Supporting professional science identity development is an important component of research internships

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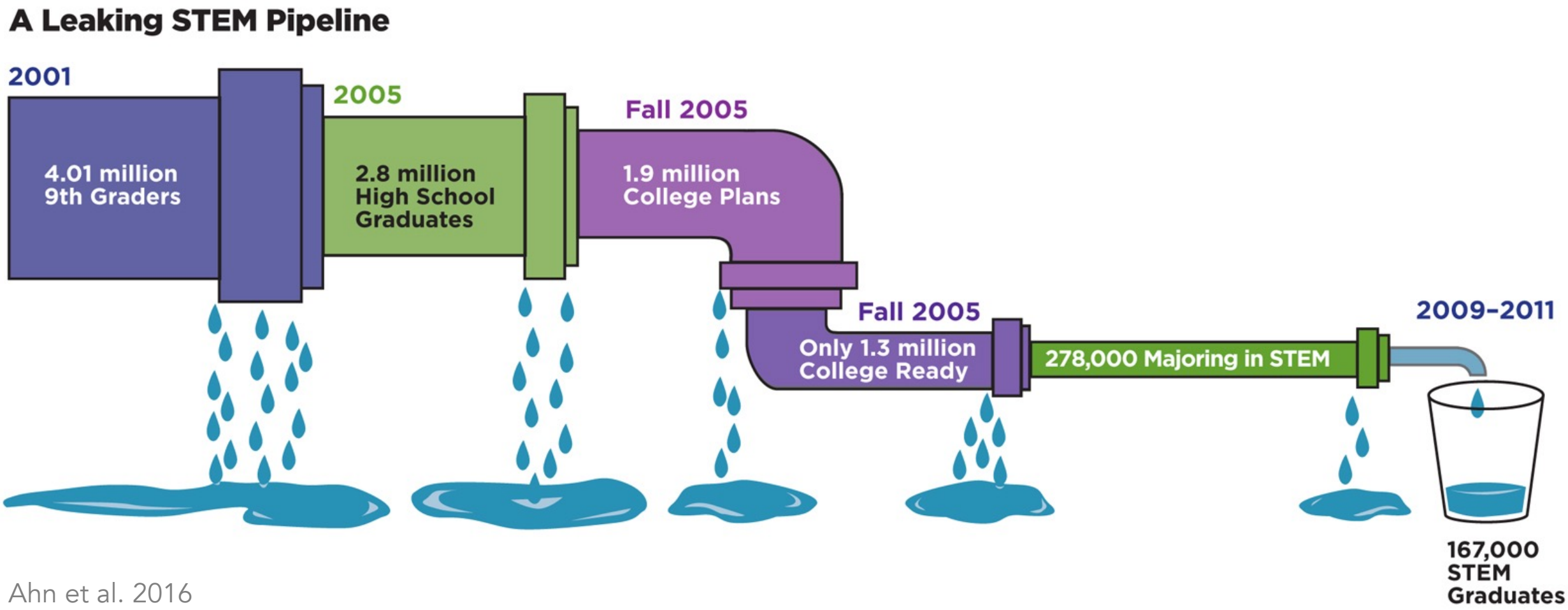
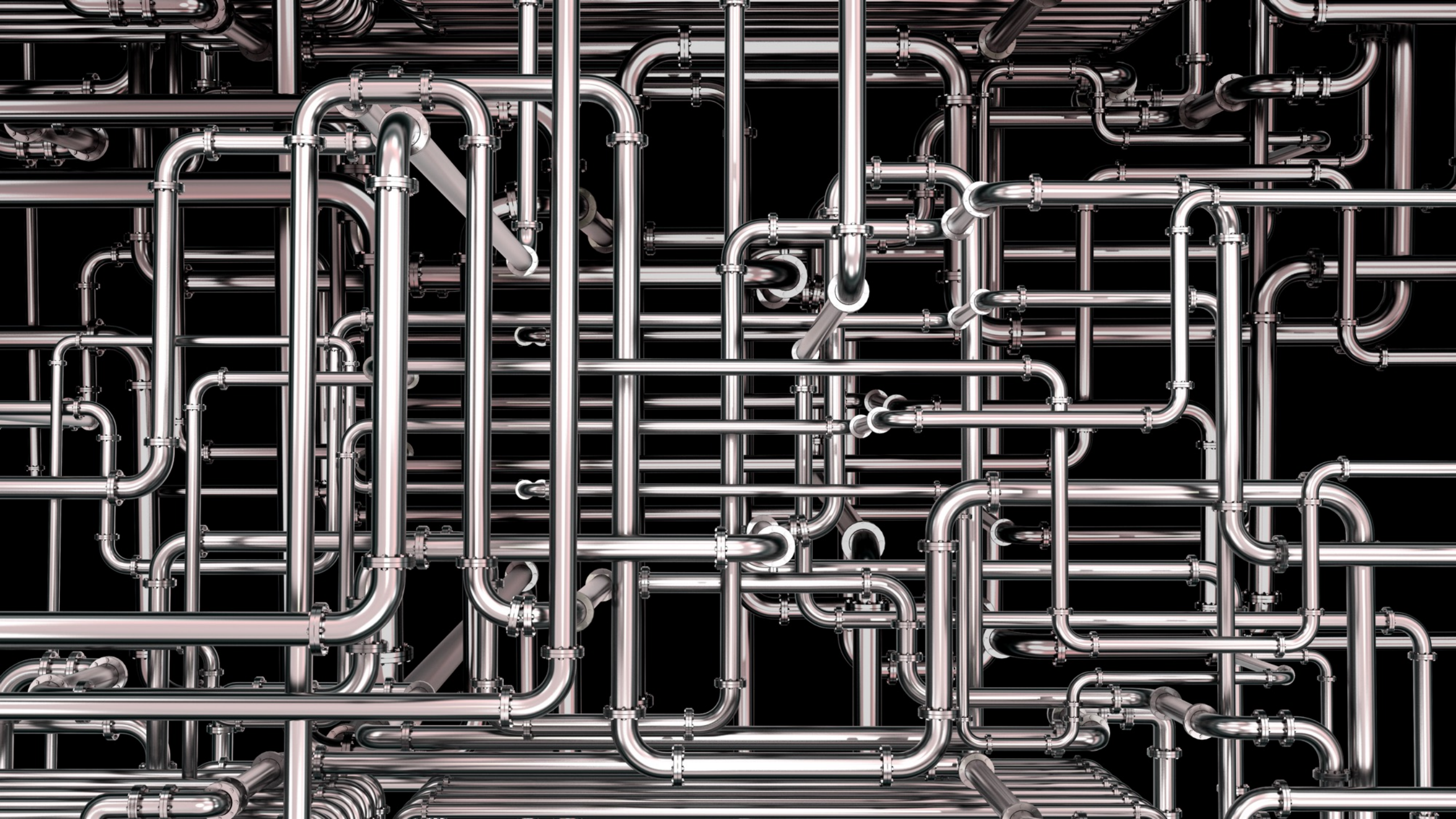
STEMS^2 Symposium
2020



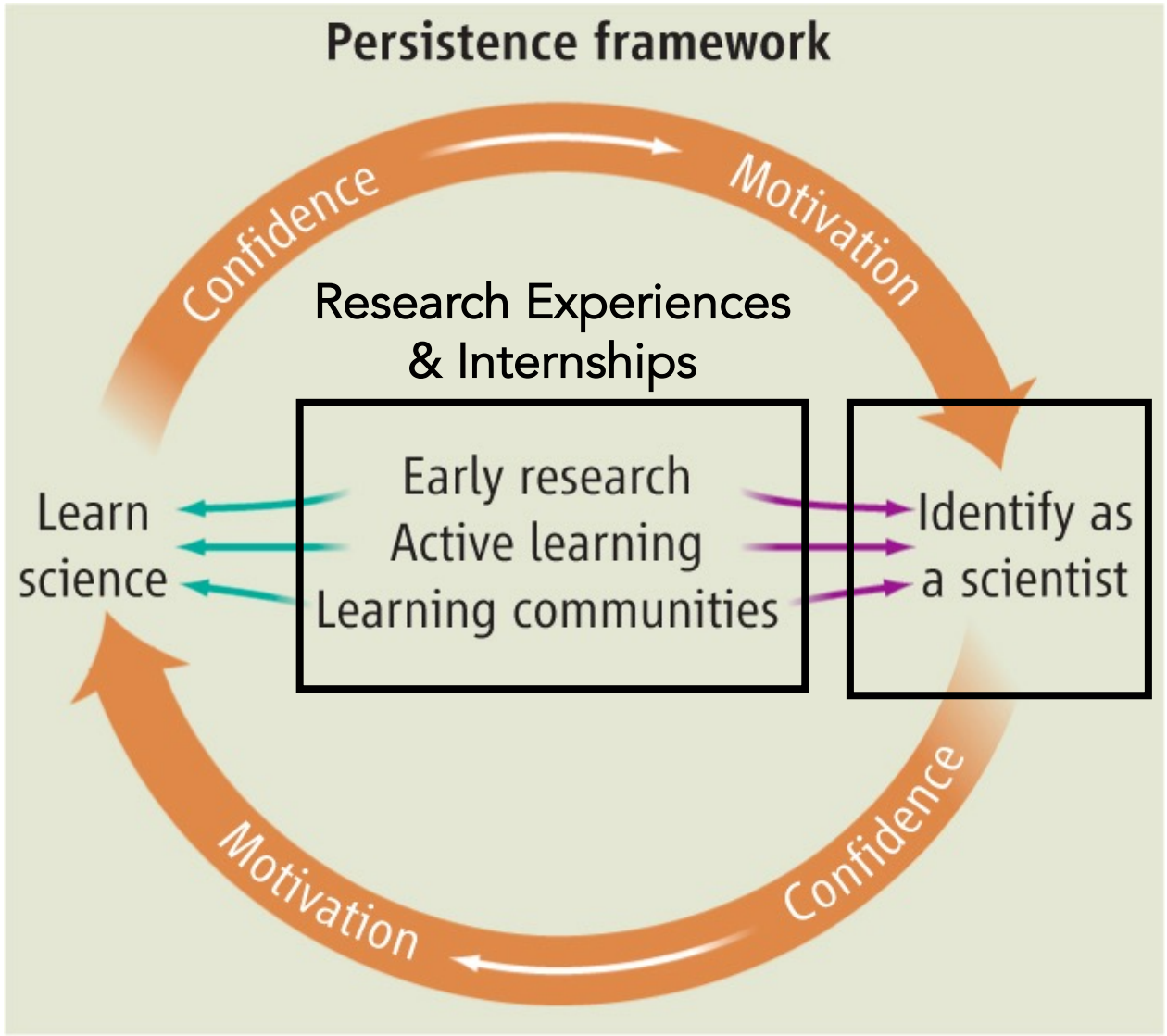
Ahn et al. 2016

Underrepresented groups in STEM: Gender, race, ethnicity inequities

Chemers et al. 2011, Carlone & Johnson 2007, Robinson 2018, 2019



Supporting student persistence in science



Graham et al. 2013

Expectancy-value: *Can I be successful in science?*

Personal views: *Am I a scientist?*

Interest: *Am I interested in science?*

Views of others: *Do others view me as a scientist?*

Science Identity

Mismatches: *Is science what I expected it to be?*

Values: *Is science important to me?*

Motivation: *What kind of scientist am I?*

Social environment: *Do I "fit in" in science?*

Carlone & Johnson 2007, Robinson et al. 2018, Vincent-Ruz & Schun 2018

Expectancy-value: *Can I be successful in science?*

Personal views: *Am I a scientist?*

Interest: *Am I interested in science?*

Science Identity

Persistence

Views of others: *Do others view me as a scientist?*

Mismatches: *Is science what I expected it to be?*

Values: *Is science important to me?*

Motivation: *What kind of scientist am I?*

Social environment: *Do I "fit in" in science?*

Carlone & Johnson 2007, Robinson et al. 2018, Vincent-Ruz & Schun 2018

STEM Degrees in Hawai'i

Fall 2019: 5,131 students enrolled in STEM

798 STEM degrees awarded in 2018-2019

University of Hawai‘i Community Colleges

Fall 2019: 52% of undergraduate students & 30% of UH System STEM majors

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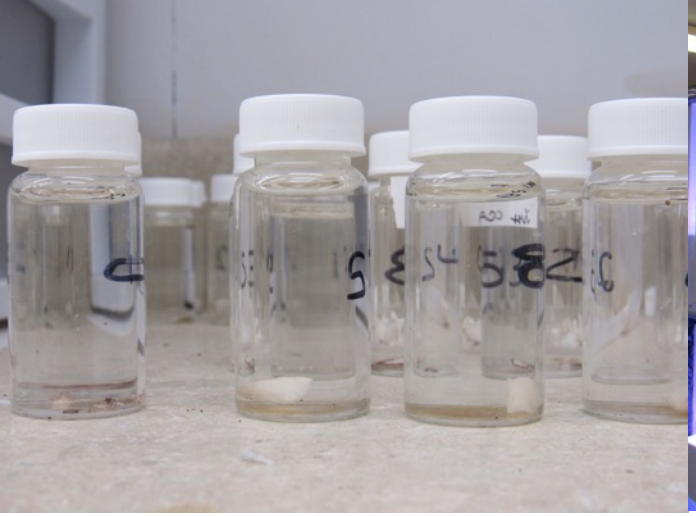
How does early participation in research influence community college student science identities and career trajectories?

Impacts of experience, science identity, trajectories

Participants: 5 community college women

1st semester: Orientation	2nd semester: Research	1st semester: Follow-Up	2nd semester: Follow-Up	3rd semester: Follow-Up

Study approved by UH Mānoa IRB




Orientation to the laboratory

Independent research projects in coral biology

1st semester: Orientation	2nd semester: Research	1st semester: Follow-Up	2nd semester: Follow-Up	3rd semester: Follow-Up

Study approved by UH Mānoa IRB

Data Collection

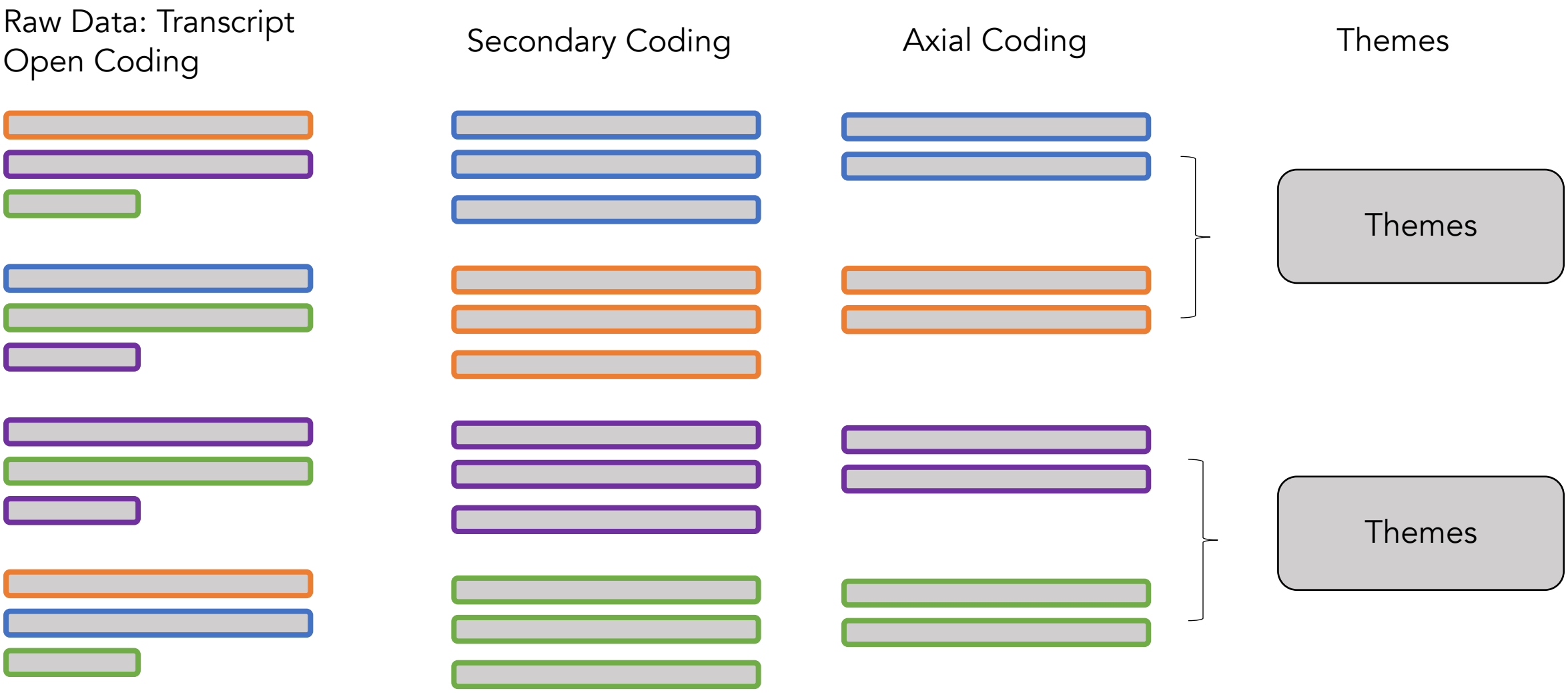
Interviews	Semi-structured interviews	Science identities, self - efficacy, trajectories, impacts
Surveys	Self-reporting surveys	Science identities, self - efficacy, trajectories, impacts
Significant Circles	Drawing/representation of important people, activities, etc.	Science identities, interests
Identity Artifacts	Item to represent science identity	Science identities
Observations	Observations of students	Impacts of participation, science understanding

Qualitative research: Thematic analysis

Raw Data: Transcript
Open Coding

Braun & Clark 2006

Qualitative research: Thematic analysis



Braun & Clark 2006

What did we learn?

Students reported:

- Gains in science understanding
- Development of interests and recognition of limitations
- Uncertainties in their professional science identity

Science identity

Sense of self as a science person

Professional science identity

Sense of self as a professional in science and identification with a career goal

Students reported increases in science understanding

Coral Biology

"I gained more knowledge about corals."

"I loved learning about corals."

Scientific Practices

"Showed me how real research is done."

"I learned science is never linear."

Involve early science students in internships

Students developed understanding of interests & limitations

Understanding of their own interests

"Helped me realize my passionate interests."

"I realized I could not see myself in a lab."

"This confirmed what I wanted to do in science."

Limitations in data analysis & statistics

"I am good at everything in research except the math."

"I need to work on how to understand data sheets."

"I had a hard time with data analysis and making graphs."

"Numbers and math are not my strong suit."

Provide individualized experiences & support for limitations

Students identified as science people …

Views of science identity

1. Curiosity & desire to learn
2. Benchmarks & qualifications

"Yes, I am a scientist. Anyone who wants to learn more about the environment or world around them is a scientist."

"I'm not at the PhD level, but I think I fit along the lines of a scientist because I'm curious and I want to know about life. So, I think that's good enough."

"Junior scientist… I feel like [scientists] have at least an Associate's or some experience like a real job."

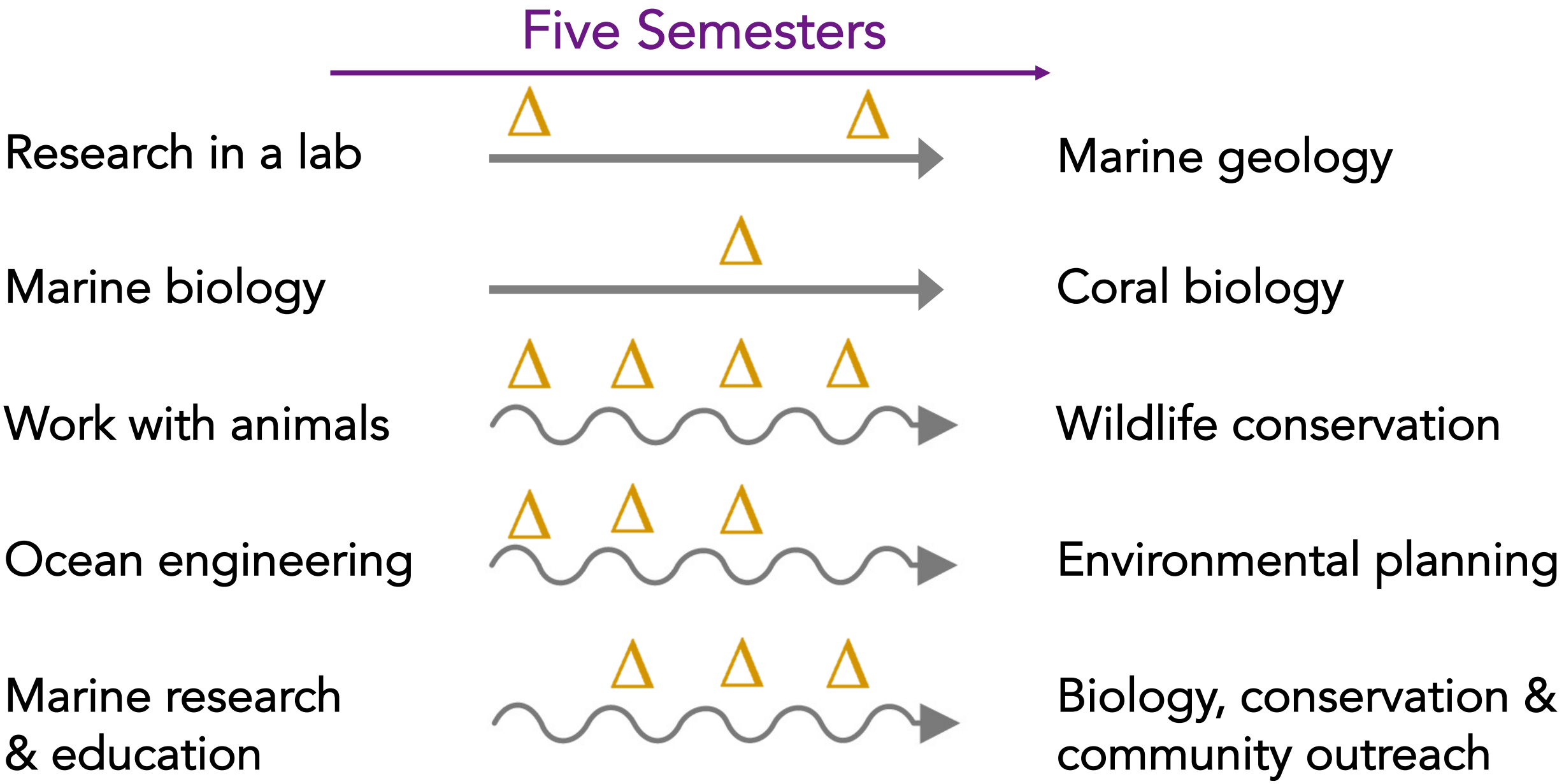
… but were unsure of their professional identity

Professional Identity

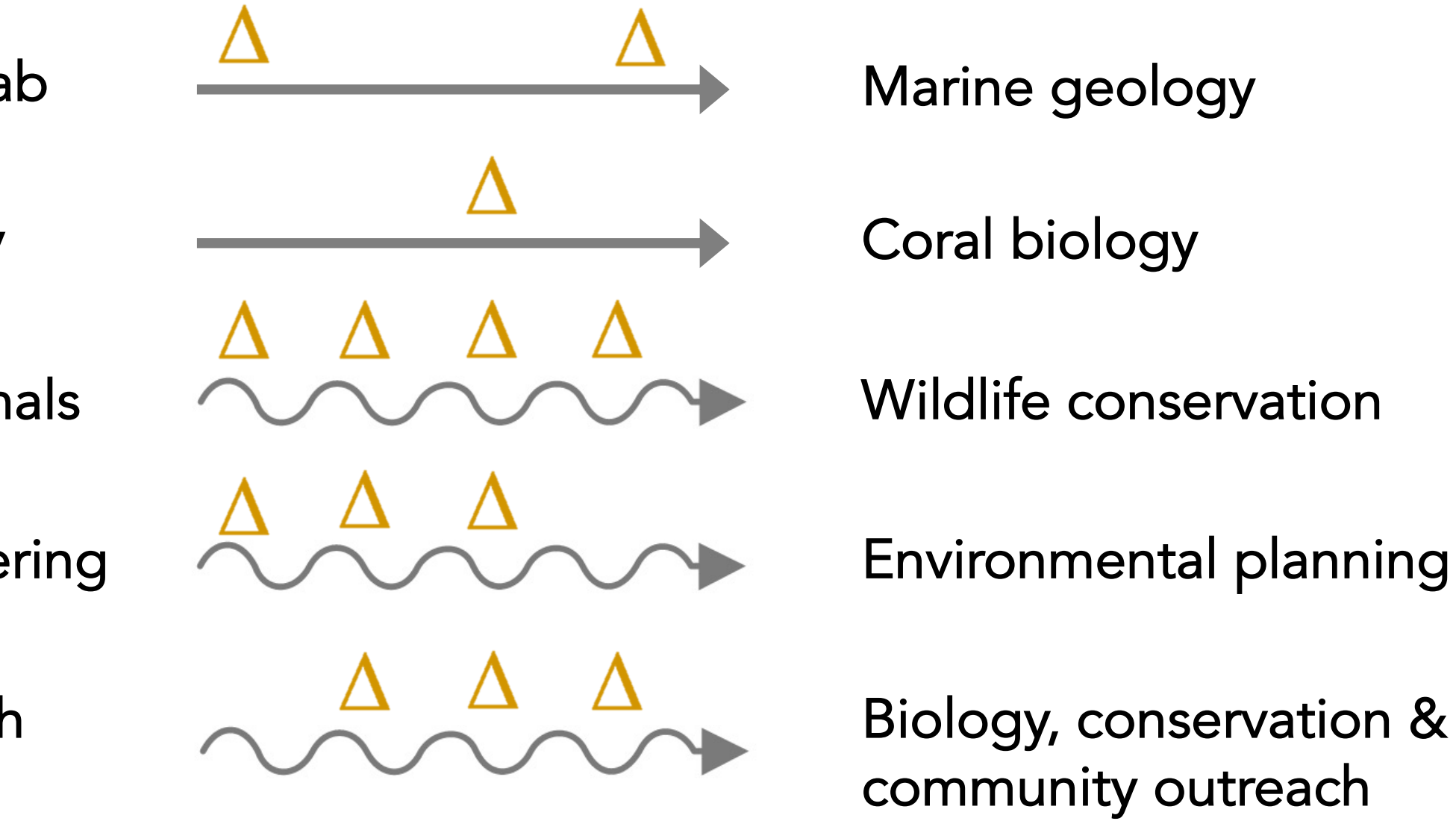
Student sense of self as a professional in science and identification with a career that fits their motivations, interests, and goals in science.

"I don't really know what I would do as a job."

"I don't know if there is a job description out there for me."


Five Semesters
Research in a lab
Marine geology
Marine biology
Coral biology
Work with animals
Wildlife conservation
Ocean engineering
Environmental planning
Marine research & education
Biology, conservation & community outreach

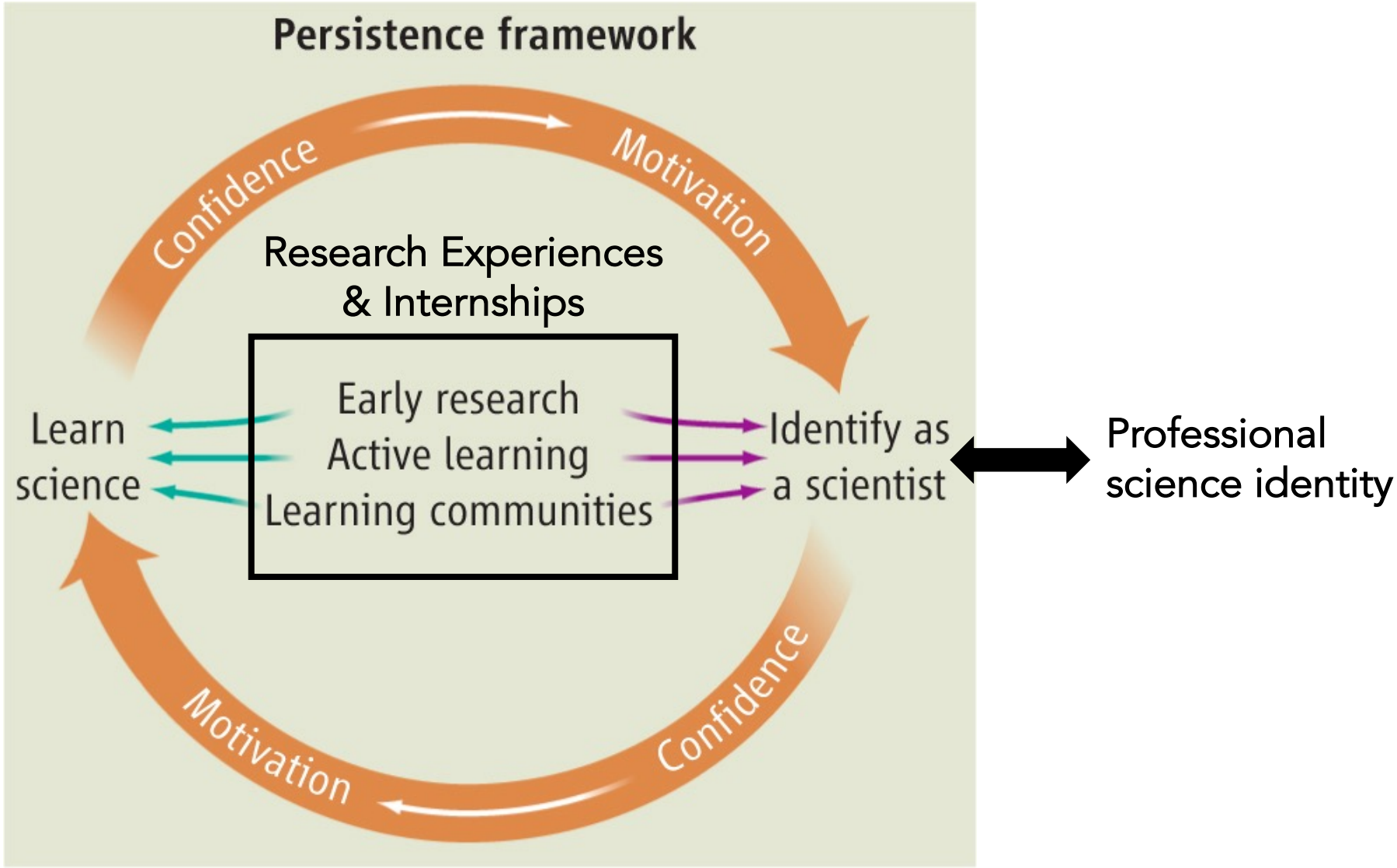
Five Semesters



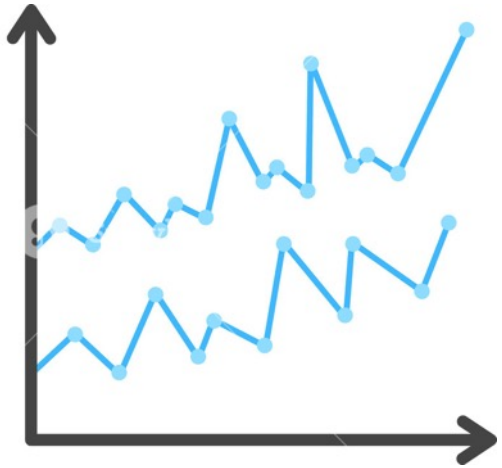
Research in a lab	Marine geology
Marine biology	Coral biology
Work with animals	Wildlife conservation
Ocean engineering	Environmental planning
Marine research & education	Biology, conservation & community outreach

Incorporate student identity discussions and career coaching

Professional identity should be considered an integral component of both science identity and student persistence



Considerations for internships



Mahalo!

Mahalo to the students who participated in this study!

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Study Support

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Hawaii Institute of Marine Biology

STEMS²

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Table 1. Data collection.

Data Type	Description	Timepoints Collected
Interviews	Semi-structured interview with discussion of science identities, science self-efficacy, degree/career trajectories and impacts of internship participation.	Pre- & post-research
Surveys	Self-reporting surveys with questions of science identities, science self-efficacy, degree/career trajectories and impacts of internship participation.	Pre- & post-internship 1, 2, 3 semesters post-internship
Significant Circles	Single-page drawing or representation of the objects, activities, people, institutions, and hobbies that were most important to each student.	Pre-research 3 semesters post-internship
Identity Artifacts	Physical items chosen by each student representing who they are as a scientist.	Pre-research 3 semesters post-internship
Observations	Direct observations of student participation and activities in the internship.	During internship

Pre-internship indicates data was collected prior to student engagement in the laboratory environment during the 1st semester of research experience. Pre-research indicates data was collected prior to students conducting research projects during the 2nd semester of research experience.

Table 2. Student reported intended career trajectories collected through surveys and interviews.

Student	**Intended Career Trajectory**		
	Pre-Internship	*One-Year Post-Internship*	*Variability*
Allison	Ocean engineering	Environmental planning	Shift
Kate	Research in a lab (geology)	Marine researcher (marine geology)	Focusing
Julie	Work with animals and integrate art	Wildlife conservation	Shift & Focusing
Hannah	Marine research & education	Biologist working in conservation and community education	Shift & Focusing
Nancy	Research (marine biology)	Research in coral biology	Focusing

Table 3. Sample quotes exemplifying salient science identities of students, but uncertainty in their professional identities.

Student	Responses		Outcomes
	Science Identity	*Professional Identity*	
Allison	"I am an aspiring scientist… the basic foundation is still not there." *How confident are you in your ability to do science?* "I think I need help. Like getting it going and thinking of the little bits and pieces. Once I get in the rhythm, I feel pretty good about it."	"Global Environmental Science is relatively new. The future part of the degree is not there yet. Even when you ask people with the degree, they aren't really using their degree. So maybe I'll do environment planning, but I don't know if I could do the politics. I don't know. I'm looking more into it." "Growing up I didn't really have any people that were professional in science, so I don't really know what I would do as a job."	Allison referred to herself as an aspiring scientist and although she enjoyed her degree program, she did not have a good idea of her career options after graduation.
Kate	"Yes, I am a scientist. Anyone who wants to learn more about the environment or world around them is a scientist." "I've called myself a scientist since I was four." *How confident are you in your ability to do science?* "I suppose it depends on the research project. [In corals] a 9/10. [I need more] foundation knowledge [to be a 10].	"That is a difficult question because as I age [it changes]. If I could do whatever I wanted [regardless of] money, I would set up my lab and do research on something that I am passionate about." "I wanted to do geology or geophysics but wasn't sure what part I wanted."	Kate was confident in calling herself a scientist and had high confidence in her ability to do research. She expressed difficulty in identifying a tangible future career due to financial and other requirements in her life.

Table 3 (cont.). Sample quotes exemplifying salient science identities of students, but uncertainty in their professional identities.

Student	Responses		Outcomes
	Science Identity	*Professional Identity*	
Julie	"I think anybody who is curious about the world is a scientist… Yeah [I would call myself a scientist]." "Junior scientist… I feel like [scientists] have at least an Associate's or some experience like a real job." *How confident are you in your ability to do science?* "I feel like maybe a 6-6.5/10, I feel like writing papers and telling people, I would still need work on those sections. I could do the actual data collecting part but conveying it to the world is where I need more practice."	"I love art and I love animals. So, if I could match the two by taking care of giant animals and doing something artistic. If I could do some photography or some type of way to incorporate those two together it would be really cool." "I'm going to try and keep going to school. I definitely want to do better than an Associate's. I feel like everyone wants at least a bachelor's to work at a zoo or something like that."	Julie called herself a junior scientist due to her degree status, but also referred to herself as a scientist because she is curios. She wanted to integrate animals and art in her future career but was unsure what a specific job would look like.
Hannah	"I like to say I'm an aspiring scientist. Because I have some experience, but a minimal amount and I know that every day is a learning experience." "I would like to [call myself a scientist], I just don't know if that's correct. I'm not at the PhD level, but I think I fit along the lines of a scientist because I'm curious and I want to know about life. So, I think that's good enough." *How confident are you in your ability to do science?* "I want to say 8/10. It comes down to data analysis and presentation."	"I don't know if there is a job description out there already for me. I don't know what the options are, so I think it's just about learning what is possible… It's on my mind all the time." "I think I want to get into education but I'm not exactly sure where. But I definitely want education with the ocean. I want to be able to somehow do research but not the PhD route. I'm still trying to figure that out. I don't know."	Hannah called herself an aspiring scientist due to a lack of experience, but also expressed more confidence in her science identity due to her desire to learn about life. She was unsure whether there was a job description available that fits her goals and motivations.

Table 3 (cont.). Sample quotes exemplifying salient science identities of students, but uncertainty in their professional identities.

Student	**Responses**		**Outcomes**
	Science Identity	*Professional Identity*	
Nancy	"I'm learning to be a scientist… I'm learning the ways to become a scientist by doing research. I'm practicing to be a scientist" "A little hesitant, but I do [call myself a scientist]. I would want more practice to feel more confident about that answer." *How confident are you in your ability to do science?* "A 9/10. I like to give myself credit, but not too much credit because I don't know. I'm kind of doubtful sometimes in projects in the past."	"A marine biologist. [Research] is the ultimate goals for me. That's what I've always wanted to do." "I want to do scientific research. I love all types of marine research, so anything like that, or through NOAA, would be idea for me that I would love to do." "I want to broaden my outlets; I would say I want to have an emphasis on coral biology. I've been thinking about that a lot."	Nancy was confident in her ability to do research and expressed hesitancy in calling herself a scientist, referring to herself as learning to be a scientist. She was confident in knowing she wants to pursue marine biology research as a career in the future.