# Ask Good Questions!

- What will happen if…?
- What must I change to make … happen?
- How is … affected by …?
- What changes, what stays the same?
- When will … be true?
- Why does this happen?
- Question Shells / “Mazes”
- Reverse order of representations



Standard Disclosure– No Restrictions

Dick & Hollebrands, 2011; Wiliam & Leahy, 2015; Rider, 2007

# Use Questions To Promote Thinking

1. Model intellectual engagement with ideas.
   - I was wondering if… ?
   - Would it always work?
2. Promote & nurture ongoing inquiry
   - Genuine questions
   - Generative questions
   - Answers not predetermined
3. Push students forward to construct understanding & make mathematical connections.
   - How do you know that?
4. Help students clarify thinking to themselves & others.

Standard Disclosure– No Restrictions

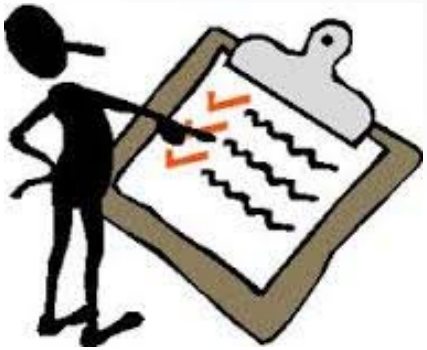
Ritchart, Church & Morrison, 2011; Smith & Stein, 2011

# Hold Students Accountable

- Restate a student's reasoning (by teacher or another student)
- Ask students to compare/contrast their reasoning with someone else's reasoning

  *Do you agree? Can you convince me?*
- Prompt students for further participation

  *Does anyone want to add to that?*
- Use wait time; require all students to record their thinking



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# Some Resources

Focus in High School Mathematics: Technology to Support Reasoning and Sense Making. Thomas P. Dick & Karen F. Hollebrands, 2011.

Five Practices for Orchestrating Productive Mathematics Discussions. Margaret S. Smith & Mary Kay Stein, 2011.

Making Thinking Visible: How To Promote Engagement, Understanding, and Independence for All Learners. Ron Ritchhart, Mark Church, Karin Morrison, 2011.

Embedding Formative Assessment: Practical Techniques for K-12 Classrooms. Dylan Wiliam & Siobhan Leahy, 2015.

Make It Stick: The Science of Successful Learning. Peter C. Brown, Henry L. Roediger & Mark A. McDaniel, 2014.

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