

Please Form Groups of 2-4

- Each group should have:
 - A small whiteboard
 - Pen
 - Kleenex eraser
- Enjoy the pre-lecture videos:
 - PSSC: https://www.youtube.com/watch?v=PhVy1WG_IKQ
 - BoxSand: https://media.oregonstate.edu/media/t/0_ydxprosh
 - New Math: <https://www.youtube.com/watch?v=UIKGV2cTgqA>

Catalyzing the Transformation of Science Learning

Corinne Manogue

April 5, 2018

LEARN WHY

SCIENCE

IS BETTER

at Oregon State



Oregon State
University

Restaurants

Menu in Folder

- Sit down
- Order
- Eat with knife and fork
- Pay

Menu on Wall

- Order
- Pay
- Sit down
- Eat with hands

Restaurants

Menu in Folder

- Sit down
- Order
- Eat with knife and fork
- Pay

Menu on Wall

- Order
- Pay
- Sit down
- Eat with hands

No Menu

- Sit down
- Don't order
- Eat with hands
- Don't miss out on dessert
- Pay

Lecture vs. Activities

- The Instructor:
 - Paints big picture.
 - Inspires.
 - Covers lots fast.
 - Models speaking.
 - Models problem-solving.
 - Controls questions.
 - Makes connections.
- The Students:
 - Focus on subtleties.
 - Experience delight.
 - Slow, but in depth.
 - Practice speaking.
 - Practice problem-solving.
 - Control questions.
 - Make connections.

Purpose

- Discuss with your group: What is the purpose of education? Write 2-3 answers on your small whiteboard.

The Purpose of Education

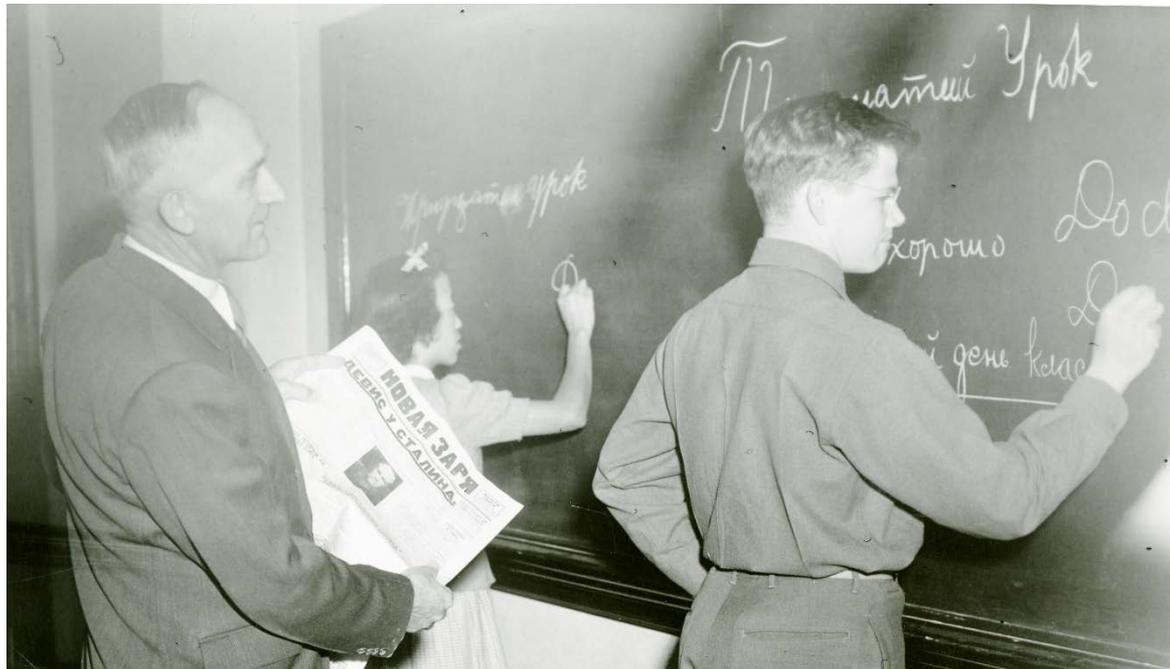
“...the purpose of your education is your growth as an individual and the development of your capacity to contribute to the transformation of society.”

—FUNDAEC

Fundación para la Aplicación y Enseñanza de las Ciencias

Dean F. A. Gilfillan

- High School Teaching
- Junior Engineers' and Scientists' Summer Institute (JESSI)
- OMSI



From Harriet's Photograph Collection , OSU Libraries Special Collections & Archives Research Center

Early Influences

- New Math
- Great Books Group
- PSSC Physics Curriculum
- Modular Scheduling/Open Space School
- Open University Model in High School
- Calculus Reform
- Robert Little: Physical Science Curriculum
- Montessori

New Math

- **Affect:** I LOVED it!
 - **Agency:** I got to teach the teachers
 - **Institutionalization:** I watched it fail
-
- New Math video:
<https://www.youtube.com/watch?v=UIKGV2cTgqA>

PSSC Physics

- **New pedagogical strategies:**
 - open-ended laboratories
 - small group activities,
 - Videos (eg. when you were arriving)
- **Affect:** Modern physics is fascinating
- **Identity:** Physicists are middle-aged white men in narrow ties smoking pipes

Modular Scheduling/ Open Space High School

- **Agency:** Students make some decisions regarding their use of time.
- **Encouragement/Change:** Teachers can try new approaches.
- **Spaces:** Subject-area resource centers/open laboratories replace study halls.

1	2	3	4	5	6
A	A	A	A	A	B
	A		A		B
	A		A		B
					B
C		C		C	
C		C		C	
	B	B	B		
Lunch	Lunch	Lunch	Lunch	Lunch	Lunch

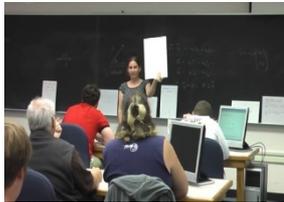
Paradigms in Physics

- Restructured/rearranged UD curriculum
 - 1 and 2 hr blocks alternate
 - Rearrangement of content

Junior Year			Winter		Spring		Senior Year	
Fall								
320 Symmetries	422 Vector Fields	421 Oscillations					431 Electromagnetism	
			425 Spins	424 1-D Waves			435 Classical Mechanics	
					427 Periodic Systems	429 Reference Frames	461 Mathematical Methods	
							451 Quantum Mechanics	
					423 Energy & Entropy		441 Statistical Physics	
						426 Central Forces	481 Optics	
411-412 Electronics					461 Math Methods		403 Thesis	
265, 36x, 415 Computational Physics/Computer Interfacing								

Paradigms Features Activities

Small Whiteboard Questions

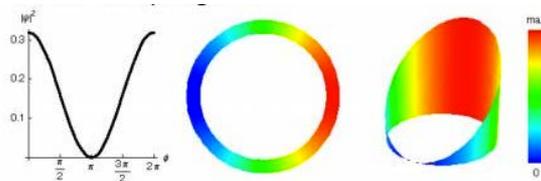


$$\vec{A} \cdot \vec{A} = |\vec{A}|^2$$

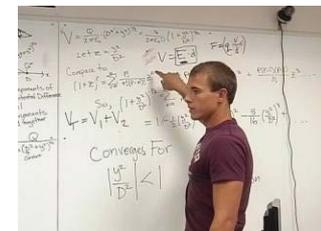
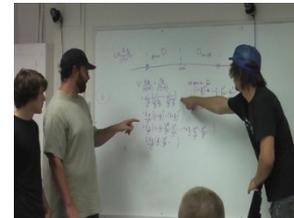
Small Group Activities



Computer Visualization



Compare & Contrast



Kinesthetic Activities



Density

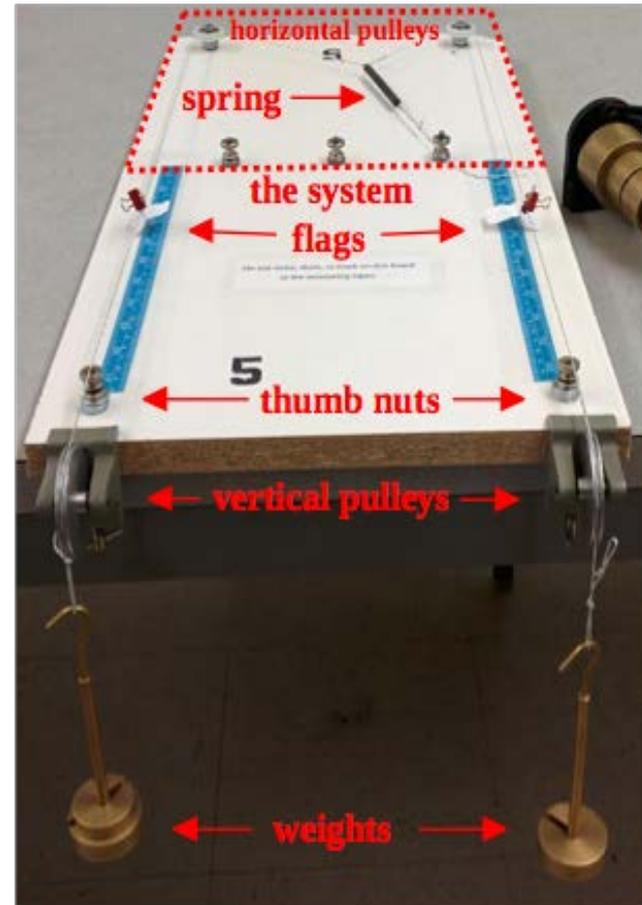
- Make a linear charge density.

Kinesthetic Activities

- Keep students awake!
- Are fun and engaging.
- Allow the instructor to see who is understanding.
- Allow students to check their reasoning against others.
- Let students see that they are not the only ones in the class having trouble.

Representations

Physical Manipulatives



Paradigms Is Informed By:

- Our own education research
 - Role of types of activities
 - Transfer of math to physics
 - Expert understanding
 - Representations
 - Rich points
- Research of others
 - Diversity, inclusivity
 - Learning spaces

Roundy: How do experts/students use math in thermodynamics?

Van Zee: How do faculty learn how to investigate and enhance their own teaching?

Emigh: How do students think about holding variables constant when finding derivatives?



Alfson: How do students use tangible representations to understand equations in physics?

Lenz: Do students find sensemaking useful?

Peterson: What kinds of physics sense-making do students engage in?

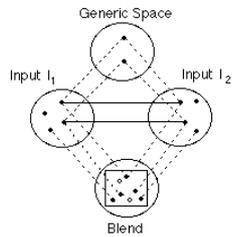
Dray: How do students transfer mathematical knowledge to physics ?



Founds: What do students not understand about finding the slopes ?

Mulder: How do physics majors coordinatize physics problems?

Scales of DBER



Cognitive Elements **Individual Student or Instructor** **Group of Students** **Course** **Program** **Institution**



Rich Points



Rich Points



Redish quoting:
M. Agar, Language Shock
(Perennial, 1994)

4/5/2018

Gilfillan: Catalyzing Transformation

Learning Spaces



4/5/2018

Gilfillan: Catalyzing Transformation

My Cultural Journey

- A child of privilege, particularly educational
 - HS: A wealthy public school in the mid-west
 - College: A liberal eastern women's college renowned for educating women scientists
 - Grad: A large R1 university in Texas
 - Postdoc: An elite research institute
 - Faculty: The first woman in physics at OSU
 - Research abroad: England, India, Australia
 - Workshops: Colombia, India

Cultural Lessons

- The subtext of my education:
 - HS: I can do anything except physicists are men.
 - College: I can do physics??? if I am manly tough.
 - Grad: Women are only sort of welcome in physics.
 - Postdoc: Physics can be wildly competitive.
 - OSU: Women need special help to be in physics.
 - Teaching: Classrooms have cultures.
 - Sabbatical: Race is still a challenge

Courage in the Classroom

- It takes courage to be publicly wrong.
- Physics culture is to NEVER be publicly wrong.
- We need to/can change this.
- Our classrooms culture can model a new culture.

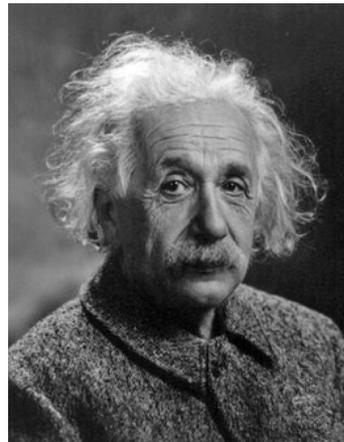
Power Poses



4/5/2018

Gilfillan: Catalyzing Transformation

Identity—Then and Now



My Coming Out

- I am a Bahá'í!

Bahá'ís in Iran

- Bahá'ís in Iran have not been allowed to attend university since the Iranian revolution in 1979

Wellbeing of Mankind

“The well-being of mankind, its peace and security are unattainable unless and until its unity is firmly established.”

Bahá'u'lláh

The World Order of Bahá'u'lláh, p. 203

False Dichotomies

Men

Women

Science

Religion

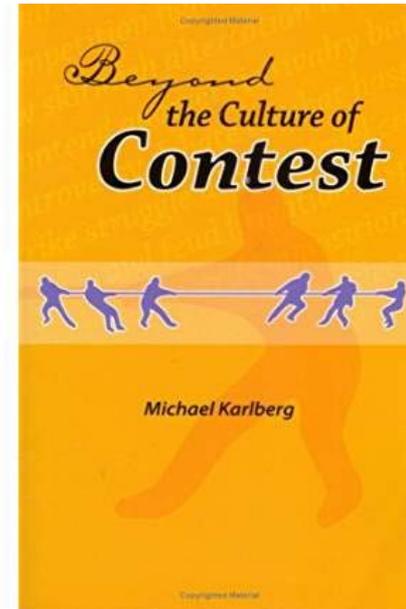
White

**Everybody
Else**



Normative Adversarialism

- Legal contests
- Economic contests
- Political contests
- Educational systems



Beyond the Culture of Contest, Michael Karlberg, George Ronald, 2004.

Adversarialism

Mutualism



Inequality

Equality

**Coercion/
Oppression**

Good Marriage

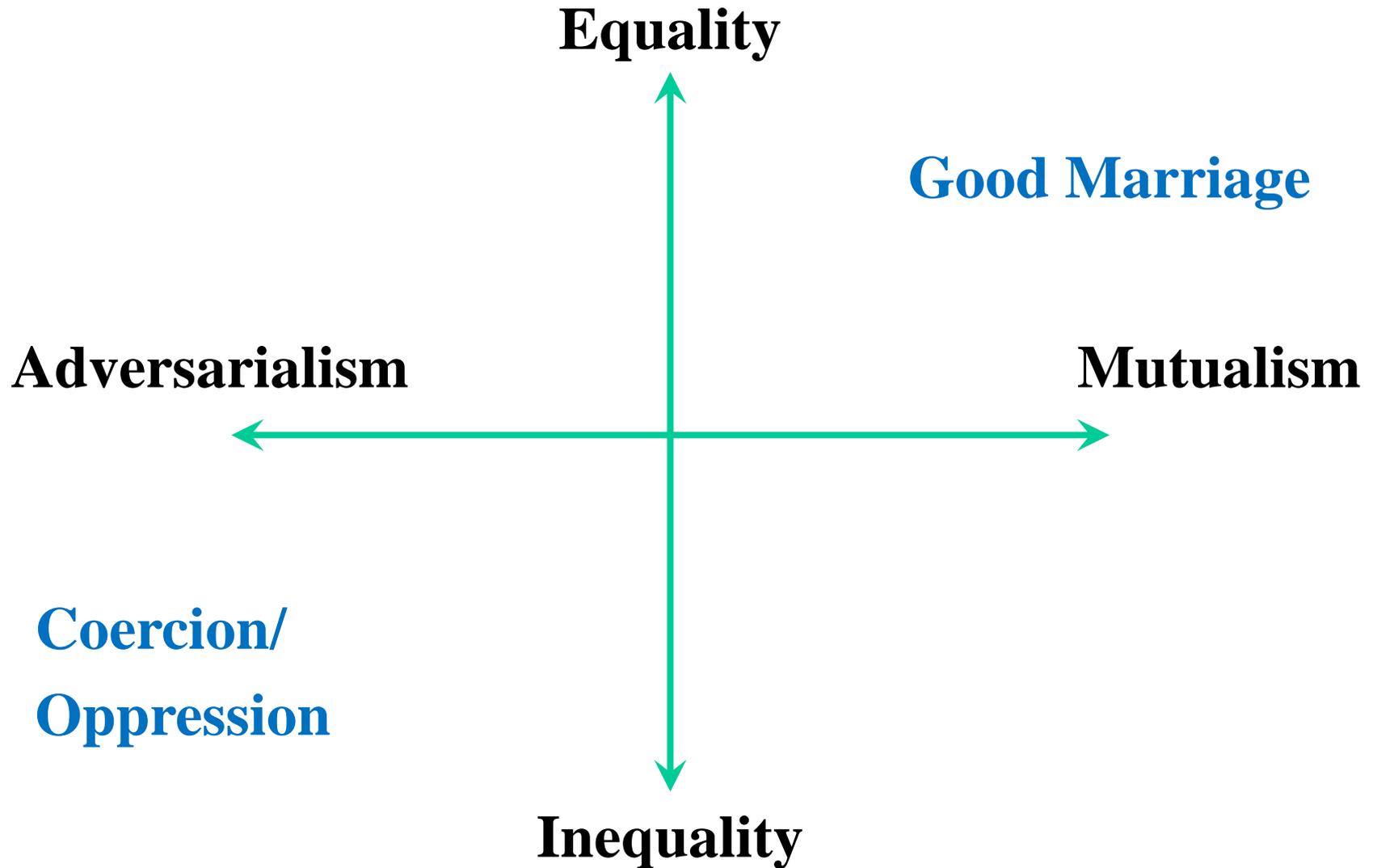
Adversarialism

Mutualism

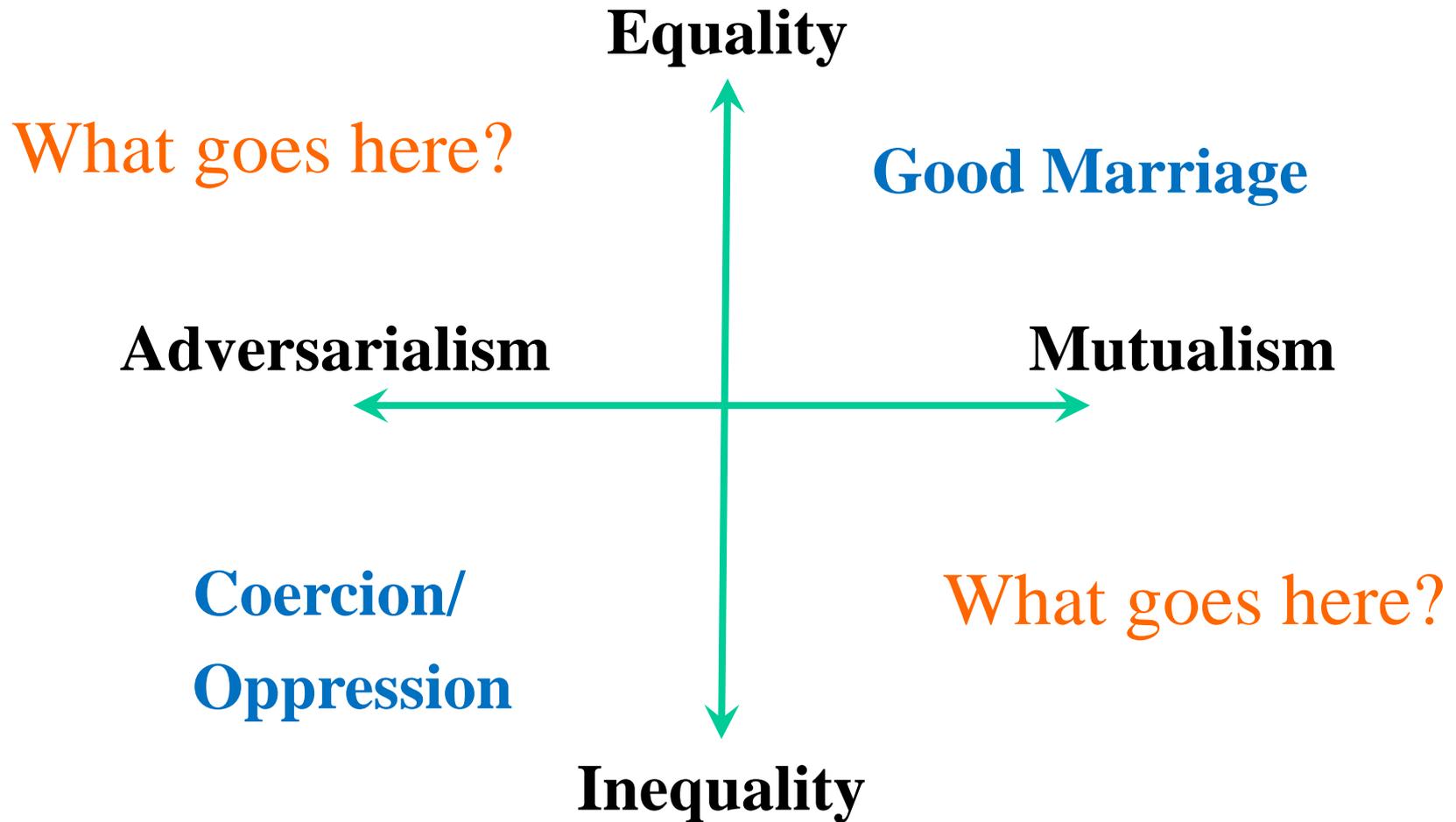


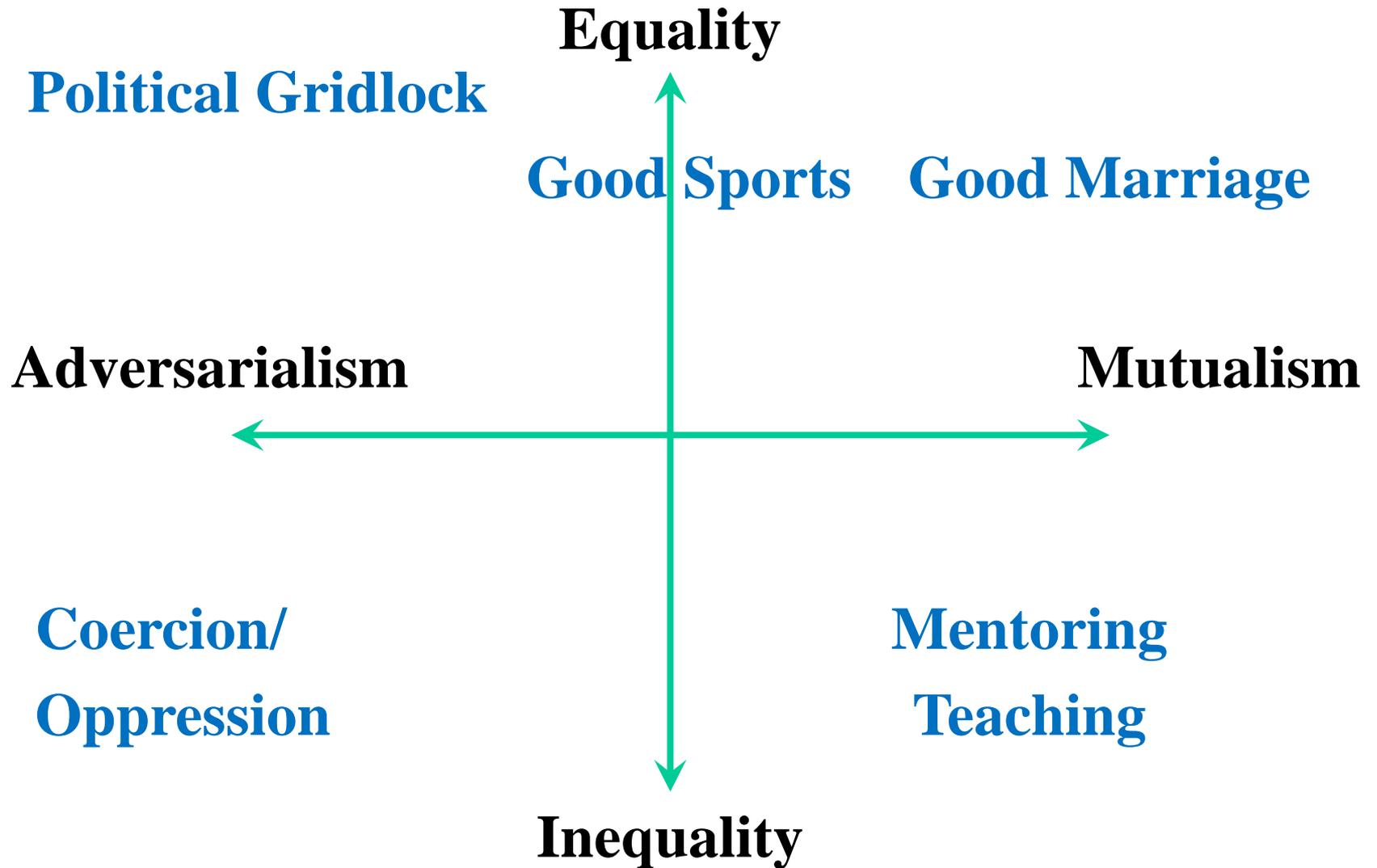
Inequality

Equality



Talk with your group:





What's Next at OSU?

- We have:
 - A small number of DBER faculty
 - A LARGE number of faculty engaging
 - Many Centers/Professional Faculty/Offices
 - A national support system

What's Next at OSU?

- Needed—A new administrative structure framework that:
 - Encourages individual initiative & collaboration
 - Employs a mutualistic, consultative process
 - Utilizes reflective cycles of growth
 - Acknowledges that change is slow
 - Pushes forward on many fronts at once
 - Builds on/sustains/learns from previous efforts
- DBER faculty as catalyzers!!!

Support

- National Science Foundation
 DUE-9653250, 0231194, 0618877, 0942983
 DUE-1256606, 1323800
 DUE-0088901, 0231032, 0837829, 1023120



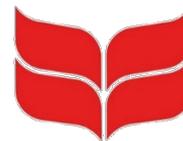
- Oregon State University



- Oregon Collaborative for Excellence
 in the Preparation of Teachers



- Grinnell College
- Mount Holyoke College
- Utah State University



The Big Picture

- Organic process of growth
- Personal growth leading to social change
- Role of individual/collaborative action
- The role of cycles of reflective practice
- Unity, diversity, culture, respect
- The long haul
- The possibilities of the next level at OSU

My Hope/Prayer

- My hope/prayer is that each of you will go home and take some time to reflect on your own personal journey. How has it affected who you are now? How has it enabled you to contribute to the transformation of society? What do you want to do next? How can you invite others to walk this path with you?