THE UPPER DIVISION

Co-req

Physics 411
Electronics

Physics 335
Theoretical
Mechanics

Physics 422
Static Fields

Physics 425
Quantum
Fundamentals

Physics 365

Co-req

Co-req

Physics 424
Oscillations and
Waves

Physics 426
Central Forces

Physics 427
Periodic
Systems

Physics 366

Physics 464
Computational
Physics

or

Physics 415
Computer
Interfacing

Physics 431
Electromagnetism

Physics 481
Optics

Physics 451
Quantum
Mechanics

Physics 403
Thesis

Physics 403
Thesis
or PH 317

Physics 423
Eneryg and
Entropy

Physics 367

Physics 441
Statistical
Mechanics

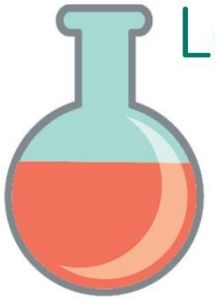
Physics 403
Thesis

Year 4

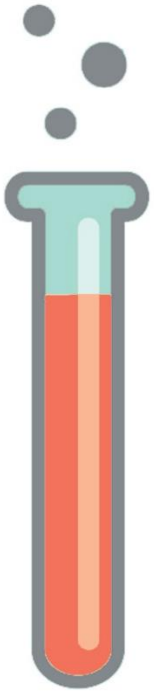
https://www.womeninscienceday.org/

INTERNATIONAL DAY OF WOMEN AND GIRLS IN SCIENCE 11th FEB

Women make up less than **ONE QUARTER** of all people employed in the STEM industries.



Less than **30%** of the world's researchers are female.

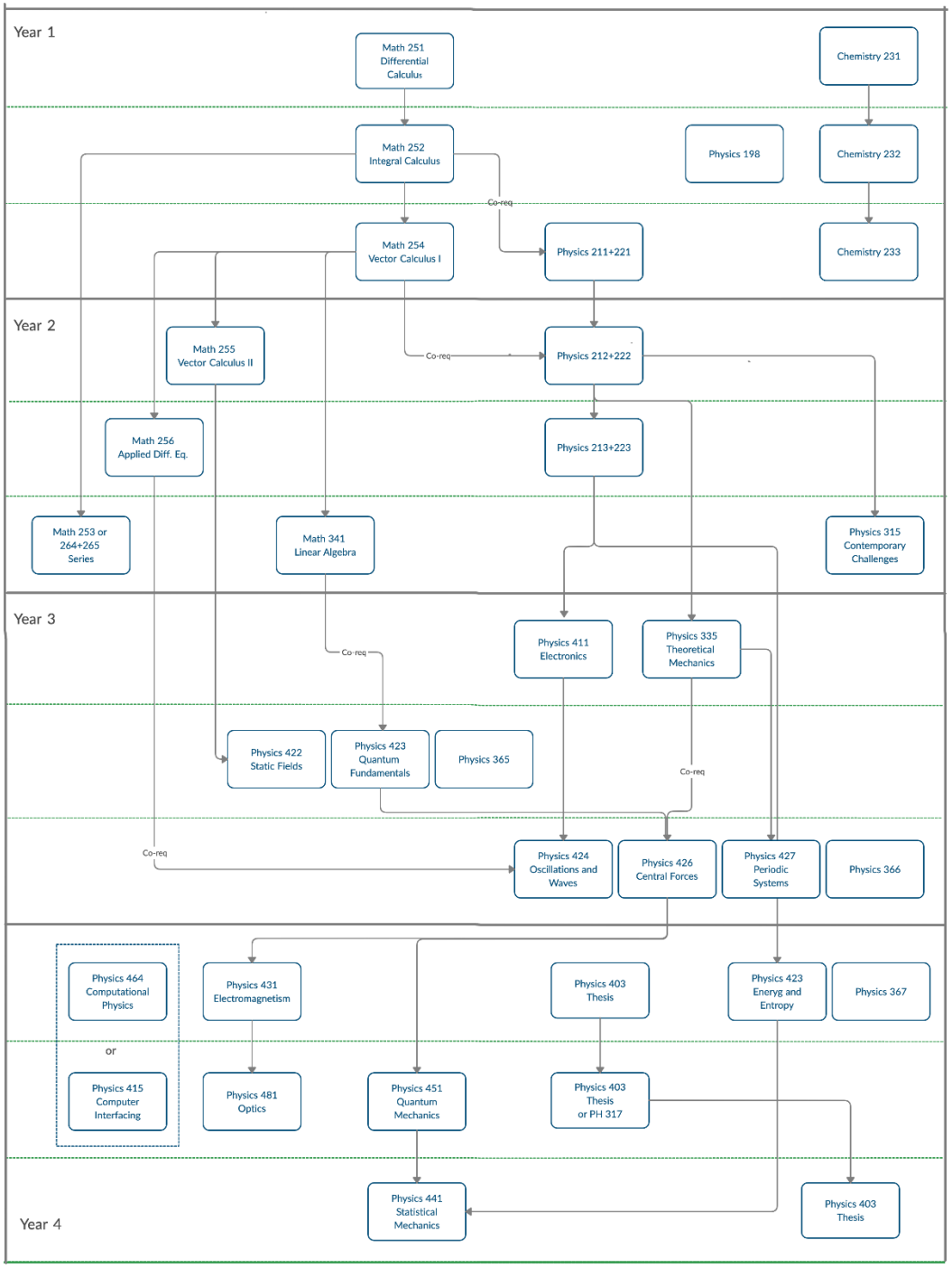


Women make up 42% of the total number of science professionals.

Paradigms in Physics

Matt Graham,
Corinne Manogue and the whole Paradigms Team

physics.oregonstate.edu/advising

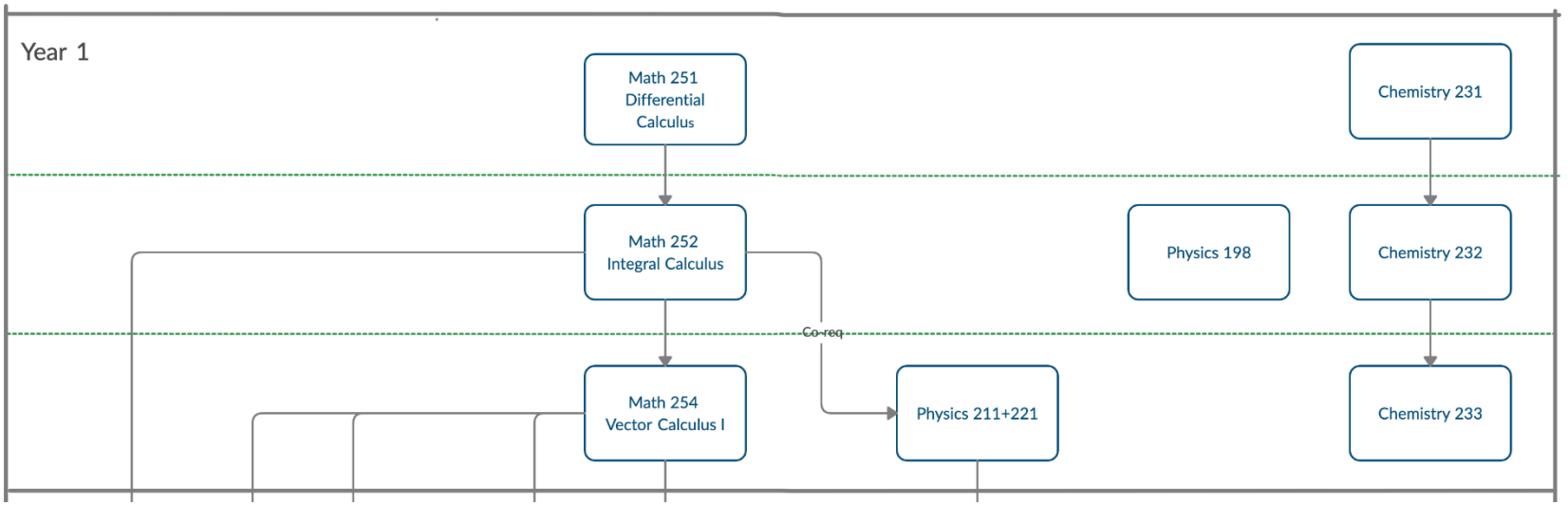


3. Are you taking any Physics courses this year? (Multiple choice)

Nope, just PH 198 this year.	(8/20) 40%
Just 211 or 201	(8/20) 40%
PH 211-3 or 201-30 full sequence	(4/20) 20%
Any PH 300s level courses?	(1/20) 5%
Any PH 400s level courses?	(1/20) 5%

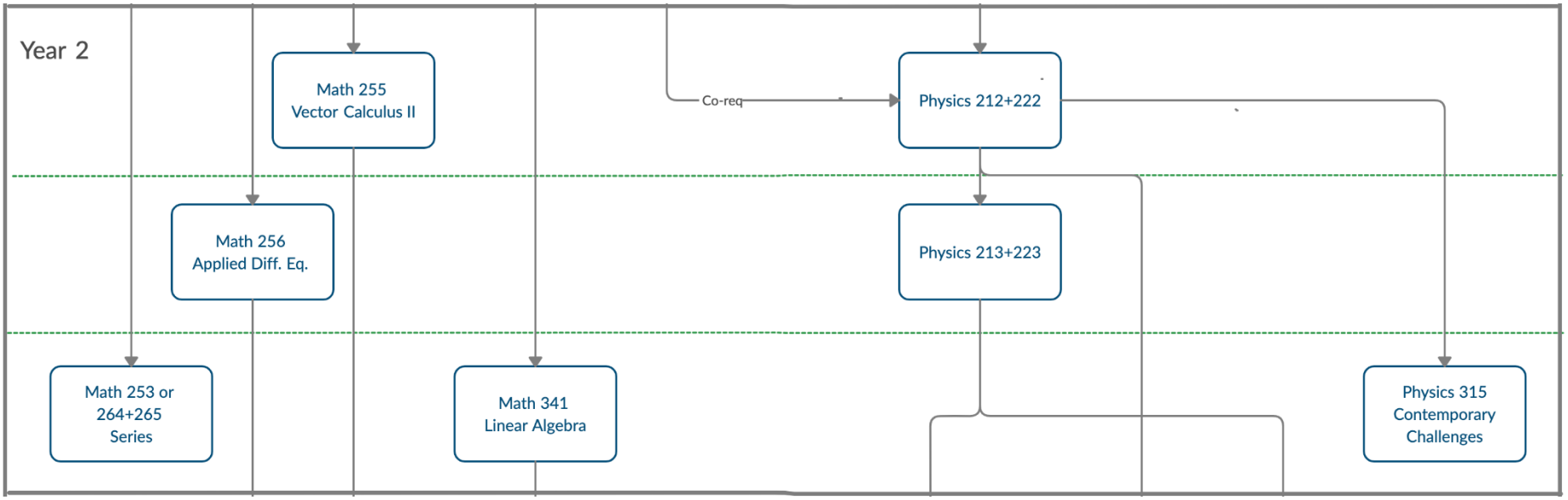
The Lower-Division Curriculum

	Fall	Winter	Spring
Year 1		**PH 198 (1)**	**PH 211 (4) + PH 221 (1)**
	MTH 251 (4)	MTH 252 (4)	MTH 254 (4)
	CH 231 (4)	*CH 232 (4)*	*CH 233 (4)*
	CH 261 (1)	*CH 262 (1)*	*CH 263 (1)*

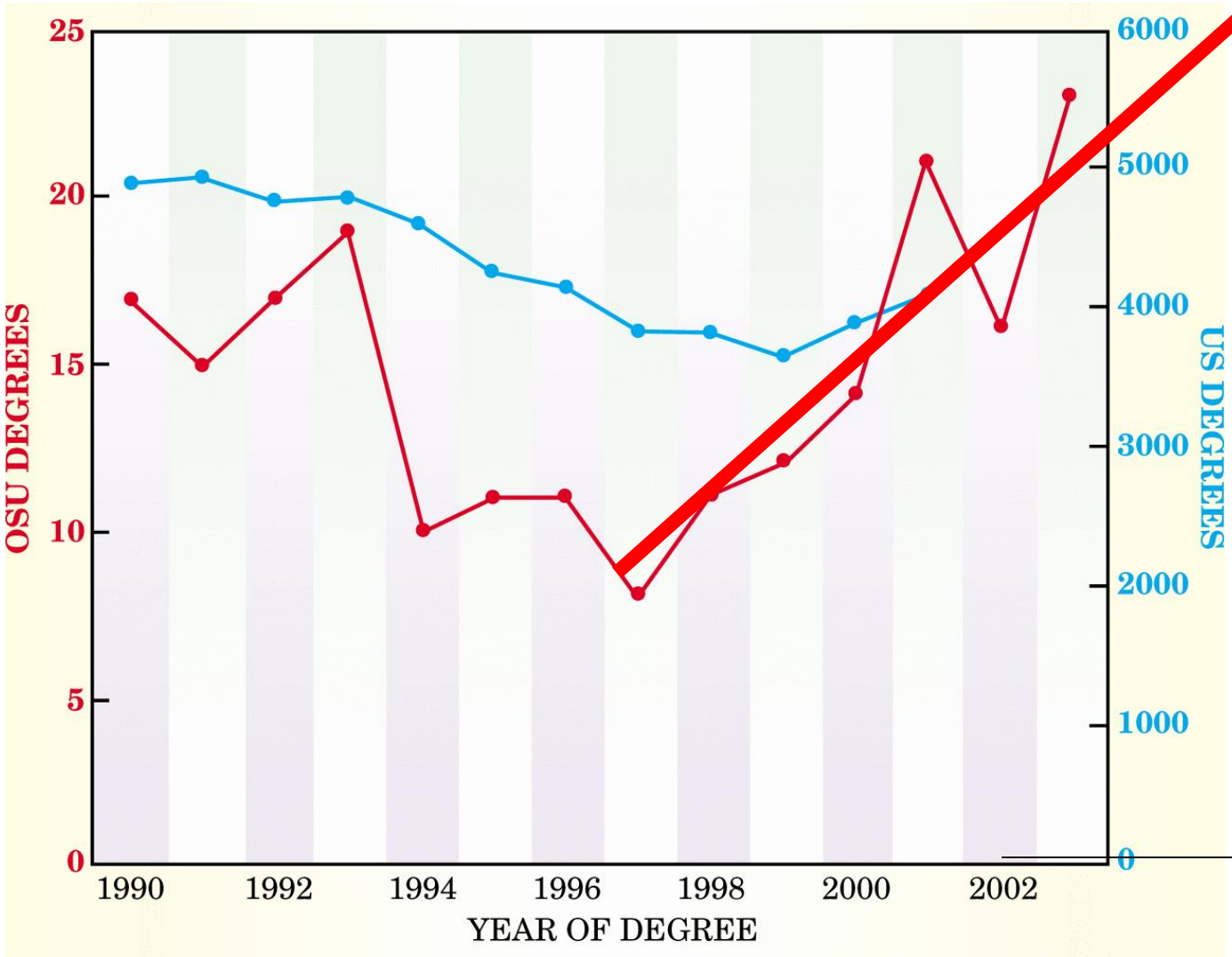


The Lower-Division Curriculum

	Fall	Winter	Spring
Year 2	**PH 212 (4) + PH 222 (1)**	**PH 213 (4) + PH 223 (1)**	**PH 315 (3) Contemporary Challenges**
	MTH 255 (4)	MTH 256 (4)	MTH 253 (4) OR MTH 306 (4) OR (MTH 264 (2) + 265 (2))
			MTH 256 (4)



Why Paradigms?



~35-40

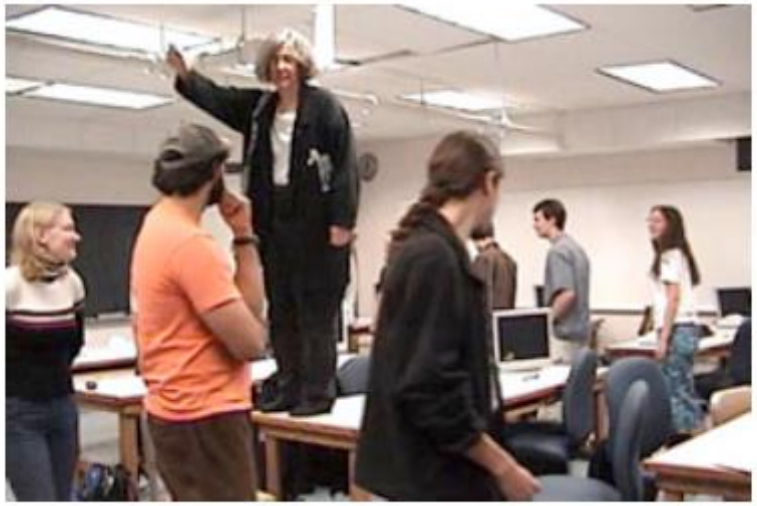
2020

Philosophy of the Paradigms

- Our approach teaches physics as physicists think about it,

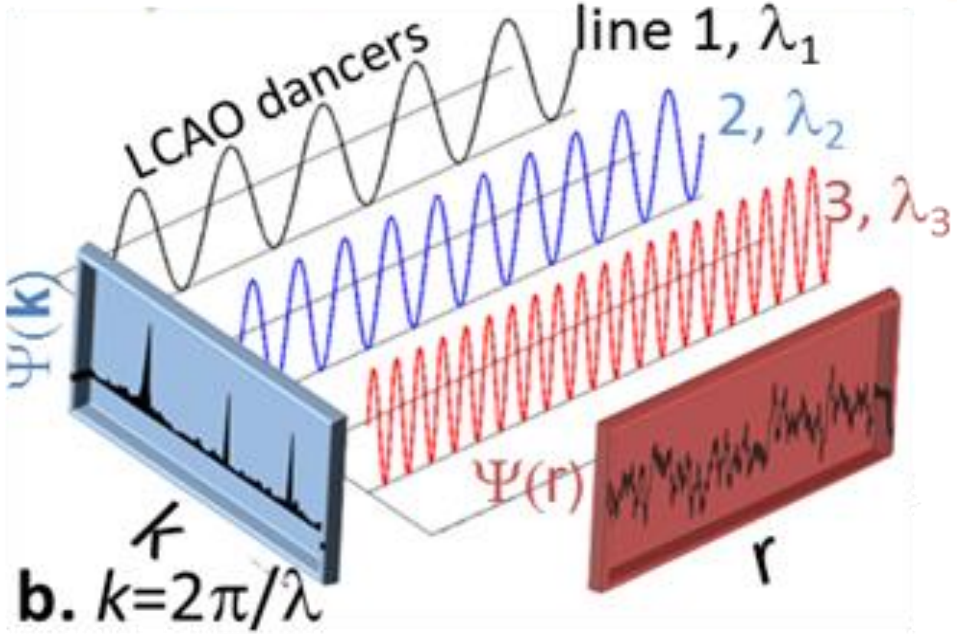
  namely in terms of concepts that broadly underlie the various subfields: energy, symmetry, wave motion, quantum spin and so forth.

Active Engagement

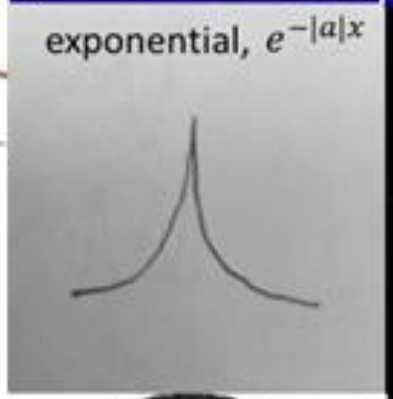


- Verbalization teaches clear thinking
- De-emphasize teacher-as-oracle
- Activate intuition
- Active problem solving
- Encourage peer-instruction
- Efficiency

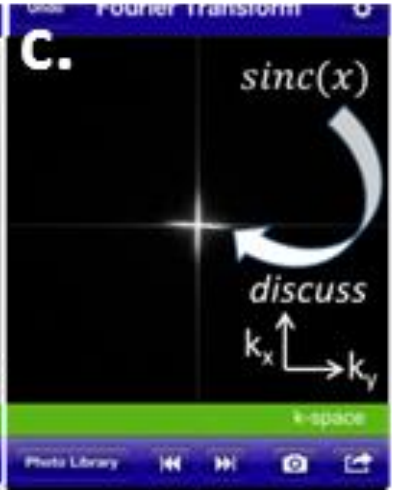

a. “ψ dance-space”, r vs k

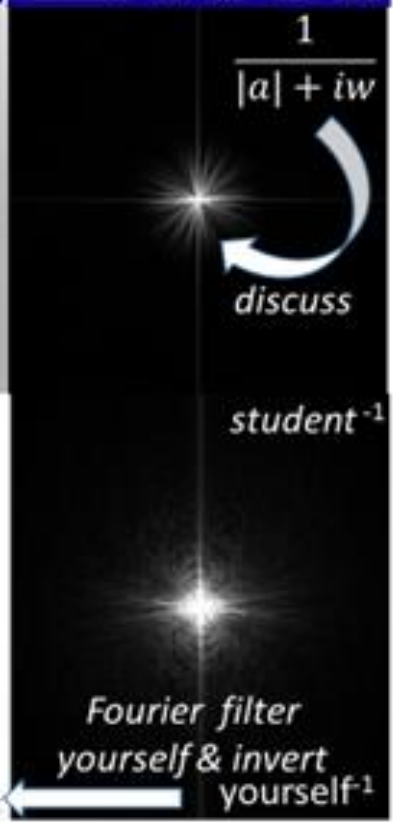

LCAO dancers
line 1, λ_1
2, λ_2
3, λ_3
Ψ(k)
Ψ(r)
k
r
b. $k=2\pi/\lambda$


Fourier Transform
square impulse
x
y
image-space
Photo Library


exponential, $e^{-|a|x}$


yourself?

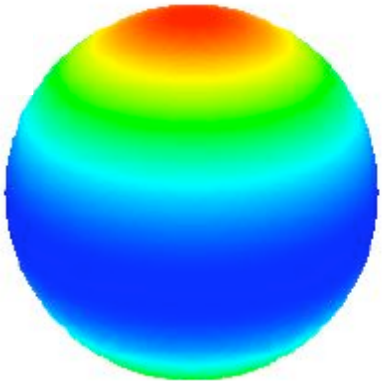

Fourier Transform
c.
$sinc(x)$
discuss
k_x
k_y
k-space
Photo Library


$\frac{1}{|a|+iw}$
discuss
student^{-1}
Fourier filter
yourself & invert
yourself^{-1}

- → Lecture
  - ✓ Illustrates professional thinking
- → Small White Boards
  - ✓ Multiple Representations
  - ✓ Integrating/extending what's already known (building larger chunks)
- → Small Group
  - ✓ Coaching new ways of thinking
  - ✓ Representational fluency
  - ✓ Monitoring understanding

- → Integrated Labs
  - ✓ Professional discourse about theory/data
  - ✓ How do you know if your data is good?
  - ✓ Very strong connection between theory development and experiment
- → Kinesthetic Activities
  - ✓ Representational fluency
- → Maple Worksheets
  - ✓ Mathematical complexity
  - ✓ Representational fluency

Computation in the Paradigms



$$|Y_{10}(\theta,\phi)|^2$$

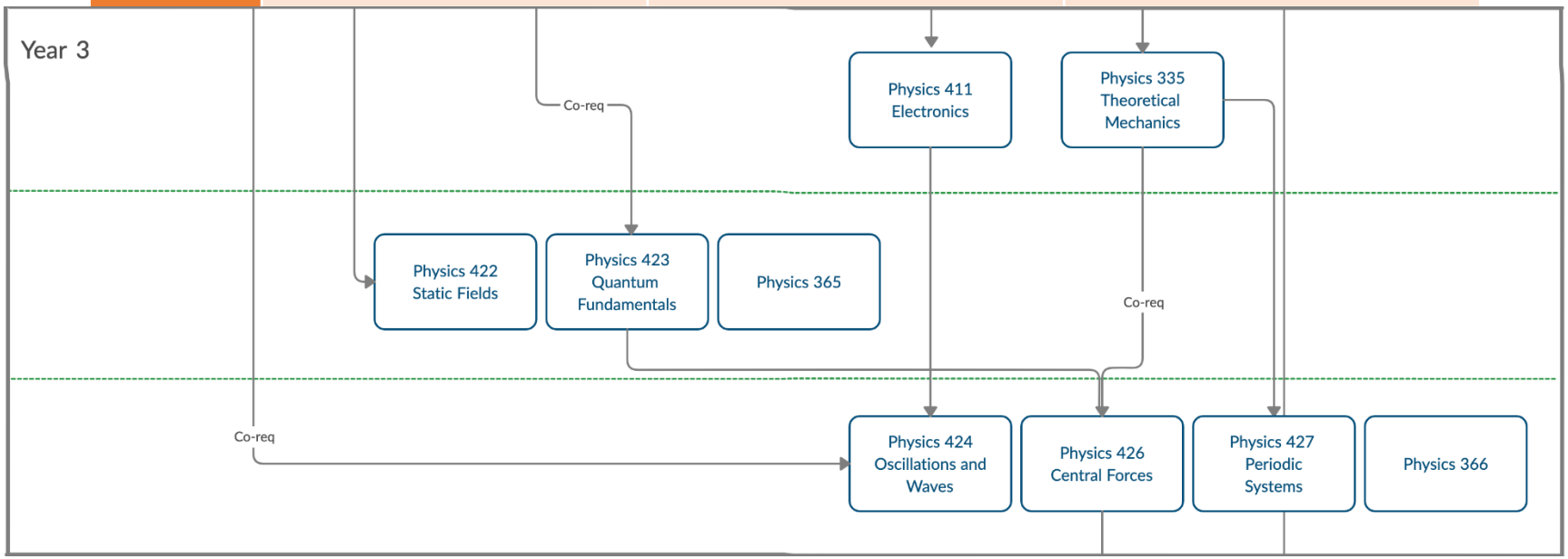
- Visualization
- Calculation
- Simulation
- Animation
- Requires literacy, but not expert coding skills
- "Reach for the computer" to solve a problem
- D. H. McIntyre, J. Tate, and C. A. Manogue, *Integrating Computational Activities into the Upper-Level paradigms in Physics Curriculum at Oregon State University*, Am. J. Phys. (2008, in press).

The Traditional Curriculum

Junior Year	Electromagnetism
	Mathematical Methods
	Classical Mechanics
	Electronics**
Senior Year	Quantum Mechanics
	Statistical Physics**
	Optics**
	Thesis

The Paradigms Curriculum

	Fall	Winter	Spring
Year 3	**PH 315 (3)** **Contemporary Challenges**	**PH 422 (3)** **Static Fields**	**PH 424 (3)** **Oscillations & Waves**
	PH 335 (4) **Intermediate Mechanics**	**PH 425 (3)** **Quantum Fundamentals**	**PH 426 (3)** **Central Forces**
	PH 411 (3) **Electronics**	**PH 415 (3)/ PH 464 (3)** **Computer Interfacing**	**PH 427 (3)** **Periodic Systems**
	Math Catch-up	**PH 365 (1)**	**PH 366 (1)**



The Paradigms Curriculum

	Fall	Winter	Spring
Year 3	**PH 315 (3)** **Contemporary Challenges**	**PH 422 (3)** **Static Fields**	**PH 424 (3)** **Oscillations & Waves**
	PH 335 (4) **Intermediate Mechanics**	**PH 425 (3)** **Quantum Fundamentals**	**PH 426 (3)** **Central Forces**
	PH 411 (3) **Electronics**	**PH 415 (3)/ PH 464 (3)** **Computer Interfacing**	**PH 427 (3)** **Periodic Systems**
	Math Catch-up	**PH 365 (1)**	**PH 366 (1)**
		New Experimental Course	***PH 401 (1)*** ***Thesis Research***
Year 4	***PH 403 (1)*** ***Thesis Writing***	***PH 403 (1)*** ***Thesis Writing***	***PH 403 (1)*** ***Thesis Writing***
	PH 423 (3) **Energy & Entropy**	**PH 481 (4)** **Optics**	
	PH 431 (3) **Electromagnetism**	**PH 451 (3)** **Quantum Mechanics**	**PH 441 (3)** **Statistical Physics**
	PH 367 (1) **Computational Physics**	**PH elective (3)**	**PH elective (3)**

Format of Paradigms Courses

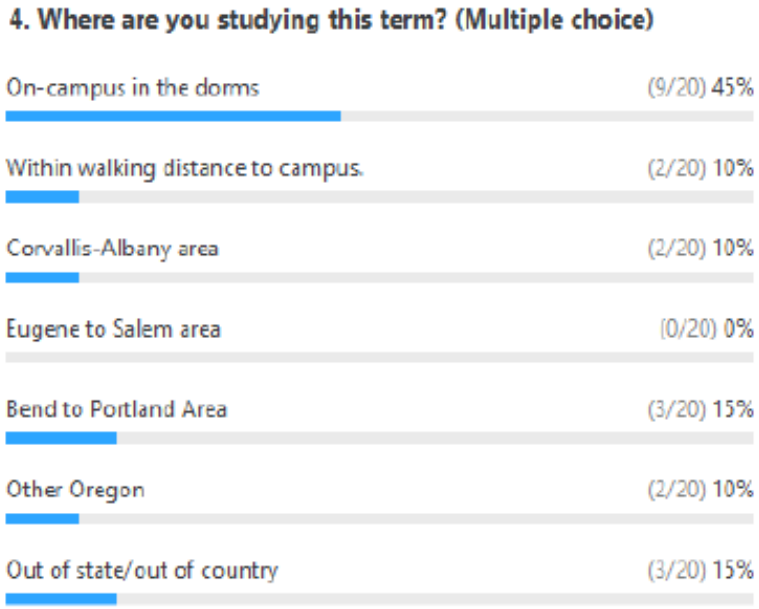
- 5 weeks long
- 1 embedded week of just-in-time math
- 7 hours per week
- 3 credits
- Two
  problem sets
  per week

Paradigms Courses

- Integrated Labs
- Small group problem solving
- Computer visualization
- Kinesthetic activities
- Small whiteboard questions
- Sequences of activities
- And, of course, lecture

Community

- Students, TA's, and faculty work together in a close-knit community to enhance the learning of everyone.
- Study rooms are provided by the department—Weniger 304F, 379.



Comments from Alums

- *Coming from the Paradigms background, I immediately felt comfortable working in a team atmosphere: sharing ideas, problem-solving, double-checking your work with others. The other benefit of the Paradigms program I have found was becoming accustomed to the quick turn-around between projects. Since the classes were only 5 weeks long, you got used concentrating heavily on one area, then switching focus to another concentration. This, I have found, is exactly what the production environment is like.*
  —Mike Joyer, engineer at aerospace company

Comments from Alums

- *The paradigms helped me understand the material better through visual aids and computer simulations. When you see it graphically, the physics of the problem becomes clear and gives life to the derived mathematical expressions. The project also helped students learn how to teach one another. Due to the rapid pace, everyone at some point in the program found themselves lost in the material. This provided multiple opportunities for fellow students to teach concepts.*
  —Tyson Olheiser, graduate student in physics at University of Illinois

Polls

Sharing Poll Results

Attendees are now viewing the poll results

1. I plan to take my first Paradigms in Physics course in:

Year 1	(1) 6%
Year 2	(5) 31%
Year 3	(4) 25%
What's a paradigm?	(6) 38%
Hopefully I won't have to take Paradigms.	(0) 0%

2. When Weniger is open where can I go to meet other physics students? [multiple answers] (Multiple choice)

Worm hole	(15/16) 94%
SPS Office	(4/16) 25%
Heidi Schellman's office	(4/16) 25%
PhIS and Astro Room	(7/16) 44%
304F	(5/16) 31%
Roof of Weniger	(4/16) 25%

3. What course preparations is recommended before taking

3. What course preparations is recommended before taking the paradigms sequence [multiple answers]

Calculus with vector calculus	(13) 81%
Complex analysis course X	(0) 0%
Intro to differential equations course	(1) 6%
Energy alternatives X	(0) 0%
Linear algebra	(2) 13%
Electronics	(0) 0%

https://discord.gg/2QCyhaa

Year 3

Co-req

Physics 411
Electronics

Physics 335
Theoretical
Mechanics

Physics 422
Static Fields

Physics 425
Quantum
Fundamentals

Physics 365

Co-req

Co-req

Physics 424
Oscillations and
Waves

Physics 426
Central Forces

Physics 427
Periodic
Systems

Physics 366

Physics 464
Computational
Physics

or

Physics 415
Computer
Interfacing

Physics 431
Electromagnetism

Physics 481
Optics

Physics 451
Quantum
Mechanics

Physics 403
Thesis

Physics 403
Thesis
or PH 317

Physics 423
Eneryg and
Entropy

Physics 367

Physics 441
Statistical
Mechanics

Physics 403
Thesis

Year 4

Our Paradigms Panel

Introductions:

1) Hello, I am a paradigms student joining you from…
2) When I was in your shoes ….

https://physics.oregonstate.edu/paradigms-students?field_class_value=2019