

# Educating the innovators of the 21st century



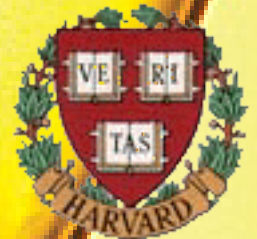
Universiteit van Pretoria  
Pretoria, Suid-Afrika, 29 May 2012





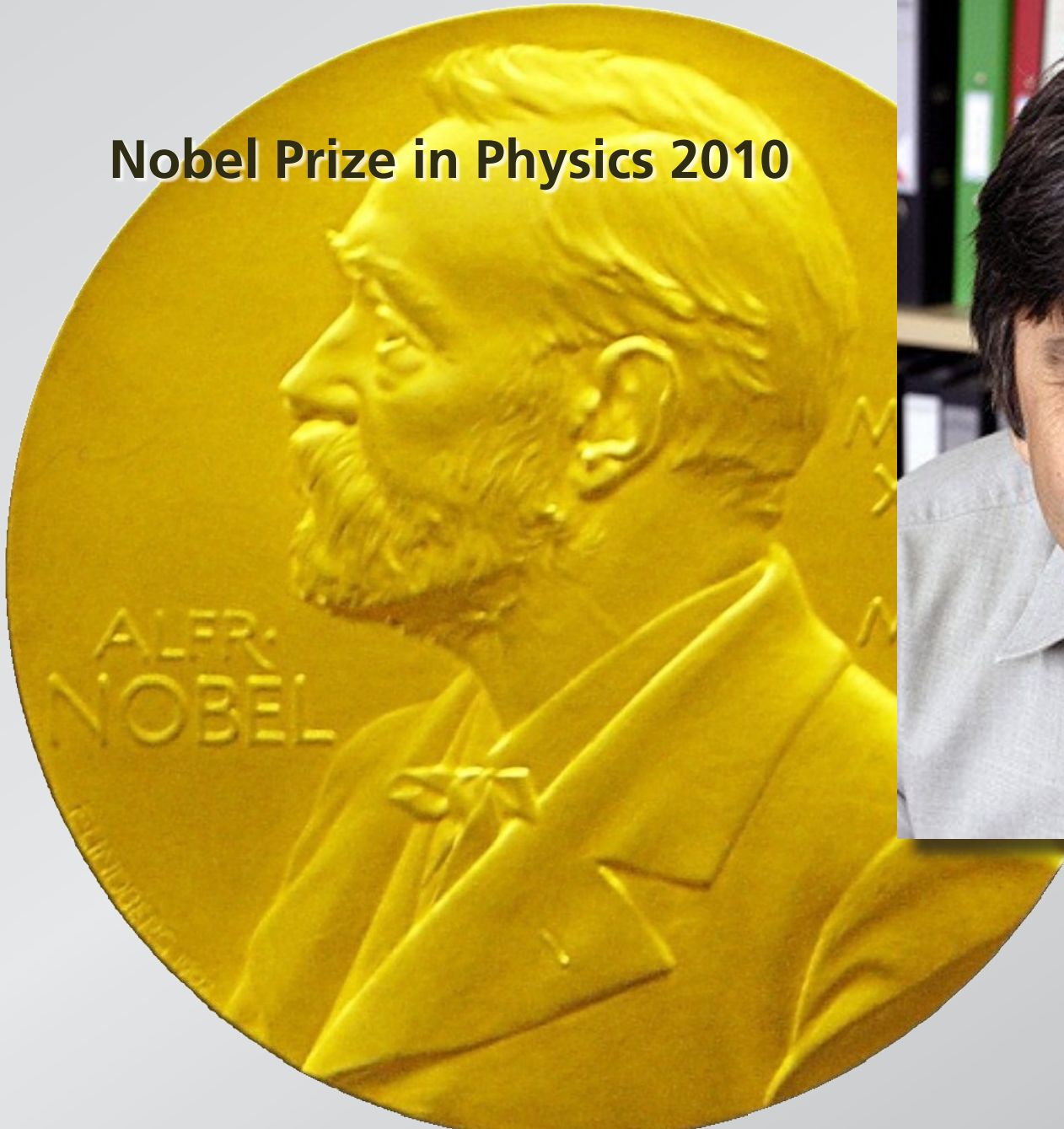
**@eric\_mazur**

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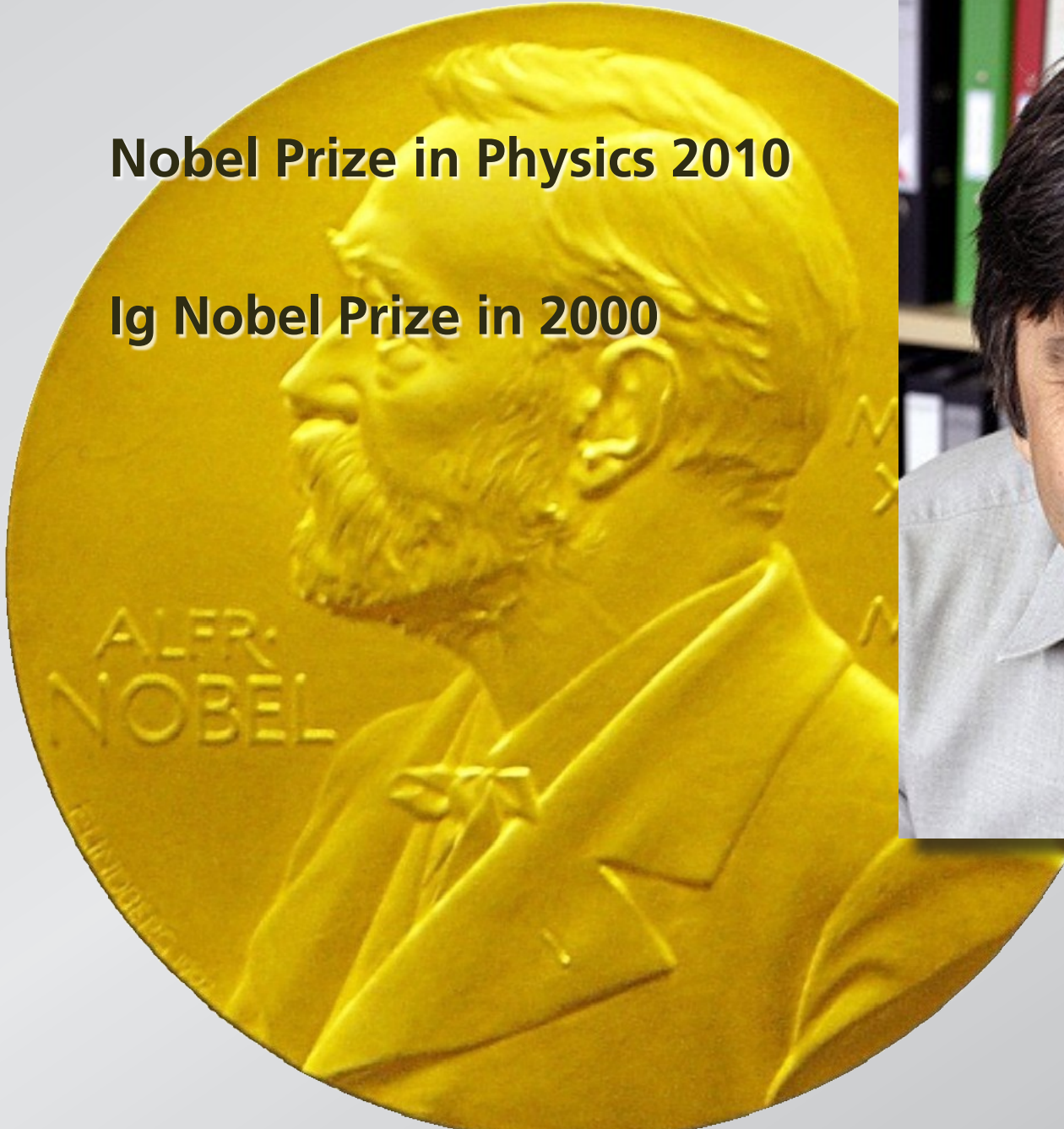
**Innovation**

**Nobel Prize in Physics 2010**

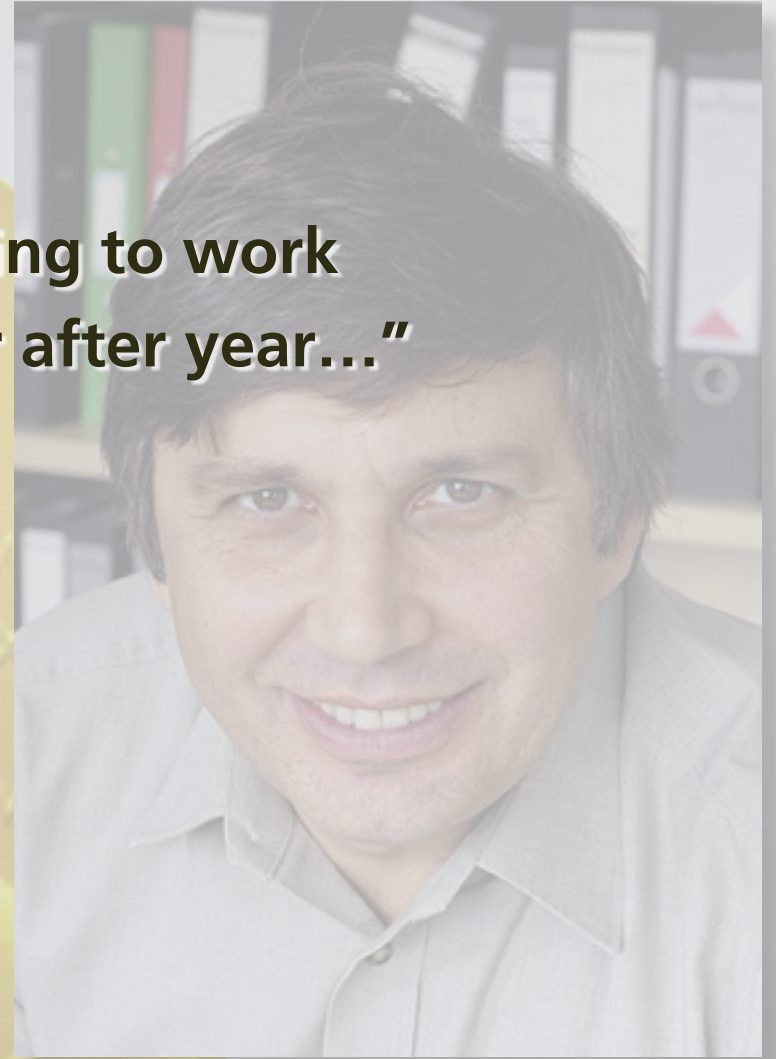


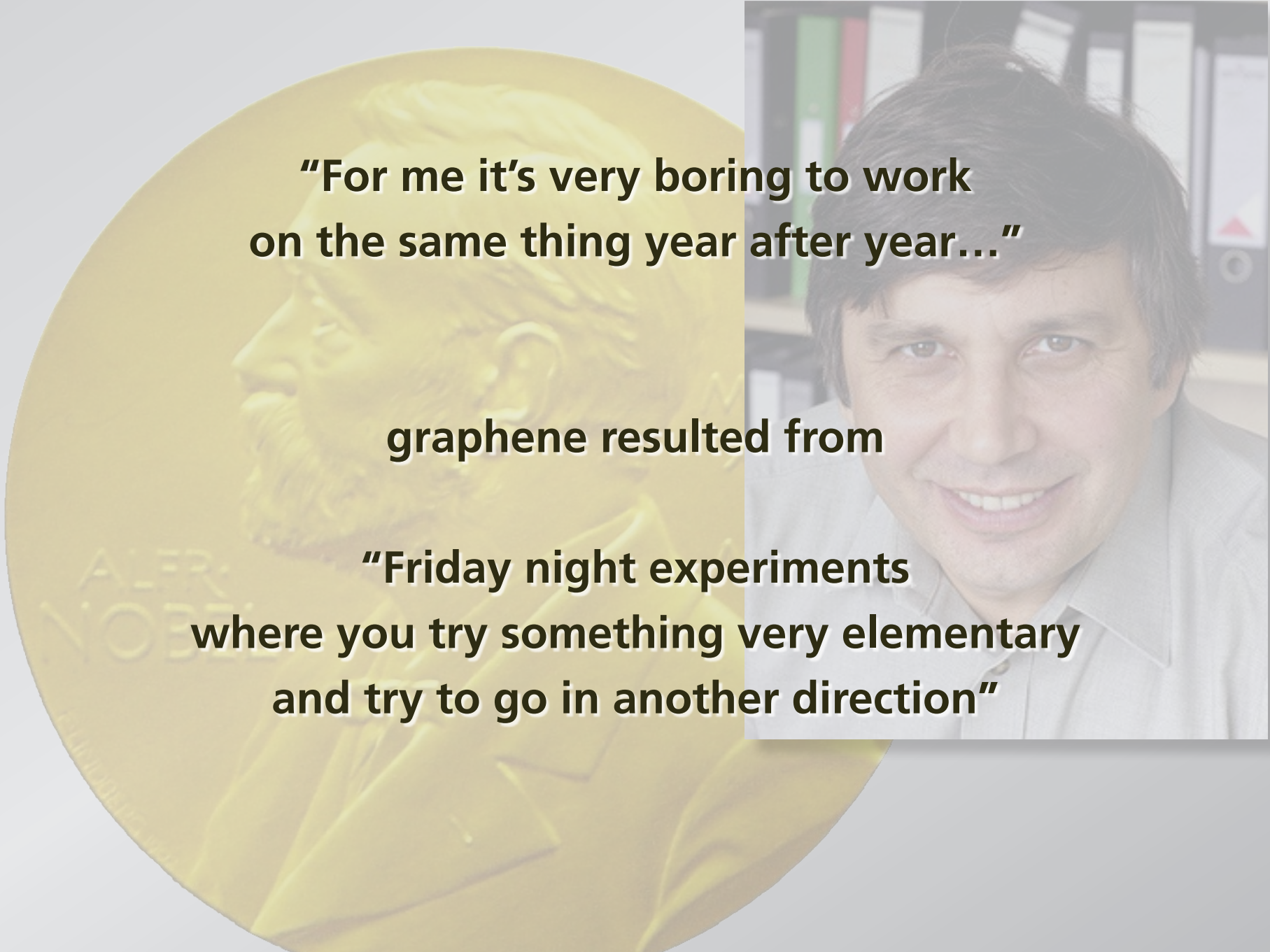
**Nobel Prize in Physics 2010**

**Ig Nobel Prize in 2000**



**“For me it’s very boring to work  
on the same thing year after year...”**





**“For me it’s very boring to work  
on the same thing year after year...”**

**graphene resulted from**

**“Friday night experiments  
where you try something very elementary  
and try to go in another direction”**

A glowing lightbulb with a warm, yellow-orange light emanating from it. The bulb is centered in the frame, and its filament is visible. The background is a soft, gradient of yellow and orange, matching the light from the bulb. The text "how can we foster/teach innovation?" is centered on the bulb's surface.

**how can we foster/teach innovation?**





**Need to...**

- **teach *problem* solving**
- **encourage risk taking**





**1** education

**2** PI



1 education

2 PI

3 test




**better pay  
attention!**

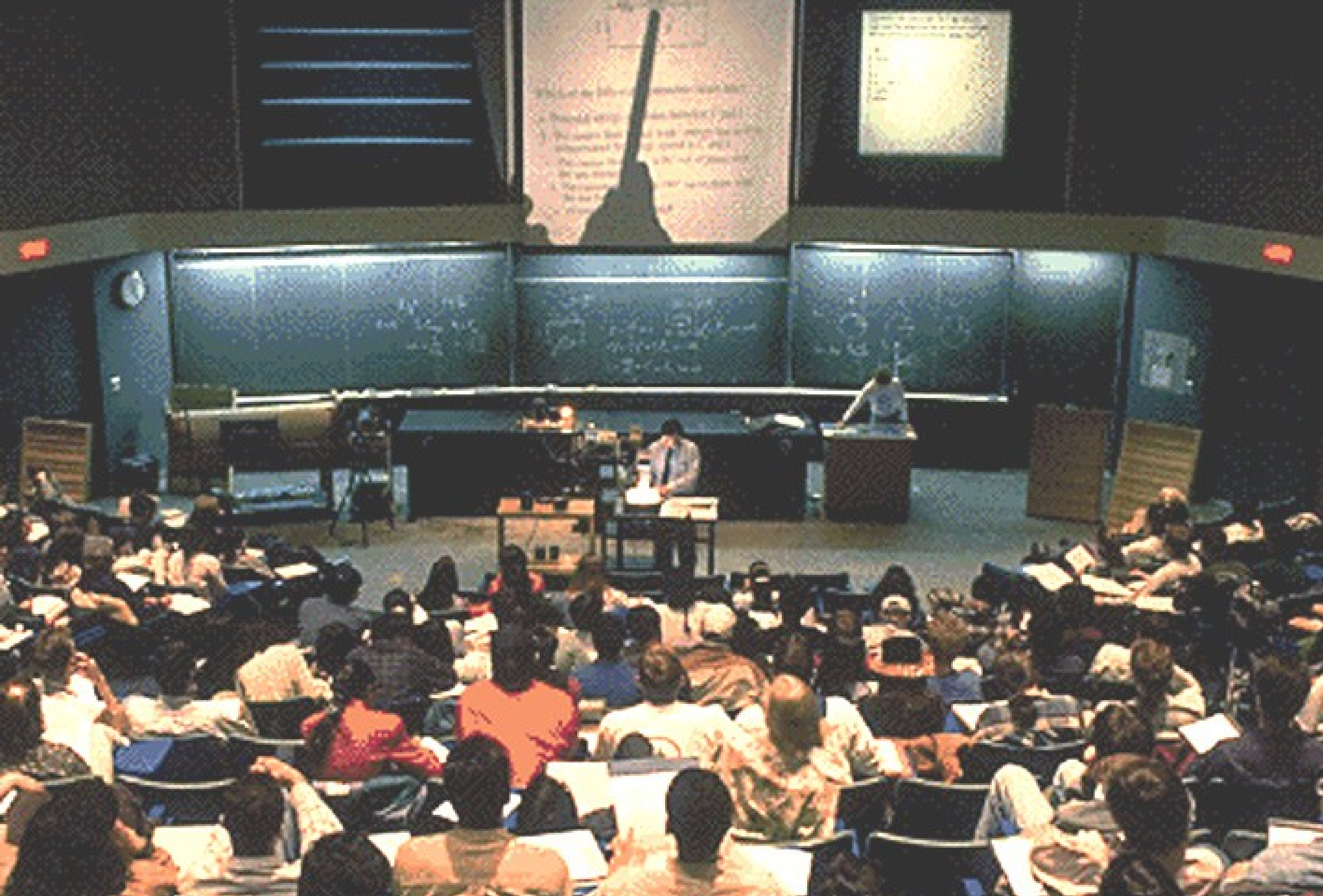
**1** education

**2** PI

**3** test



**What happens  
in a lecture?**







The result?

EDUCACION

Lack of learning

EDUCACION

**Lack of learning**

**Lack of retention**

**assessment promotes memorization and stifles creativity**

**EDUCACION**

**problem**

**EDUCACION**

**problem**

**outcome**

**EDUCACION**

**problem**

**solution**

**outcome**

**EDUCACION**

problem

solution

outcome

**KNOWN**

EDUCACION



problem

solution

outcome

UNKNOWN

KNOWN

EDUCACION

problem

solution

outcome

UNKNOWN → KNOWN

problem

EDUCACION

problem

solution

outcome

UNKNOWN

KNOWN

problem

procedure

EDUCACION

problem

solution

outcome

UNKNOWN

problem

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solution

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UNKNOWN

KNOWN

problem

procedure

answer

KNOWN

problem

solution

outcome

UNKNOWN

KNOWN

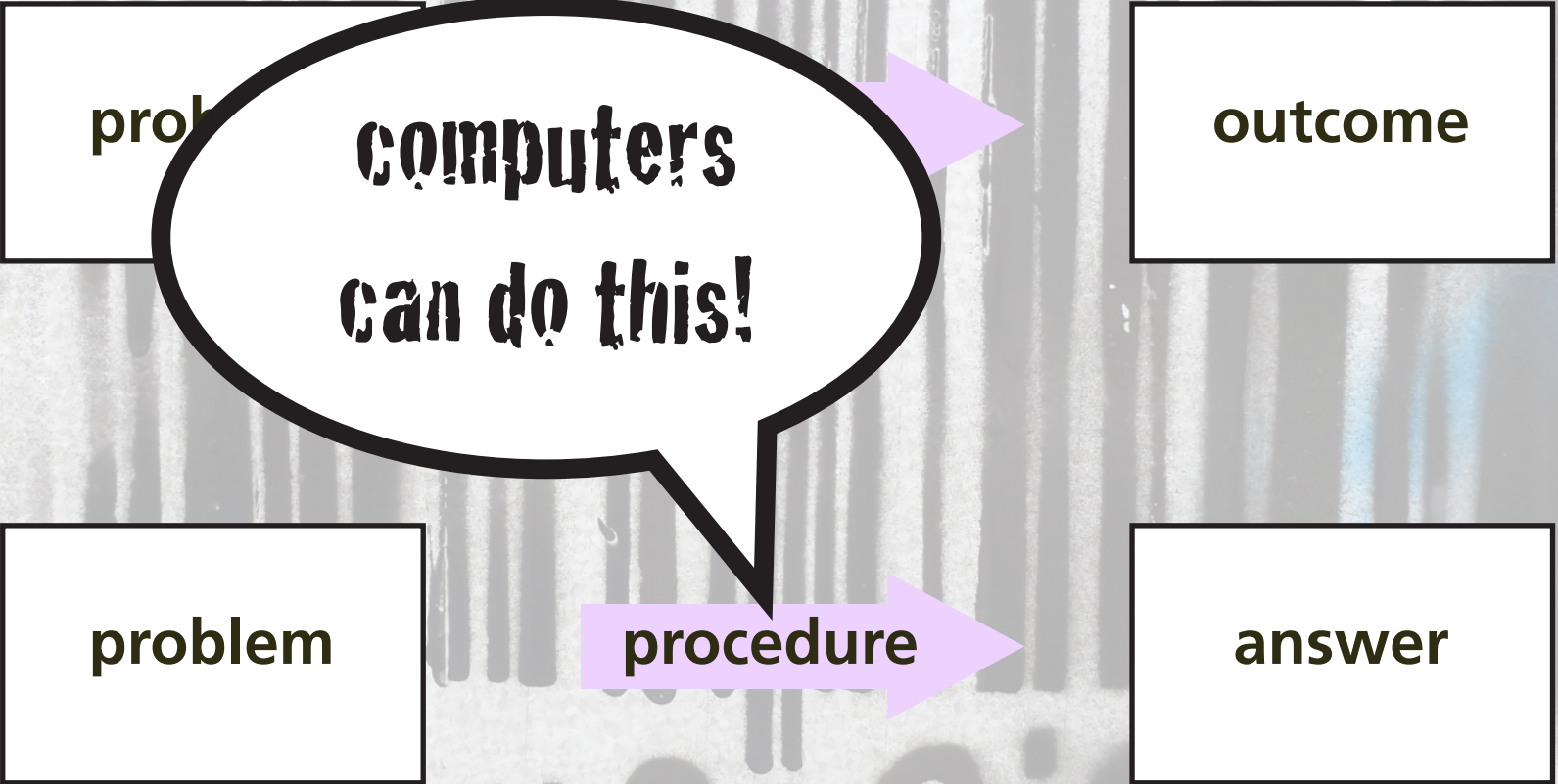
problem

procedure

answer

KNOWN

UNKNOWN



problem

solution

outcome

problem

pre... ver

**REAL**  
**problem solving**



**problem**

**approach 1**

**approach 3**

**approach 2**

**outcome**

**EDUCACION**

**problem**

**approach 1**

**approach 3**

**approach 2**

**outcome**

**assessment incompatible with real problem solving**

**EDUCACION**

## Traditional assesement

- focuses on outcome, not process

EDUCACION

## **Traditional assesement**

- **focuses on outcome, not process**
- **discourages risk taking**

**EDUCACION**

## Traditional assesement

- focuses on outcome, not process
- discourages risk taking
- focuses on individual, not group

EDUCACION

## **Traditional assesement**

- **focuses on outcome, not process**
- **discourages risk taking**
- **focuses on individual, not group**
- **does not mirror future work environment**



1 education

2 PI



# 1. transfer of information





**1. transfer of information**


**2. assimilation of that information**

- 
- 1. transfer of information (in class)**
  2. assimilation of that information



1. transfer of information (in class)

2. assimilation of that information (out of class)



**Should focus  
on THIS!**

1. transfer of information (in class)

**2. assimilation of that information (out of class)**

- 
- 1. transfer of information (in class)**
  - 2. assimilation of that information (out of class)**



**1. transfer of information (out of class)**

**2. assimilation of that information (in class)**

# Peer



1. transfer of information (out of class)

2. assimilation of that information (in class)

INSTRUCTION

question

1 education

2 PI



question



think

question



think



poll

**question**



**think**



**poll**



**discuss**

**question**



**think**



**poll**



**discuss**



**repoll**

**question**



**think**



**poll**



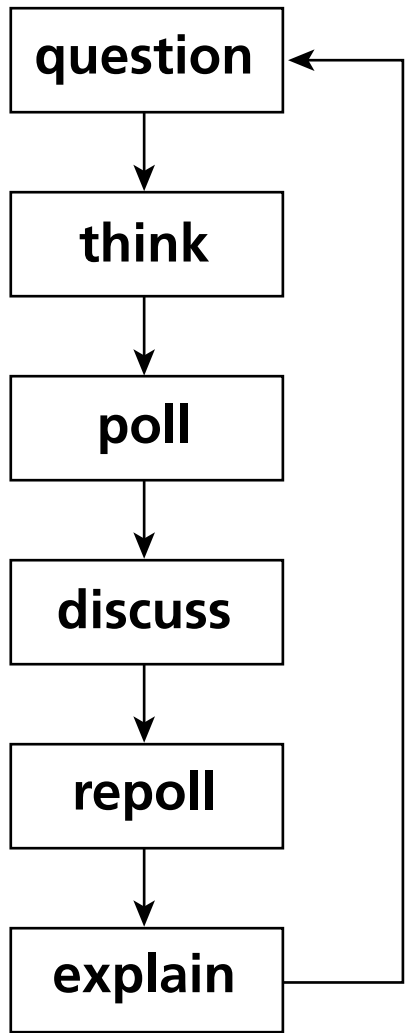
**discuss**

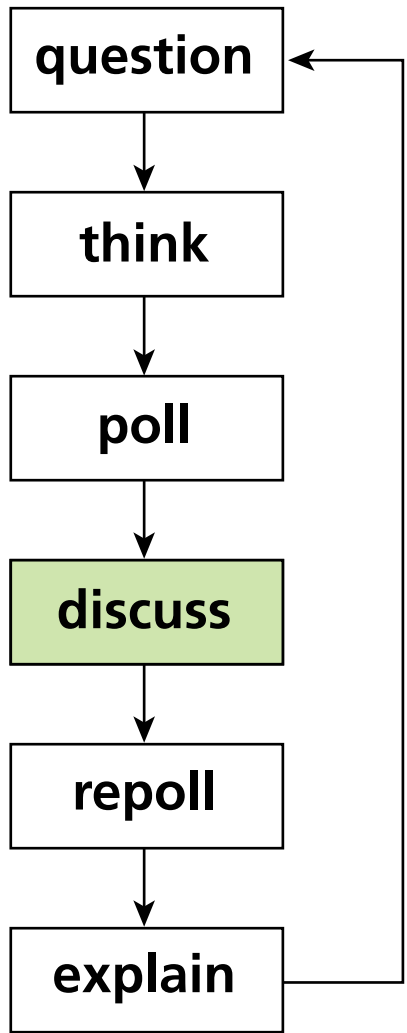


**repoll**



**explain**





**1** lecture

**2** PI



Peer  
Higher learning & gains

INSTRUCTION

1 education

2 PI

3 test

**Higher learning gains**

**Better retention**

**INSTRUCTION**

**1 education**

**2 PI**

**3 test**



**1** education

**2** PI

**3** test

in a lecture, students...

**1** education

**2** PI

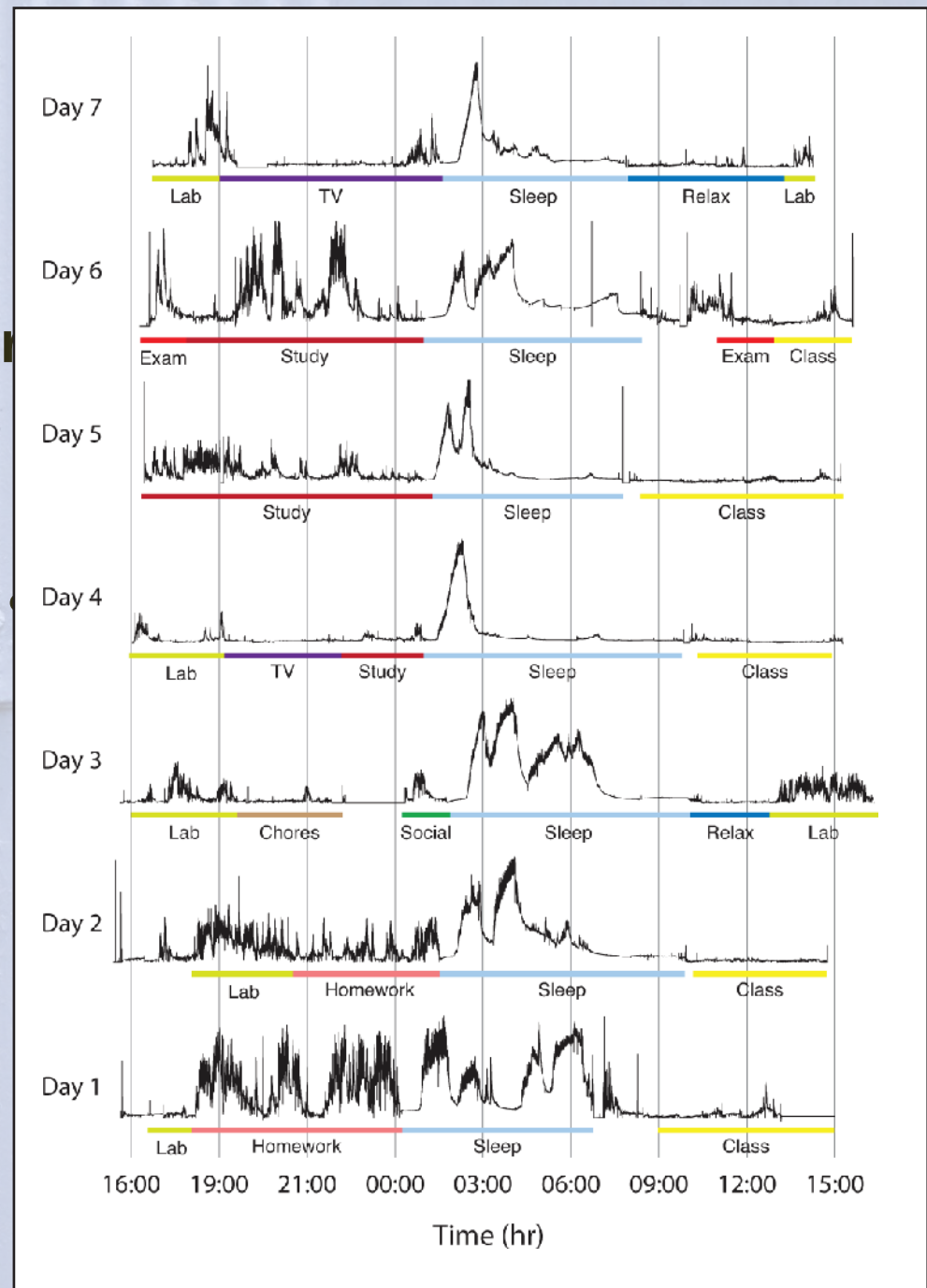
**3** test

**in a lecture, students...**

**1. don't pay utmost attention**

in a lecture

1. don't pay utmost



doi: 10.1109/TBME.2009.2038487

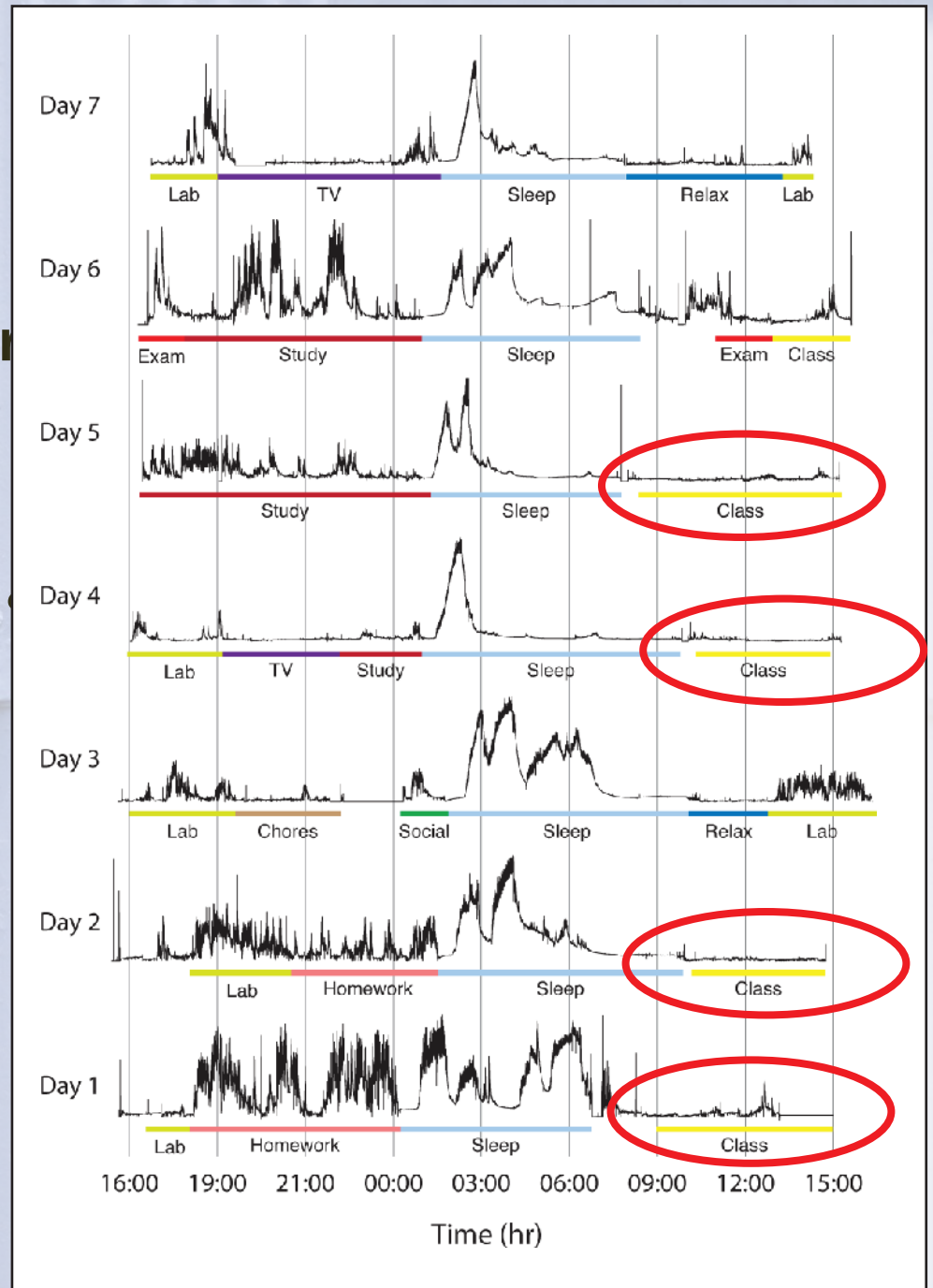
1 education

2 PI

3 test

in a lecture

1. don't pay utmost



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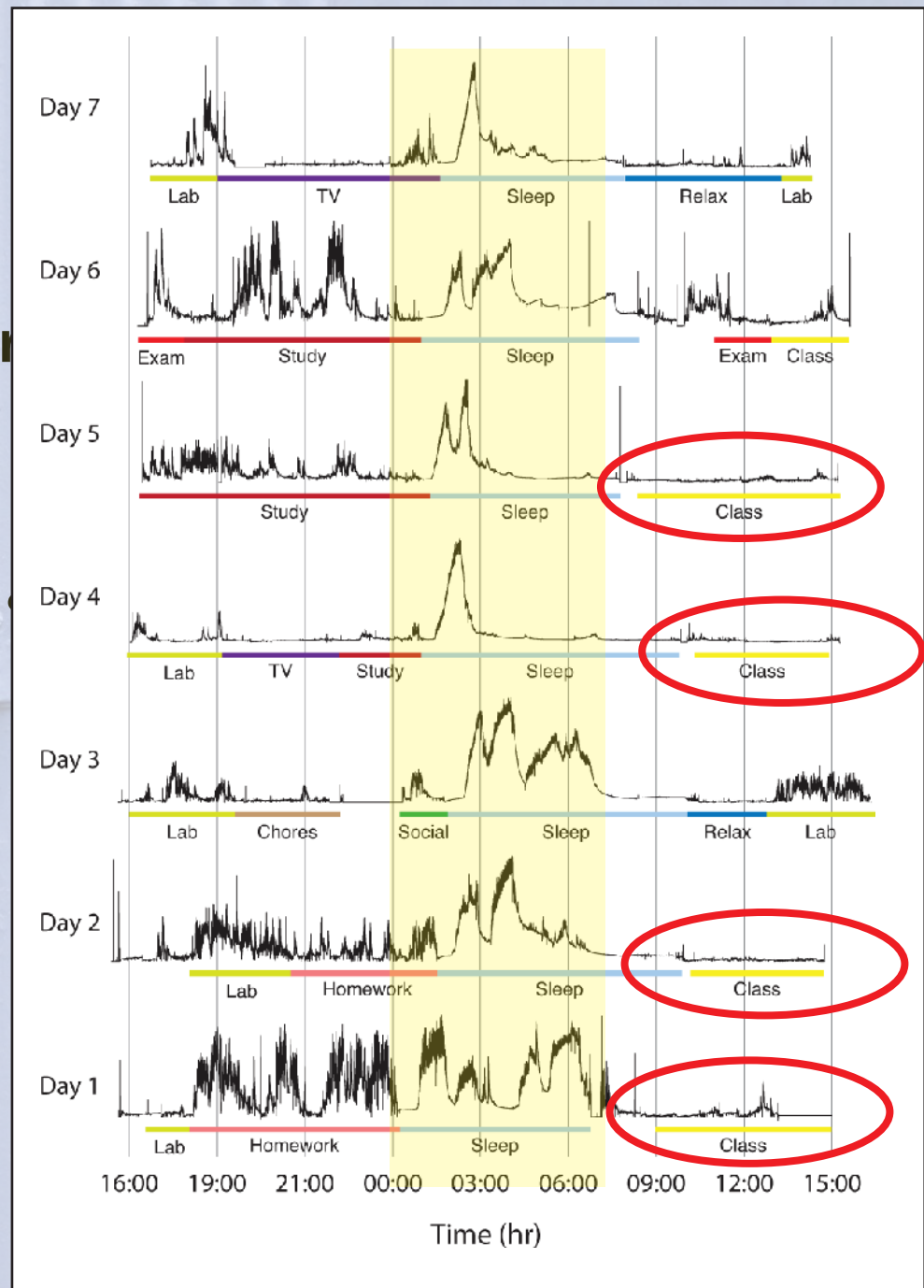
1 education

2 PI

3 test

in a lecture

1. don't pay utmost



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1 education

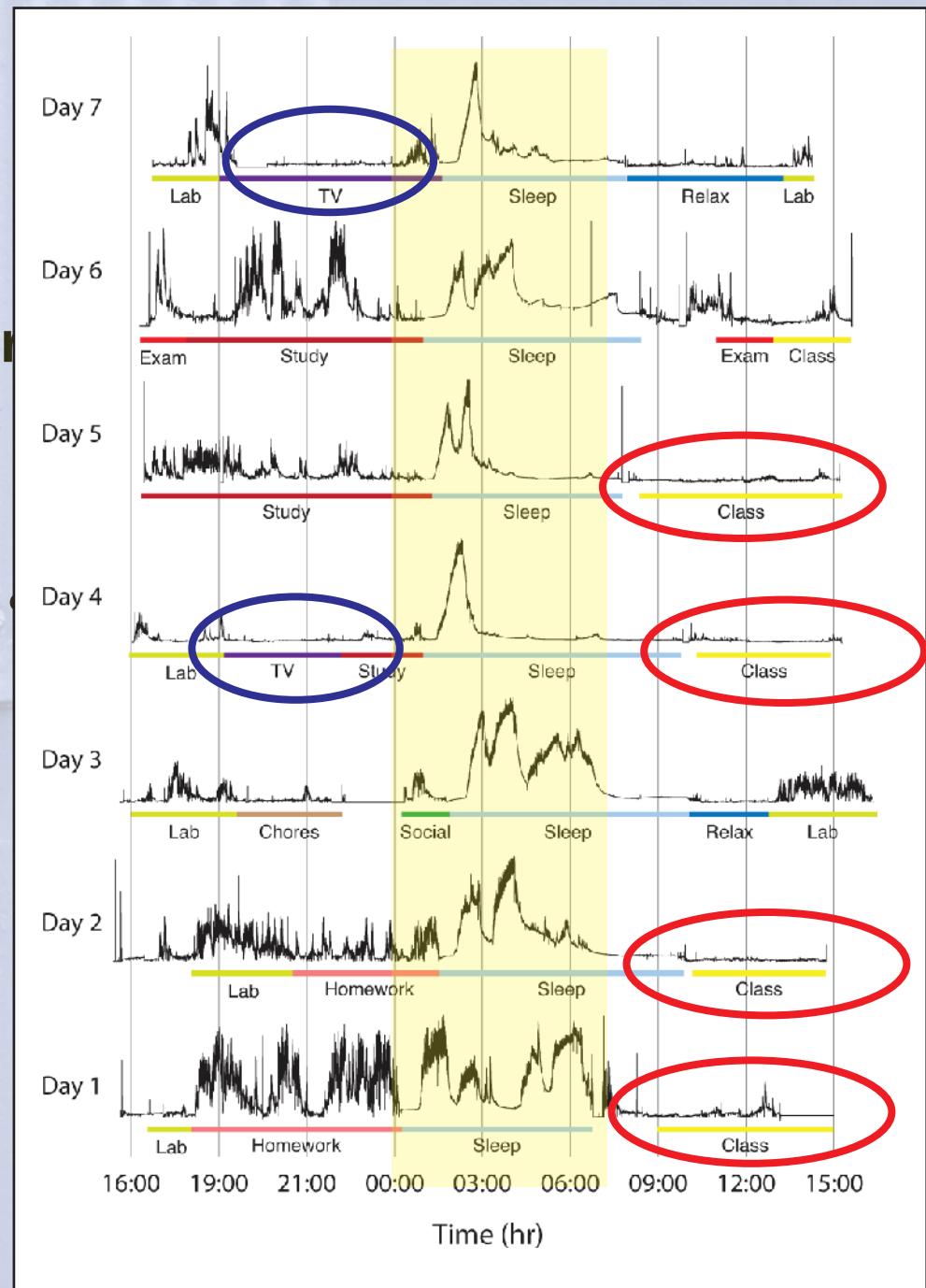
2 PI

3 test



in a lecture

1. don't pay utmost



doi: 10.1109/TBME.2009.2038487

1 education

2 PI

3 test

**in a lecture, students...**

- 1. don't pay utmost attention**
- 2. think they know it**

**in a lecture, students...**

- 1. don't pay utmost attention**
- 2. think they know it**
- 3. are not confronted with misconceptions**

in a lecture, students...

1. don't pay utmost attention

2. think they know it

3. are not confronted with misconceptions

**false**  
**sense of security**



**1** education

**2** PI

**3** test



**an illusion. . .**

**1** education

**2** PI

**3** test



**With a simple change, Peer Instruction...**

- teaches *real* problem solving
- encourages risk taking

**1** education

**2** PI

**3** test

**Funding:**

**National Science Foundation**

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