Strengthening the scientific workforce

Insights from my time leading an MIT Physics Department committee

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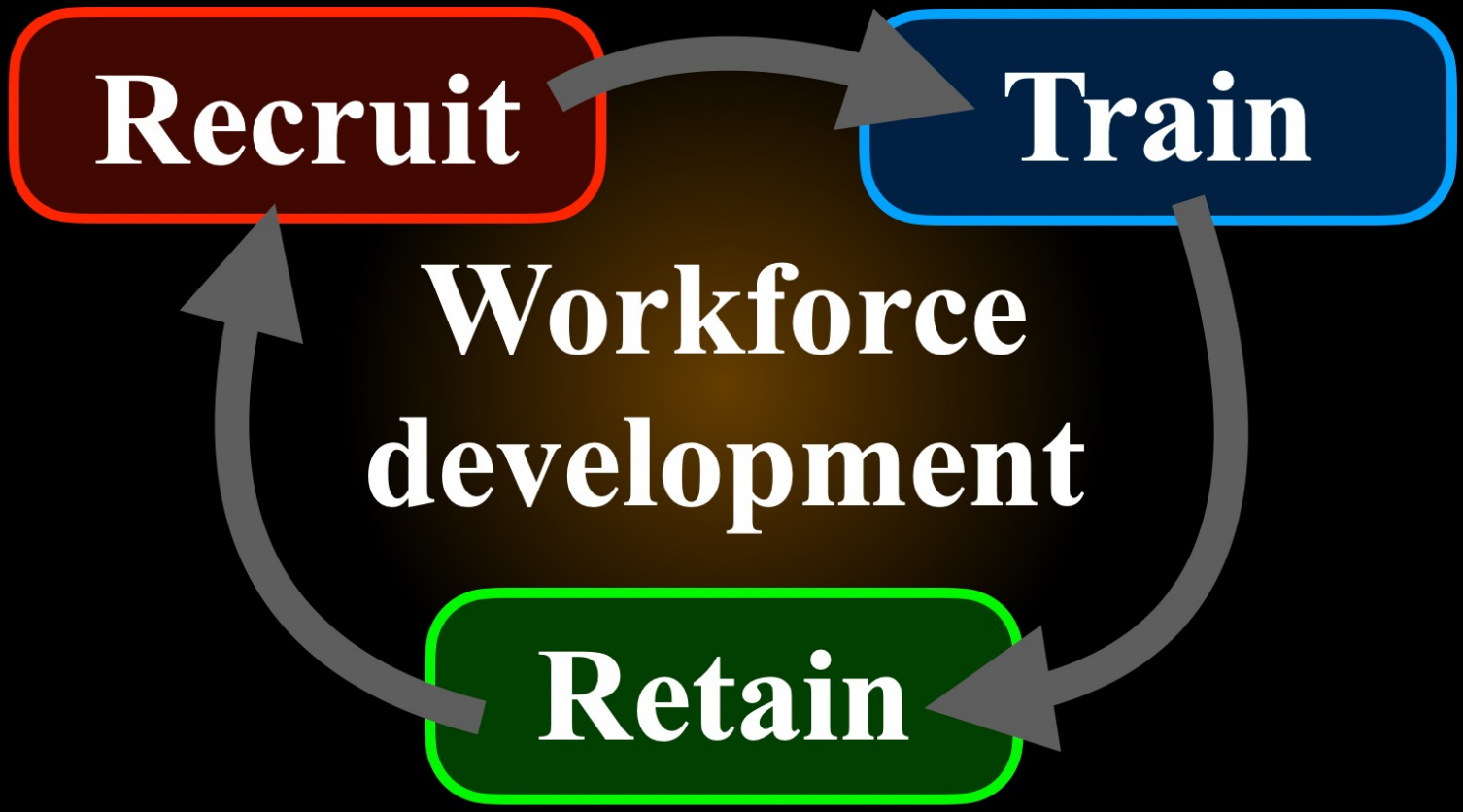
1. What is workforce development?

2. How can departments help?

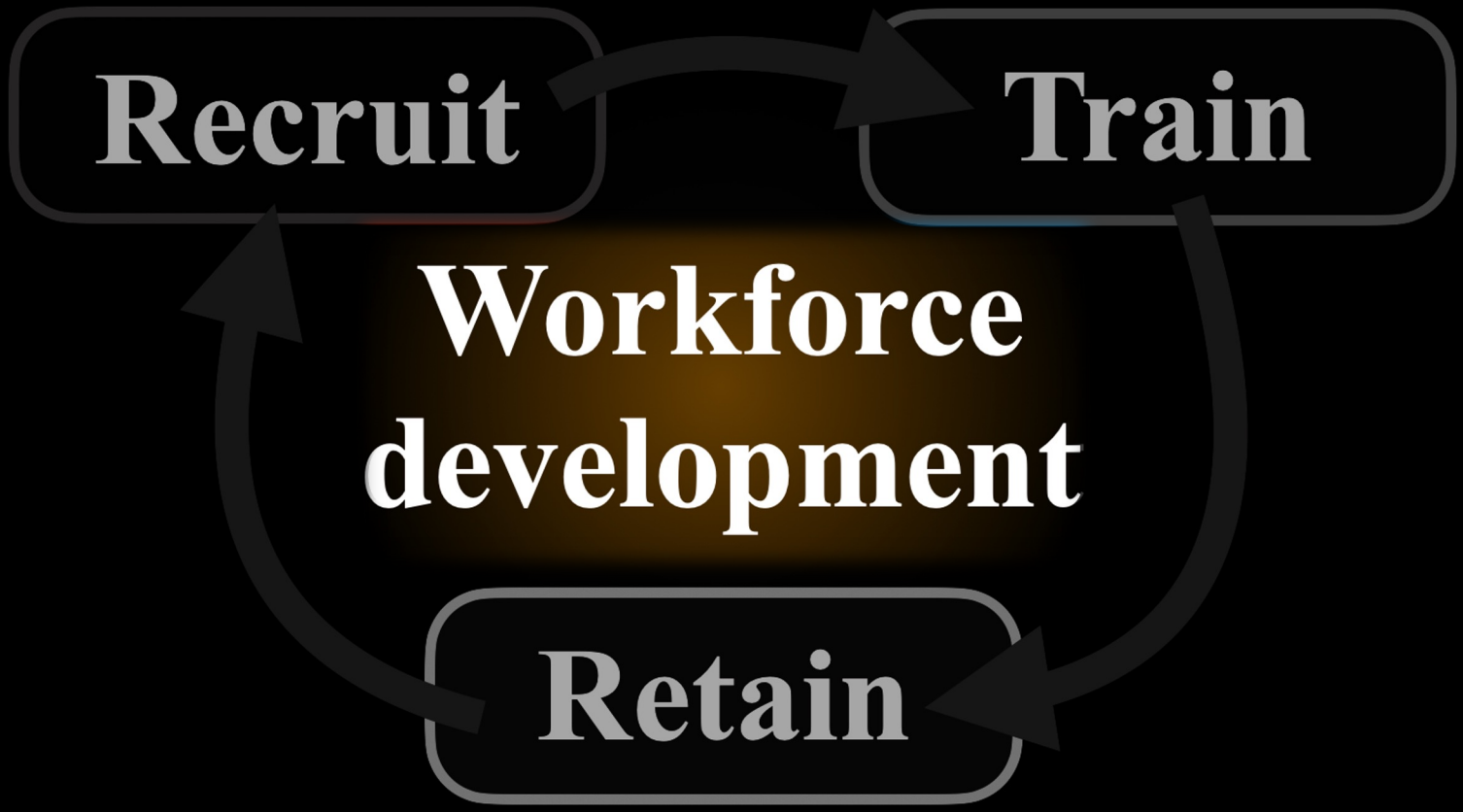
3. How can you help?

Outline for Part I



Phrase attribution: Unknown, but it's very common.

Outline for Part I



Who is in our workforce?

Research ecosystem

- Faculty
- Researchers & technicians
- Postdocs
- Students

Main focus

Support staff

- Administrators
- Secretaries
- Teaching staff
- Custodians, cafeteria workers, …

Institute leadership

Directors, Boards, & Offices of

- Finance
- Facilities
- Operations
- Academics
- Technology
- Communications
- HR
- …

Not scientists, but crucial for the scientific mission

Why focus on workforce development?

Two driving forces:

1. **Mission:** What we do
2. **Values:** How and why we do it

Mission and Values

Massachusetts Institute of Technology

Mission

"To advance knowledge & education of students in science, technology, & other areas of scholarship that will best serve the nation & the world."

Values

- Excellence & curiosity
- Openness & respect
- Belonging & community

Los Alamos NATIONAL LABORATORY

Mission

"To solve national security challenges… by integrating R&D solutions with operational excellence & community engagement."

Values

- Excellence
- Integrity
- Service
- Teamwork

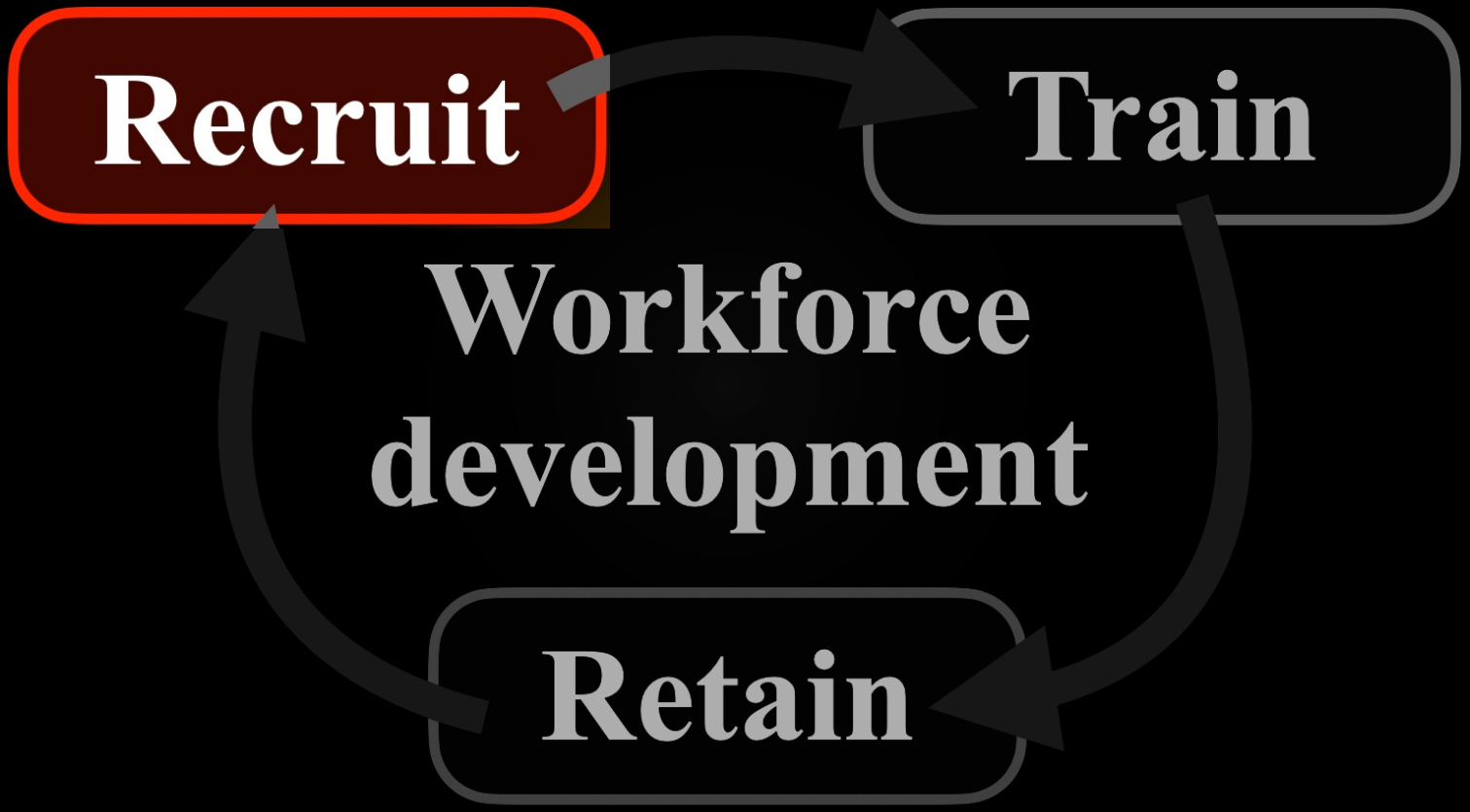
Fulfilling our mission

Critically dependent on our workforce:

- Only a few world experts per topic
- Requires highly specialized knowledge and skills
- Decade or more of training per person

Need to attract talent, train people well, and keep them in the field

Outline for Part I



Recruitment & Outreach

Recruitment

- Attract talented applicants
- Ensure our criteria select strong candidates
- Convince someone to accept a job offer

Outreach

- Excite and inform the public about science
- Inspire people to pursue scientific careers
- Provide resources and guidance to others

What makes a strong physicist?

Accomplishments

- Awards
- Grants
- Papers
- Citations
- Invited talks
- Test scores
- …

Skills

- Idea generation
- Technical prowess
- Paper writing
- Giving talks
- Managing teams
- Mentoring
- …

Personal qualities

- Curious
- Creative
- Perceptive
- Persistent
- Independent
- Integrity
- …

How do we pick the best recruits?

$$\text{Indicator of future potential} = \frac{\text{Current level of achievement}}{\text{Past access to opportunity}}$$

Achievement vs. potential

- Faculty need strong skills on Day 1
- Trainees have 3-6 years to grow

Confounding factors (students)

Opportunity in childhood

Home environment and support, quality of schools, family and community resources, path at age 18 (school, military, workforce)

Experience in academia

Resources at previous institution, workplace climate and culture, quality of mentorship and support

Outside commitments

Medical issues, part-time job while in school, student loans, child & elder care, unusual disruptions (e.g. natural disaster)

Outreach audiences

University

- In the classroom
- Student groups
- Prospective students & job hires

Local

- Neighborhood schools
- At-risk youth
- Gifted / talented youth

Regional

- Members of the general public
- Politicians
- Individual and corporate donors

International

- Collaborating countries
- Nearby countries
- Developing countries

Outreach, in your comfort zone

Teaching

- Host a research student
- Mentor a child one-on-one
- Coach a team at a math contest

Behind the scenes

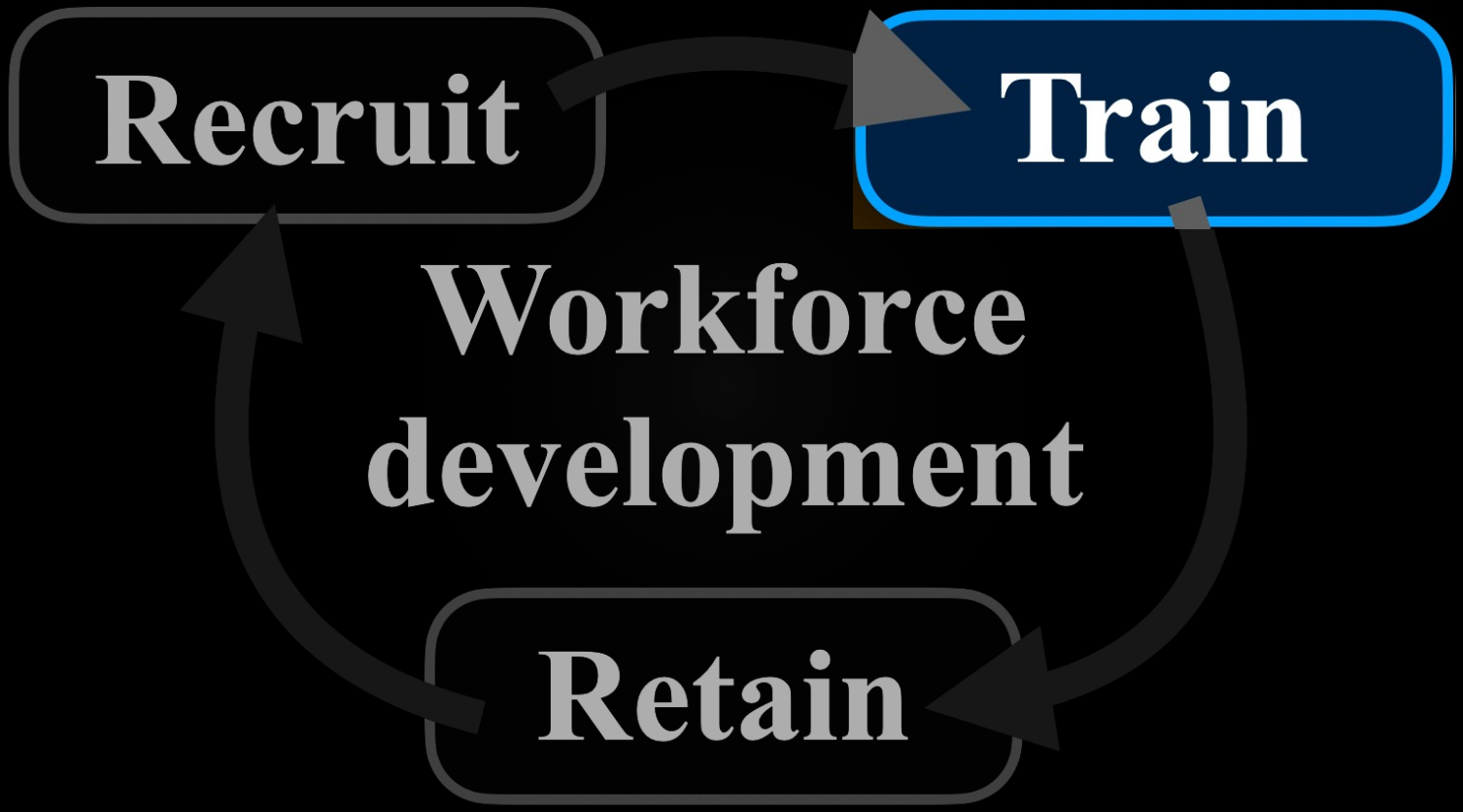
- Plan new initiatives or events
- Serve on management/committees
- Donate or raise money

Public communication

- Give an outreach talk
- Write a popular book or article
- Participate in political advocacy

Many types of outreach,
for many types of people

Outline for Part I



Goals in academia are obvious, right?

Master's & PhD

- Pass classes
- Write papers
- Get a postdoc job

Postdoc

- Develop a portfolio
- Give talks
- Get a faculty job

Junior faculty

- Build a research group
- Make discoveries
- Get tenure

The general idea is obvious, the details are not.

How did you learn to navigate academia?

Which tools do your students use?

Advisor	Dedicated first-year class	Department handbook
Senior group members	University-led workshops	Books, blogs, or articles
Other students	Conferences	CV stalking
External collaborators	Summer schools	Trial and error

Breaking down our goals as physicists

Researcher

Focus today

Teacher

Group leader

Institute governance

Marketing pro

Mentor

…and more!

Defining a successful researcher

Metrics

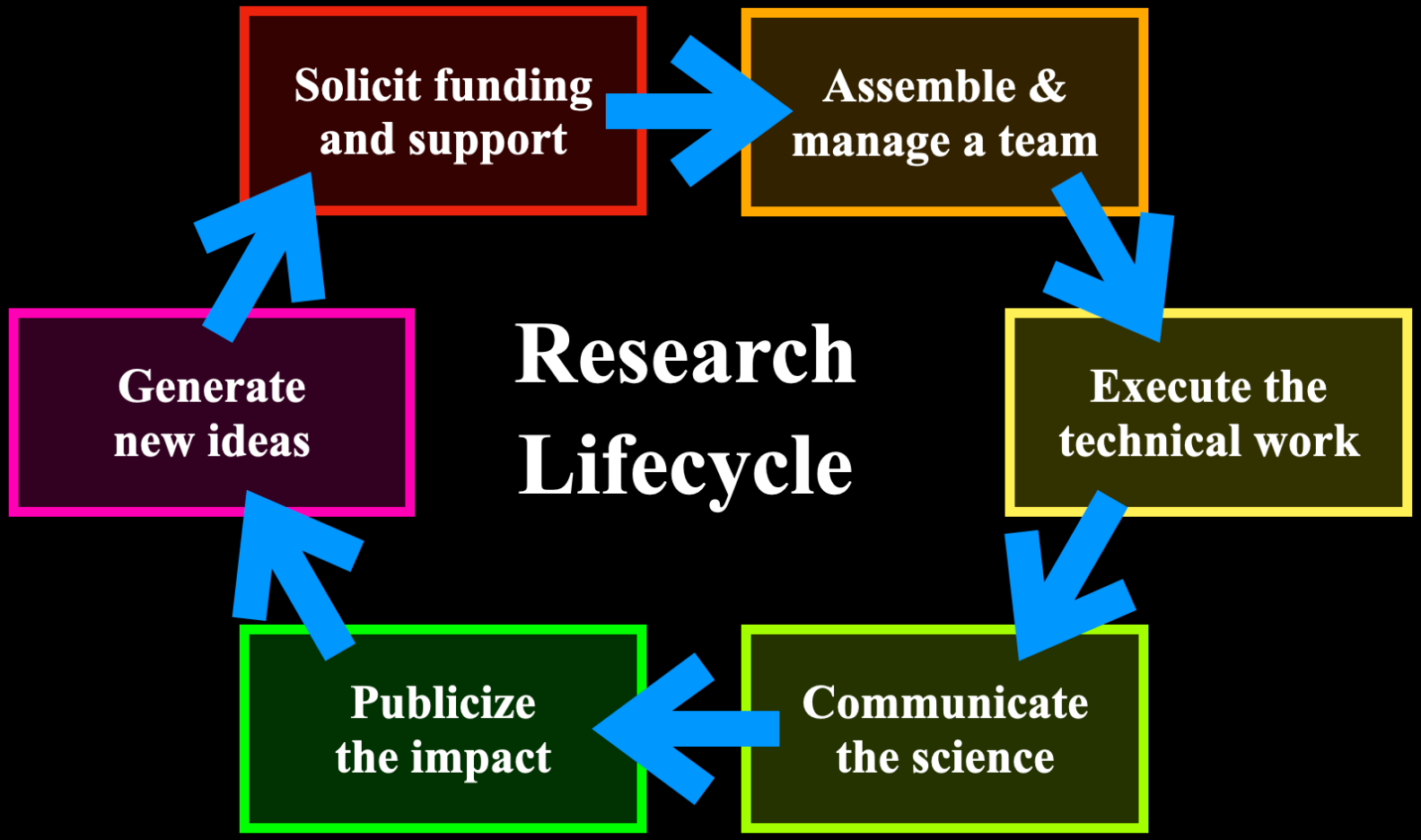
- # of papers
- # of citations
- *h*-index
- Prestigious journals
- Awards
- Grants
- Invited talks
- …

vs.

Abstract measures

- **Quality** of research contributions
- **Impact** on the field

Developing research capabilities



Characterizing research impact

"Jack of all trades"	vs.	Master of one
Expert on a topic	vs.	Expert at a technique
One famous paper	vs.	Many good papers
Work on established topic	vs.	Start a new field
Good at a hot field	vs.	Star of a smaller field
Few close-knit collaborators	vs.	Many short-term collaborators
Do great work quietly	vs.	Tell a great story loudly

Challenges of leaving academia

Few industry jobs titled “Physicist”

- Must leave behind your “physics identity”
- Overwhelming number of options; nobody can choose but you!

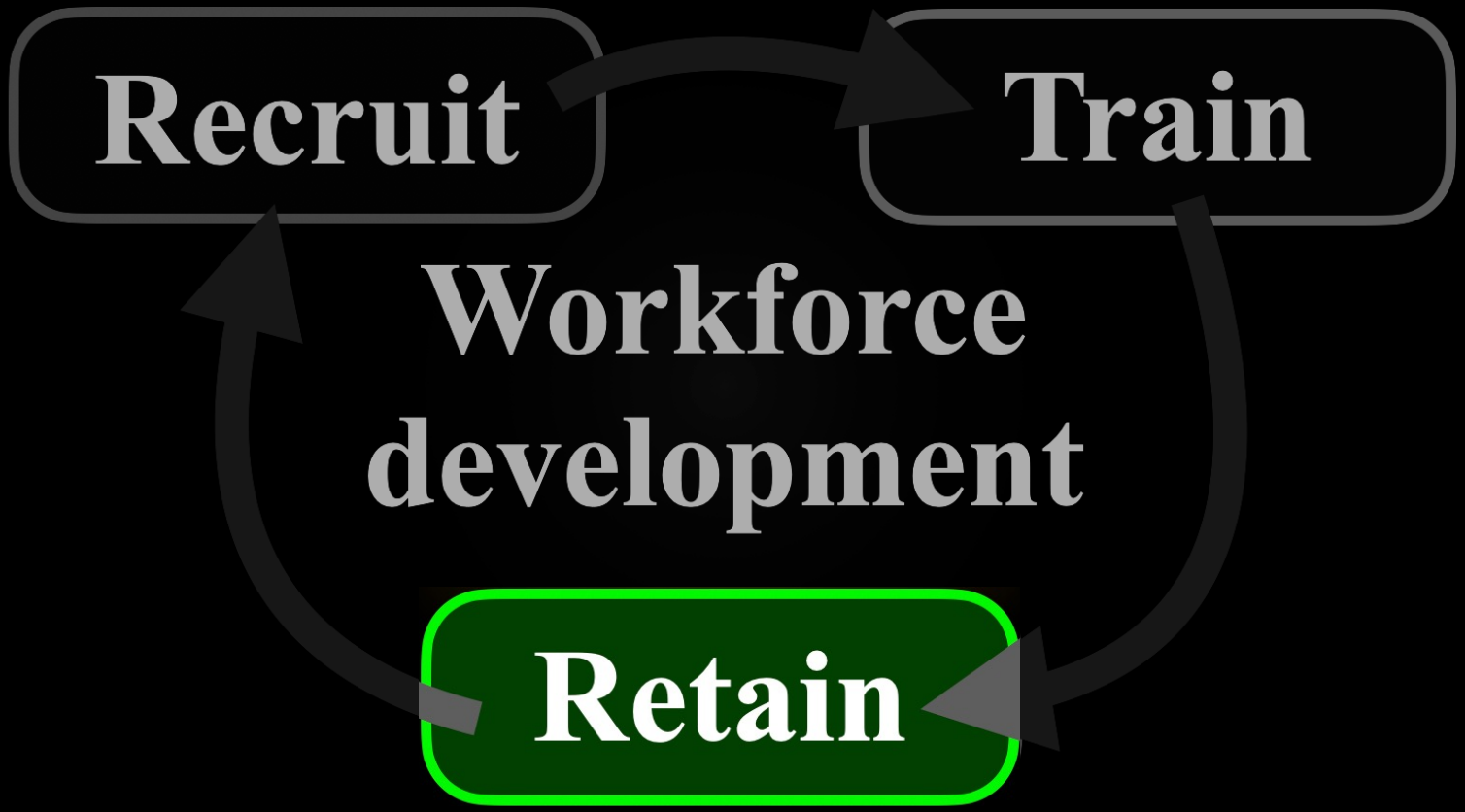
Transition to new mentors

- Research: Close relationship with faculty with deep academic ties
- Industry: Often get better tips & contacts from the career office

Effort of the job search

- Start ~1 year early, might send 100’s of applications
- Need to develop new skills unrelated to classes & research

Outline for Part I



Retention and Support

What do you love about your workplace?

What makes you think about quitting?

Do your colleagues feel the same way?

Many factors can impact someone's experience of workplace climate

Career stage

- Bachelor's and Ph.D. students
- Postdocs and research staff
- Junior and senior faculty
- Non-research staff

Department sector

- Administrative offices
- Divisions and centers
- Theory or experiment

Population

- Physics background and academic path
- Personal background and life experiences

Structural support

Operations and management

Strong leadership, well-structured administration, clear policies and procedures, efficiently run, …

Physical & financial resources

Revenue, endowment size, facilities and instrumentation, start-up funds, internal grants, salary and benefits, ...

Personnel

Instructors, administrative and support staff, technical staff, …

Interpersonal support

Deans and department chairs	Your research group	Peer mentorship programs
Conflict resolution offices	Professors and advisors	Social and support organizations
Student support offices	Campus mental health services	Colleagues and classmates

Workplace climate

Interpersonal dynamics

- Collaborative vs. Competitive
- Supportive vs. Undermining
- Friendly vs. Hostile
- Courteous vs. Offensive
- Peer group vs. Solo
- …

Physical environment

- Accessible vs. Inaccessible
- Safe vs. Unsafe
- Comfortable vs. Unpleasant
- Neutral vs. Offensive material
- …

Leadership

- Objective vs. Favoritism
- Consistent vs. Capricious
- Open vs. Secretive
- Responsive vs. Aloof
- Integrity vs. Unethical
- Structured vs. Disorganized
- …

1. What is workforce development?

2. How can departments help?

3. How can you help?

Who will do the work?

Most departments don't have the funds to hire dedicated workforce development staff.

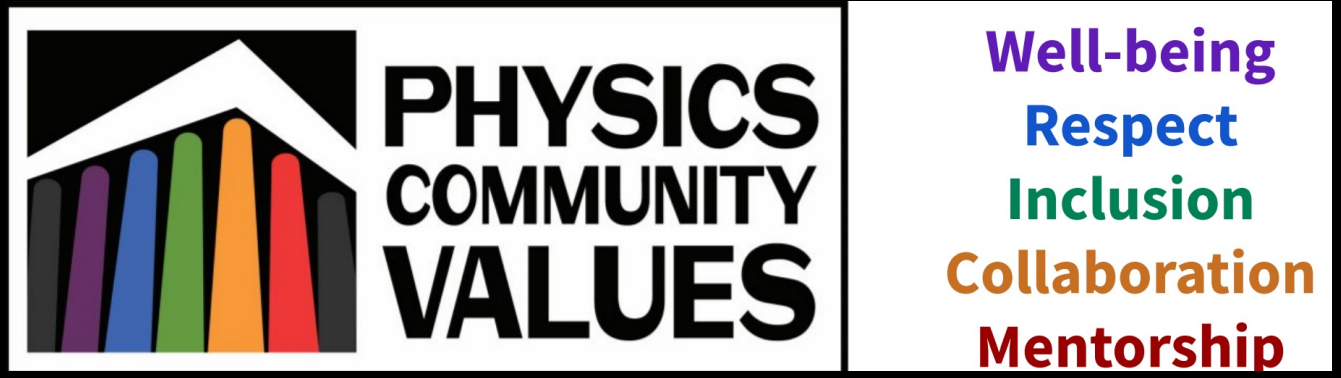
However,

- Our professional societies regularly release new guides and resources
- Physics departments can make strides forward even without extra staff

Committee strengths

Committees have the freedom to…	Whereas department leaders must also…
Make a big impact on a broad-reaching issue	Put Band-Aids on varied, frequent problems
Do slow, deliberate work	Quickly respond to crises
Assess and propose changes to policies and procedures	Enforce existing policy
Focus on 2-3 areas at a time	Responsible for all facets of the department

MIT Physics Values Committee

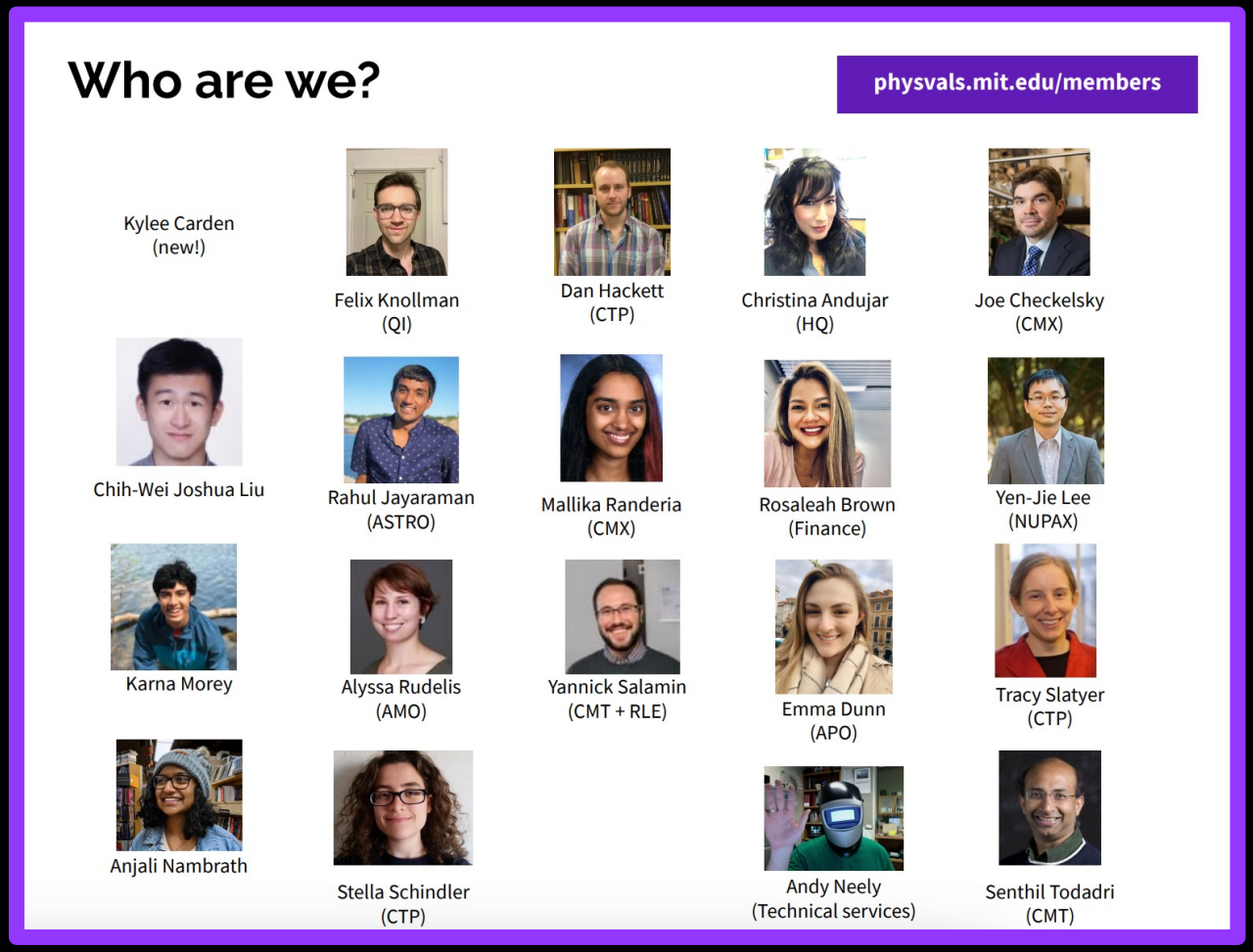


Mission

"The Physics Values Committee (PVC) is an ***advisory council*** whose role is to help guide the MIT Physics Department to better uphold its values at a ***systemic and structural*** level through its policies, procedures, and practices.

The PVC considers problems brought to its attention by the MIT Physics community and devises action plans to resolve them."

MIT Physics Values Committee



Slide from Fall 2020 Town Hall

Bachelor's, PhD, postdocs, non-research staff, faculty

Committee process

Assessing issues

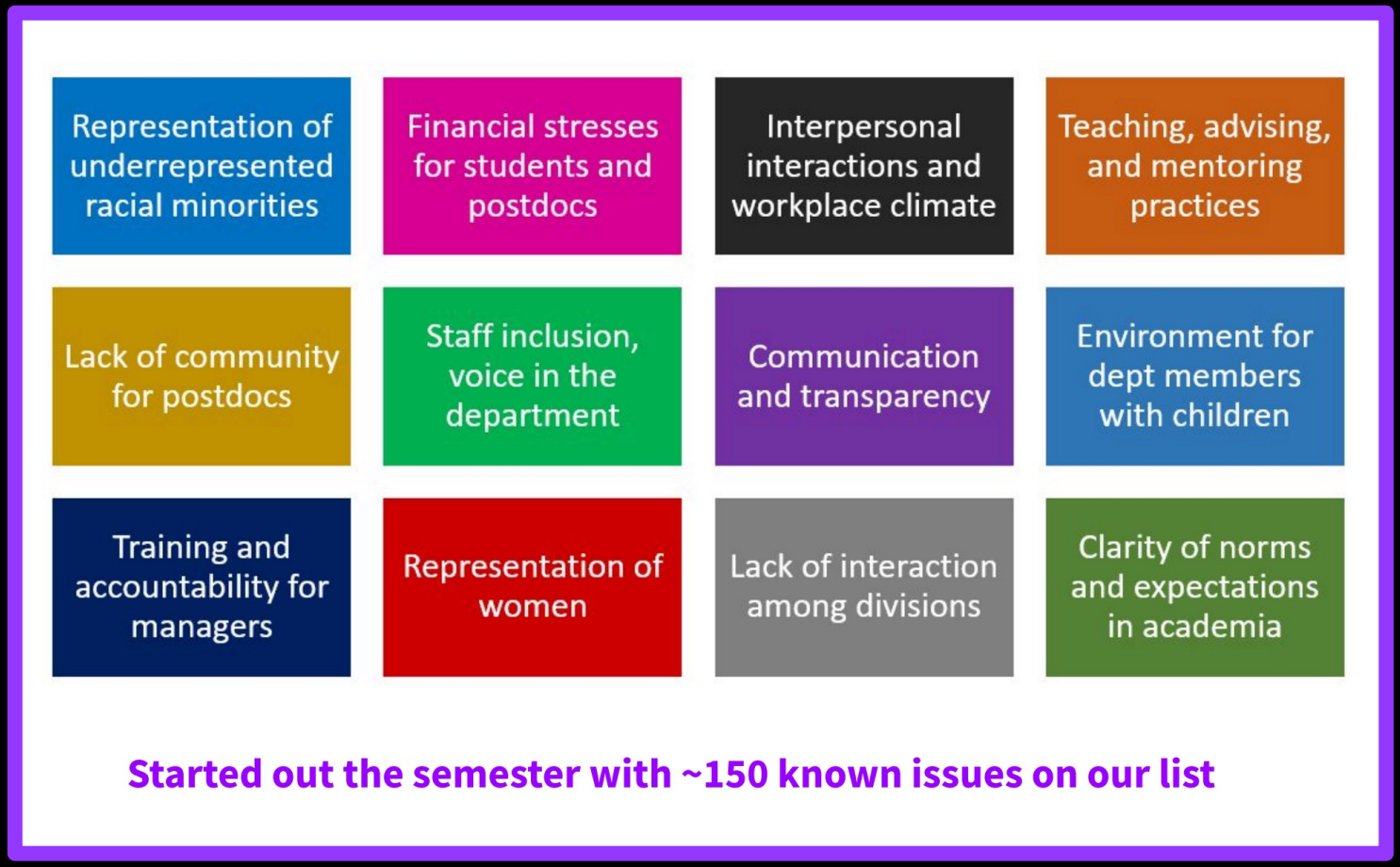
Formal

- Department Town Hall
- "Exit survey" for people who graduate or quit
- Create an anonymous complaints form online
- …

Informal

- Ask committee members what their peers say
- Engage with student & staff group advocacy
- Read community articles about common issues
- …

Problems people raised to MIT's committee

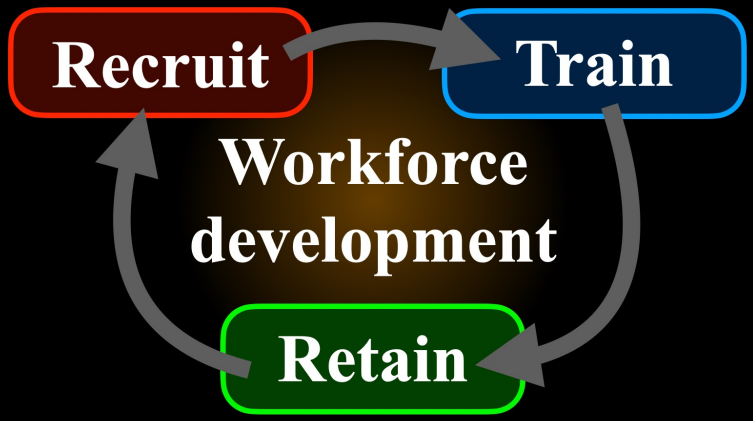


MIT Physics Values Committee Town Hall slides, Fall 2020.

Prioritization

Rinse and repeat

1. Compile a list of problems
2. Order problems by priority
3. Research solutions
4. Recommend changes
5. Assess their impact



Can’t do everything, everywhere, all at once.

Prioritization criteria

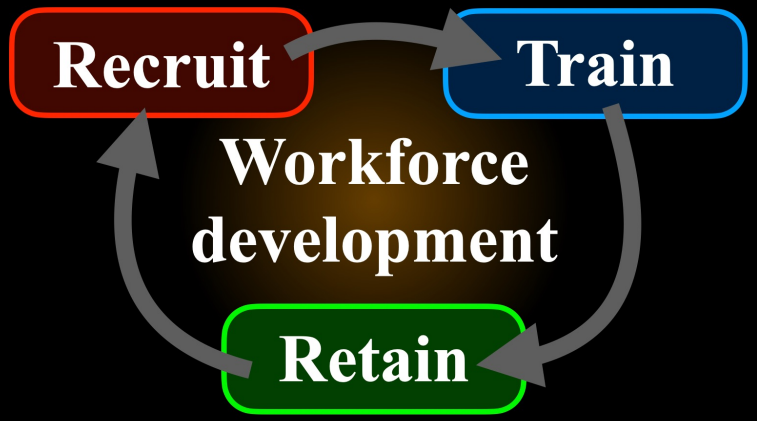
Impact

- **How many** people does this affect?
- **How much** does it affect them?
- **How long** has it been going on?

Effort

- **Start-up costs:** What resources will it take to implement improvements?
- **Ongoing costs:** What resources are needed to continue these changes?
- **Resources:** Time, money, personnel, physical space, …

Allocating your attention



Career stage

- Bachelor's and Ph.D. students
- Postdocs and research staff
- Junior and senior faculty
- Non-research staff

Population

- Physics background and academic path
- Personal background and life experiences

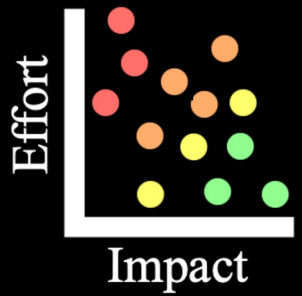
Department sector

- Administrative offices
- Divisions and centers
- Theory or experiment

Building a committee's portfolio

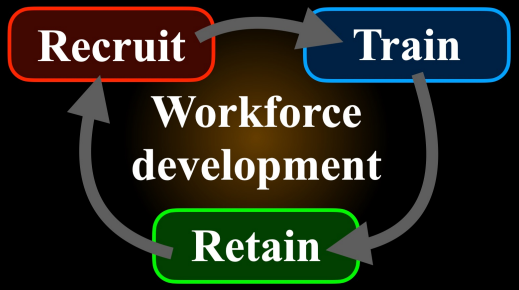
1. Start small and local

- "Put on your own mask first before helping others"
- Build up your team's experience and camaraderie



2. Make the work sustainable

- Have a balanced portfolio of high- and low-effort work
- Don't let perfect be the enemy of good



3. Distribute committee focus

- Don't focus on one issue at the expense of all others
- But also, don't spread yourself too thin

Devising solutions

Rinse and repeat

1. Compile a list of problems
2. Order problems by priority
3. Research solutions
4. Recommend changes
5. Assess their impact

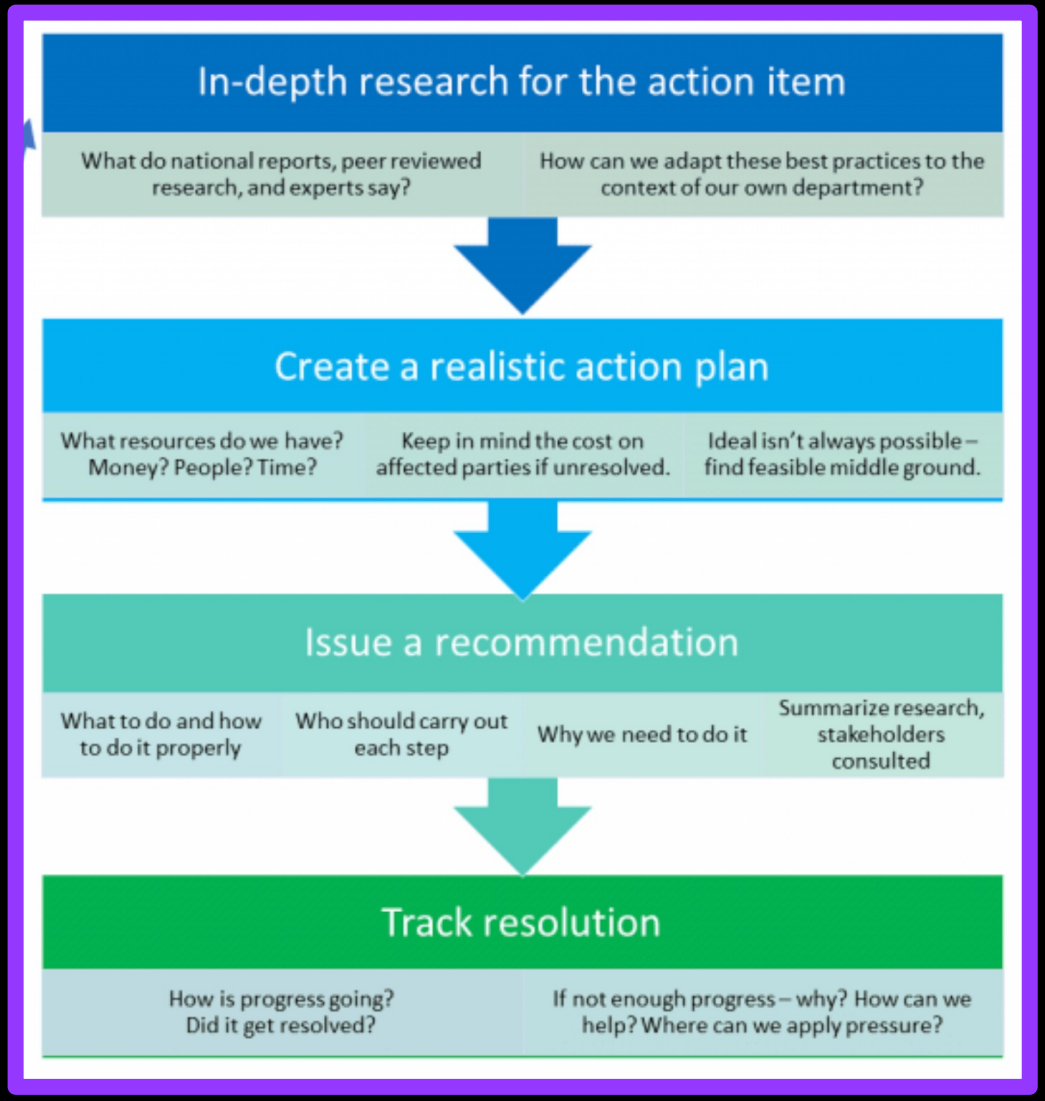


Figure: MIT Physics Values Committee.

Contents of a recommendation

1. Background information
2. Specific goals for resolving the problem
3. Concrete action items for achieving these goals
   Who, what, when, and where. The more specific and actionable, the better.

At this time, the committee should also decide on a plan for following up on progress.

Key inputs for an action plan

Stakeholder input

- People who are affected
- People responsible for implementing changes

Best practices

- What is known to work; not unproven strategies
- May depend on values, culture, and legal situation

Available resources

- If you add new staff duties, you'll have to take others away or hire new people

Department leaders

- Consult & negotiate *before* issuing a recommendation
- Should not be surprised by what the committee does

Many resources to utilize

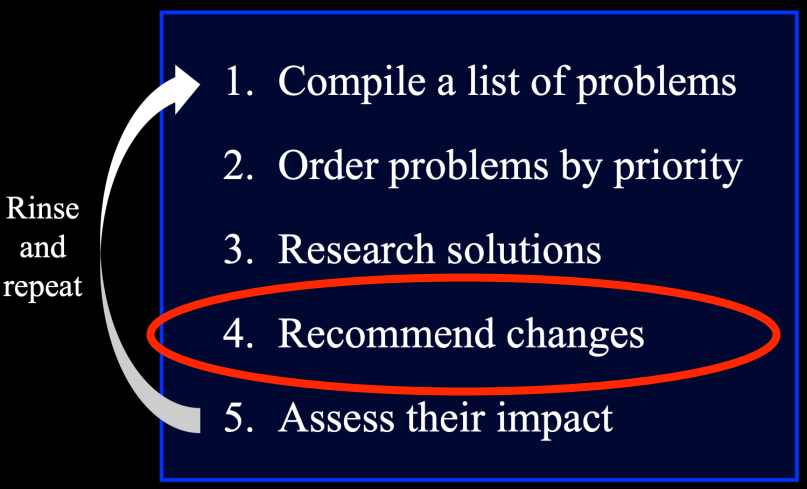
Institutional

- **Offices** ranging from community partnerships to student support to careers
- **Professional development,** like teaching evaluations, peer mentoring, workshops…
- **Existing organizations,** such as outreach initiatives or focused committees

Community

- **Reports/guides** from professional societies or other universities (e.g. NASEM, EP3 guide)
- **Professional development** via workshops or working groups (e.g. APS-IDEA)
- **Local organizations** for science outreach, public policy, support

Key points for follow up



Assign a point person

- For long-term issues, this should be a faculty or staff member

Establish concrete metrics

- Were the action items completed?
- Measurable change in outcomes?

  (Survey results, student grades, postdoc job acquisition, department enrollment, …)

Example: Graduate advising

Dear Department Leadership,

We have written the following report responding to your charge concerning undergraduate and graduate advising within the MIT Department of Physics. From consulting advising surveys, soliciting town halls, and frequent conversations with PGSC and faculty members, we attempted to solicit feedback from a representative cross section of our community on the experience of advising.

We have developed the following recommendations/resources for graduate research advising:

- We recommend that all incoming graduate students meet with their advisor before they decide to start formally working in a research group. At this meeting, students and advisors should base their discussion on the *Setting Advising Expectations – New Graduate Students* document below and fill out a form to record that they met. We also recommend that all graduate students meet with their advisors once a year to reflect on the previous year and set expectations for the upcoming year. We have developed a *Self Reflection Exercise* for advisees to complete before the meeting and a discussion guide (see *Setting Advising Expectations – Returning Students)* to form a basis for the meeting itself.

- We recommend that faculty write an advising/group values statement that will be accessible to incoming first year students who are looking to pick an advisor, as well as existing MIT physics students. We have developed *Guidelines for Faculty Advising Statements* to assist faculty in writing these statements, as well as an example statement from a faculty member on our committee.

- We recommend that the department provide some general guidelines on how to fo productive research environment for both advisees and advisors. We have develop *poster-style list of DOs and DON'Ts* for faculty and students to aim to abide by throughout the PhD. We have also compiled a list of *Resources for students and advisors* to post to the Department website and highlight to current graduate stude and faculty, especially when they first arrive.

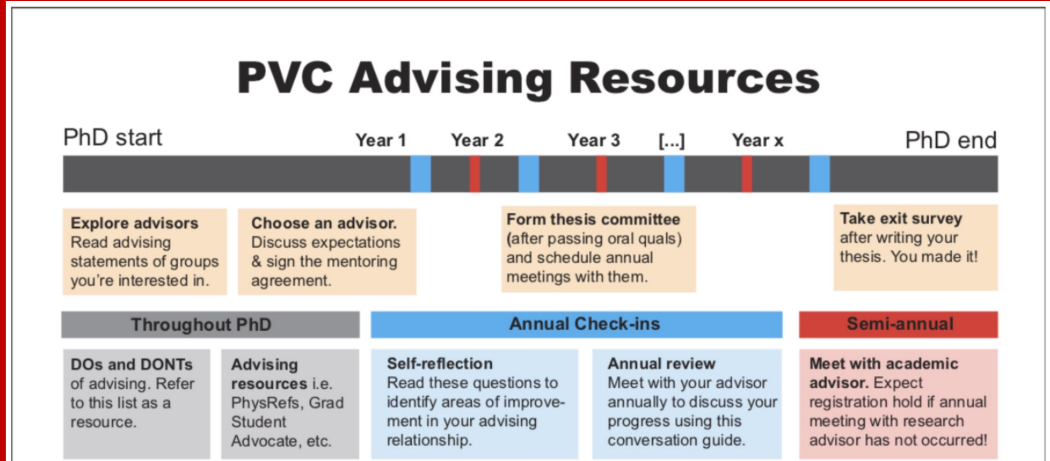
- We recommend that the department encourage each of the divisions to update the language on the central department website to reflect their current policies regardi first-year rotations.

We provide an explanatory figure on the first page of our report to summarize these recommendations/resources and how they would fit into a typical PhD timeline.

Sincerely,

The MIT Physics Values Committee

- 18-page report
- Here, a 1-page cover letter and a summary figure



Source: MIT Physics Values Committee.

Graduate advising

1. Problem list: Students discussed poor advising in surveys, Town Halls, and informal conversations.

2. Prioritization: The Department Chair specifically asked the Committee to study advising practices and develop recommendations for improvement.

Inputs for advising action plan

Stakeholder input

- **Sometimes:** Bad actors
- **Often:** Poor communication, mismatched expectations

Best practices

- Well known and advertised
- Many resources: available online and at MIT

Available resources

- **Institute:** Many mentoring guides, programs, awards, …
- **Major constraint:** Faculty have very little extra time

Department leaders

- **Aware in advance:** Asked for this project to happen
- **In contact:** Regular meetings with committee leaders

Advising recommendations

1. Clarify rotation policies

- Each research area has different policies that weren't clearly conveyed to students

2. Faculty advising statements

- The committee created an outline for what norms and expectations these 1-page documents should include

3. Onboarding meeting for new group members

- The committee created an agenda for what students and their advisor should discuss

4. Provision of new guidance documents

- "Do's and don't's"
- Yearly check-in meeting agenda
- Self-reflection exercise for students to pinpoint prolems

Low burden of implementation

Recommendation	Who's responsible	Effort	Time	How often
Clarify and post rotation policies	Administration	**Easy**	15 min.	"One and done"
Write advising statement	Faculty	**Hard**	1-2 hours	"One and done"
Meet about expectations with each new student	Faculty	**Medium**	1 hour	Recurring, once per student
New guidance documents & exercises	Students	**Easy**	20 min.	Use as needed

Hopefully, these efforts save time and energy overall by mitigating conflict

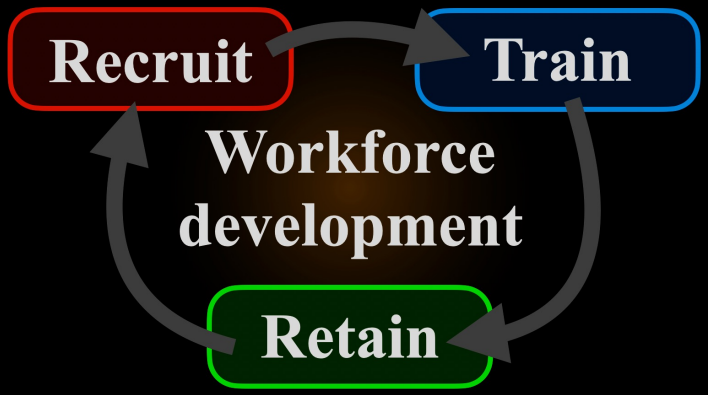
1. What is workforce development?

2. How can departments help?

3. How can you help?

The more, the merrier

There are many ways that we can strengthen our community, along many different axes



The more people we get involved in these efforts, the more progress we can make

Promoting individual involvement

Incentivize

- **Recognize:** Spotlight people in newsletters or meetings
- **Reward:** Nominate or create new awards for mentoring, service, leadership, etc.
- **Evaluate:** Include mentoring and service as explicit criteria in the hiring or promotion process

Make it easy

- **Host:** Outreach projects, school partnerships, mentor workshops, etc., right in your department
- **Advertise:** Campus and local service or learning opportunities
- **Subsidize:** Outreach project expenses, conference fees, …

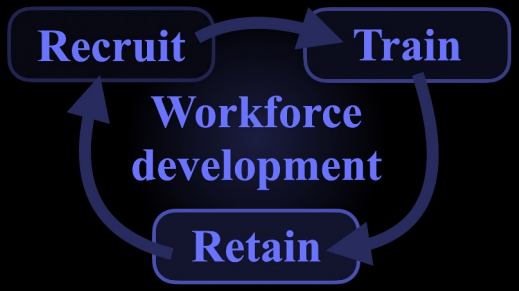
What should I get involved in?

1. Start small and local

- Helping your mentees thrive is your first and foremost responsibility

2. Make the work sustainable

- You don't have to start a major new initiative to make an important difference



3. Find your niche

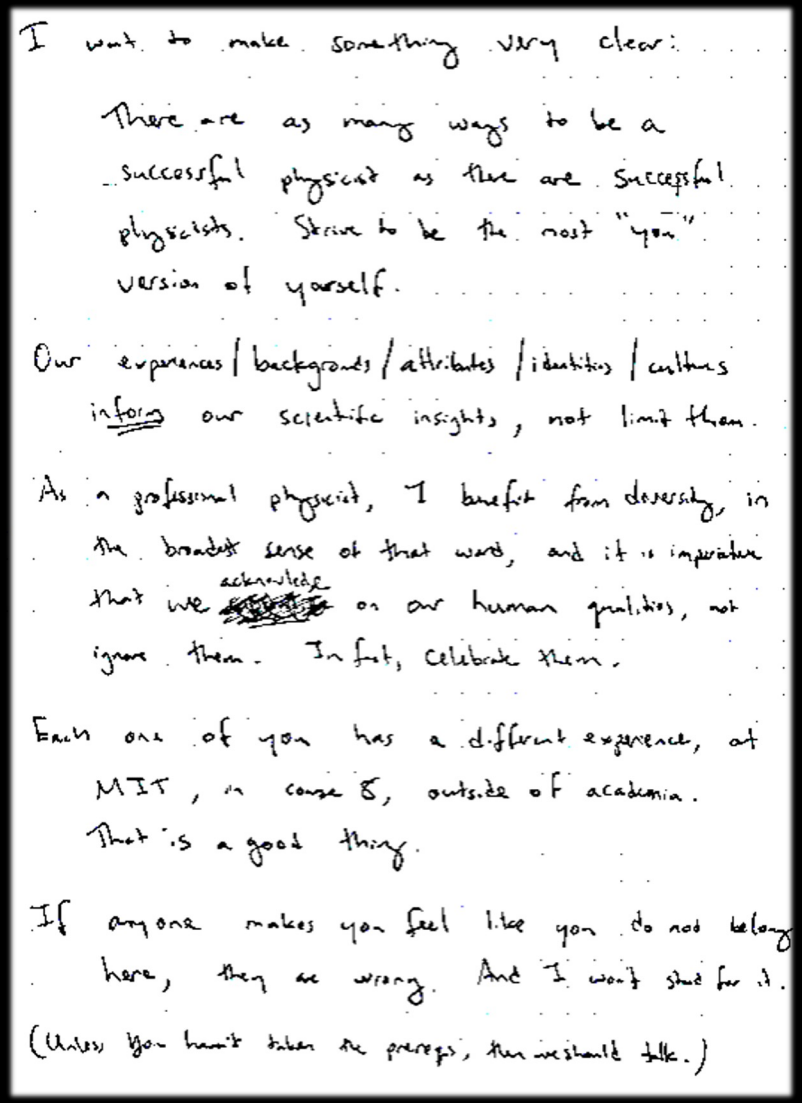
- There are many different ways to make valuable contributions to the community

Be a supportive mentor

- When you take on a trainee, you should commit to being their #1 advocate and supporter
- We recruit talented people into our programs, and we have a responsibility not to waste their potential

Hanging on the door of Moti Segev, Technion

Establish a supportive culture



I want to make something very clear:

There are as many ways to be a successful physicist as there are successful physicists. Strive to be the most "you" version of yourself.

Our experiences / backgrounds / attributes / identities / cultures inform our scientific insights, not limit them.

As a professional physicist, I benefit from diversity, in the broadest sense of that word, and it is imperative that we acknowledge on our human qualities, not ignore them. In fact, celebrate them.

Each one of you has a different experience, at MIT, in course 8, outside of academia. That is a good thing.

If anyone makes you feel like you do not belong here, they are wrong. And I won't stand for it.

(Unless you haven't taken the prereqs, then we should talk.)

First day of class

Special relativity (8.033)

Jesse Thaler, MIT

Workforce development outcomes

Iain Stewart, MIT

● = Jobs in academia ● = Jobs outside academia

It's highly unlikely that the people you train will ever return to your institution.

Nonetheless, you stand to benefit

- A healthier workplace
- Better productivity for all
- Spreading your influence broadly in the long term

The well-being of our field depends on physicists everywhere taking workforce development seriously.

Conclusion

Massachusetts Institute of Technology

Mission

"To advance knowledge & education of students in science, technology, & other areas of scholarship that will best serve the nation & the world."

Values

- Excellence & curiosity
- Openness & respect
- Belonging & community

Ultimately, this is about our mission and values as a global scientific community