

Vertically Integrated Projects (VIP)

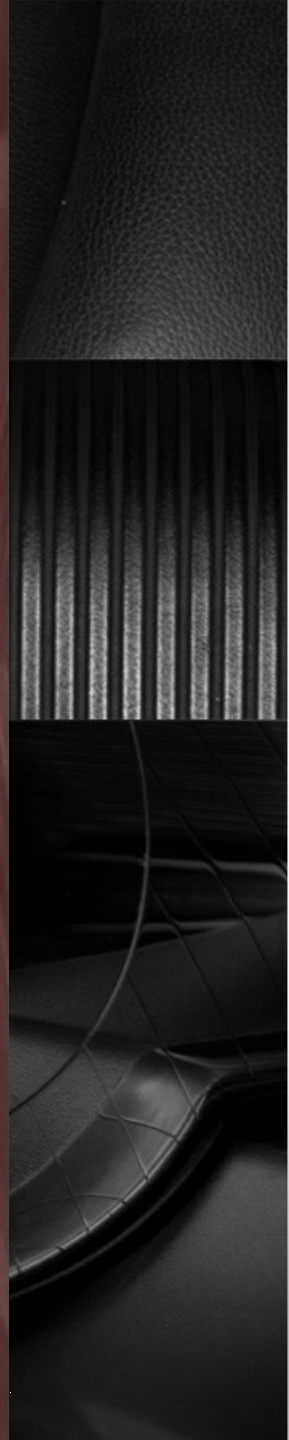
Faculty Mentoring Info

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Suggestions for 1st Week Lab Meeting

- Introductions (include students)
- Icebreaker and/or team building activity
- Introduction to projects
- Discuss expectations:
 - Support for VIP Expectations
 - Specific expectations for individual and team project documentation
- Assign students to teams
 - Use “Info Sheet” - Have students provide basic info and preferences, then “assign” based on preferences and project needs
- Other assignments:
 - Papers
 - Accessing/posting to documentation site
 - Exercises



Suggestions (many from Yung-Hsiang Lu)

- It is important explaining expectations and requirements at the beginning.
 - Give students feedback often so that they are not surprised when they see their grades. You may take advantage of peer evaluations.
 - Communicate goals: whether it is create new knowledge (“real research”) and publish papers or focus on learning and give students opportunities for development.
 - Believe that undergraduate students can do research and publish papers, if they have been given the proper training and guidance.
 - Start with the end in mind: Start with what you expect by the end of the semester and work backwards to identify appropriate milestones



Suggestion, continued

- Continuity is one of the most serious challenges in VIP teams.
 - A research team with undergraduate students has to consider that many students come and leave every semester.
 - There are at least three solutions to manage such disruptions:
 - (1) make the problem small enough so that some progress can be made each semester;
 - (2) encourage some students to stay for multiple semesters;
 - (3) assign a graduate student to hand over the progress from the previous semester to new members.



Suggestion, continued

Making connections:

- If you have fund to support students, you may consider sending the students to major conferences in your areas. Attending a conference can really open students' eyes and change their careers.
- If you have collaborators outside Purdue, invite your VIP students to join the meetings with the collaborators (maybe video calls). Such experience may broaden students' views about their projects and help them understand "bigger pictures".

Learn from other advisors:

- Some VIP teams have been running for years (a few teams more than 10 years). Exchanging experience among advisers is encouraged.



Suggestion, continued

Entrepreneurship/Commercialization:

- VIP can be an excellent way to explore commercialization of research discoveries.
- VIP students can participate in programs organized by Purdue Foundry (such as Firestarter and Customer Validation) to understand the process.
- VIP students may interview potential customers and write business plans. Advisers are encouraged to talk to the Office of Technology Commercialization and understand the process.



Managing Expectations

- Graduate vs. Undergraduate
- Well-being
 - What you do makes a difference: The mentoring that you are doing as part of VIP has the potential to impact student persistence. It is important to consider how to make it inclusive to make sure every student can reach their full potential.
 - Growth Mindset to feedback
 - More interactive nature of VIP – can impact well-being

Factors Crucial to Persistence in STEM

Capacity

Both the capacity to learn and demonstrate competence in STEM as well as self-efficacy, or confidence in one's ability to achieve, have been linked to persistence in STEM.

Interest

“When students are interested in STEM topics, they are more likely to persist.”

Belongingness

“When students feel that their identities are valued, or they find connections to others who share similar interests, they are more likely to feel a sense of belongingness and want to solidify their commitments to the field.”

Capacity

Students need to feel like they have the resources to succeed in engineering.

Underrepresented students often **underestimate** their own abilities or some times are **not given equal opportunities** to develop capacity (assigned less technical or difficult tasks within lab pairs and project teams, or have group or lab partners take over, re-write code, etc.)

It is vital that faculty express a **growth mindset**, the belief that ability is not fixed but can improve, to encourage students to keep trying.

“Research has shown that when students have a growth mindset, they are more likely to challenge themselves, believe that they can achieve more, and become stronger, more resilient and creative problem solvers. Educators can have an enormous impact on the mindset of their students.”

Quick Tips to Infuse a Growth Mindset in Your Team

- Assign work that allows for **growth/improvement** (e.g., multiple drafts of papers, opportunities to respond to feedback).¹
- Encourage a growth mindset after potentially challenging assignments/exams.
- **Use practice and feedback**, avoid having a gap between what is done in class and what is expected on assignments/exams. ¹
- Reinforce the notion that there is no such thing as a Math/X/Y person -- everyone can do Math/X/Y with proper training. ¹
- Give feedback that highlights the values of planning and trying different learning strategies

Effective Feedback

- Tendency to think that effective feedback is about the quality of the information — telling the learner to do *this* and not *that*.
- [Study](#) found that 7th grade students receiving a certain kind feedback chose to revise their paper far more often than students who did not (40% increase for white students and 320% increase for black students) and improved their performance significantly.
- Phrase: ***I'm giving you these comments because I have very high expectations and I know that you can reach them.***



Effective Feedback

The phrase:

I'm giving you these comments because I have very high expectations and I know that you can reach them.

....contains several distinct signals:

- 1) You are part of this group.
- 2) This group is special; we have higher standards here.
- 3) I believe you can reach those standards.

<http://danielcoyle.com/2013/12/13/the-simple-phrase-that-increases-effort-40/>

Effective Feedback

Lessons for educators:

- “First, **connect**: like John Wooden said, they can’t care how much you know until they know how much you care.”
- “Highlight the **group**: seek ways (traditions, mantras, fun little rituals) to show what it means to belong in your crew.”
- “Don’t soft-pedal high standards. Don’t pretend that it’s easy — do the opposite. Emphasize the toughness of the task, and your belief that they have what it takes.”



Strategies to Build Capacity

Provide consistent feedback so that students can recognize their progress: Early feedback on documentation, prompt mid-semester feedback. Utilize peer feedback (CATME).

Provide opportunities for students to build confidence: Break up complex problems and projects into distinct steps; Expose students to tools used in real research and industry

Destigmatize students needing help: Preemptively provide extra resources for historically tricky material

Embrace questions in class: Respond with “That’s a good question” to encourage asking more

Strategies to Build Belongingness

Promote diversity in student leadership roles: Encourage underrepresented undergraduate students to apply for extra-curricular leadership positions

Include diverse students in class participation: Arrange seating in clusters so that underrepresented students are not isolated; Ask for participation from students who haven't spoken so a diverse group is heard

Use diverse engineers as examples: Showcase the accomplishments of diverse engineers when discussing real applications; Represent diversity in practice problems that involve people

Show interest in individual students: Learn and address students by name in class; Ask students how they're doing when you see them outside of class

Share examples of journeys and challenges faced: Often underrepresented students feel they are alone in their struggles.