Peer Instruction — in person or online

Best Teachers Institute 2021
January 30, 2021

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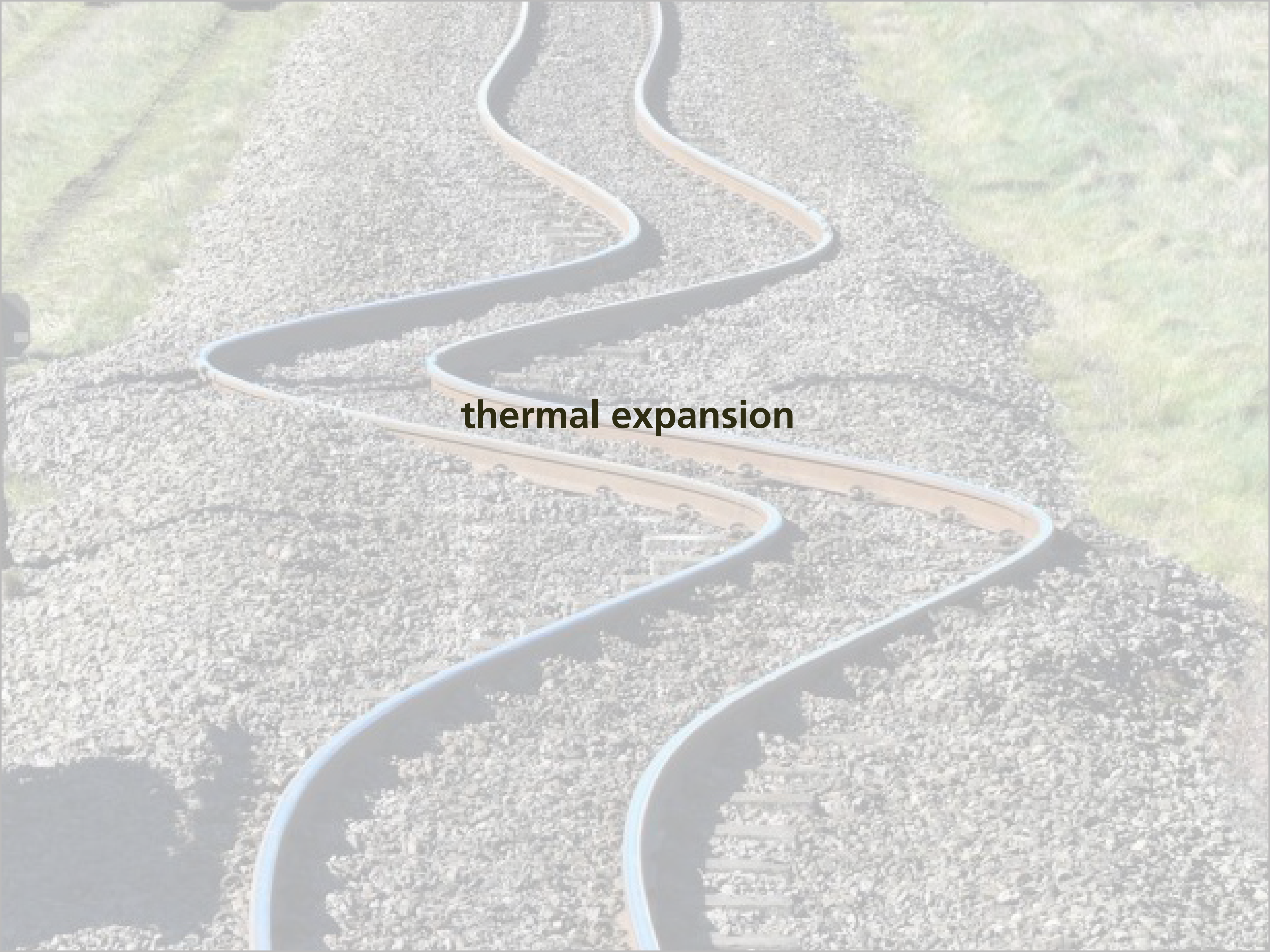
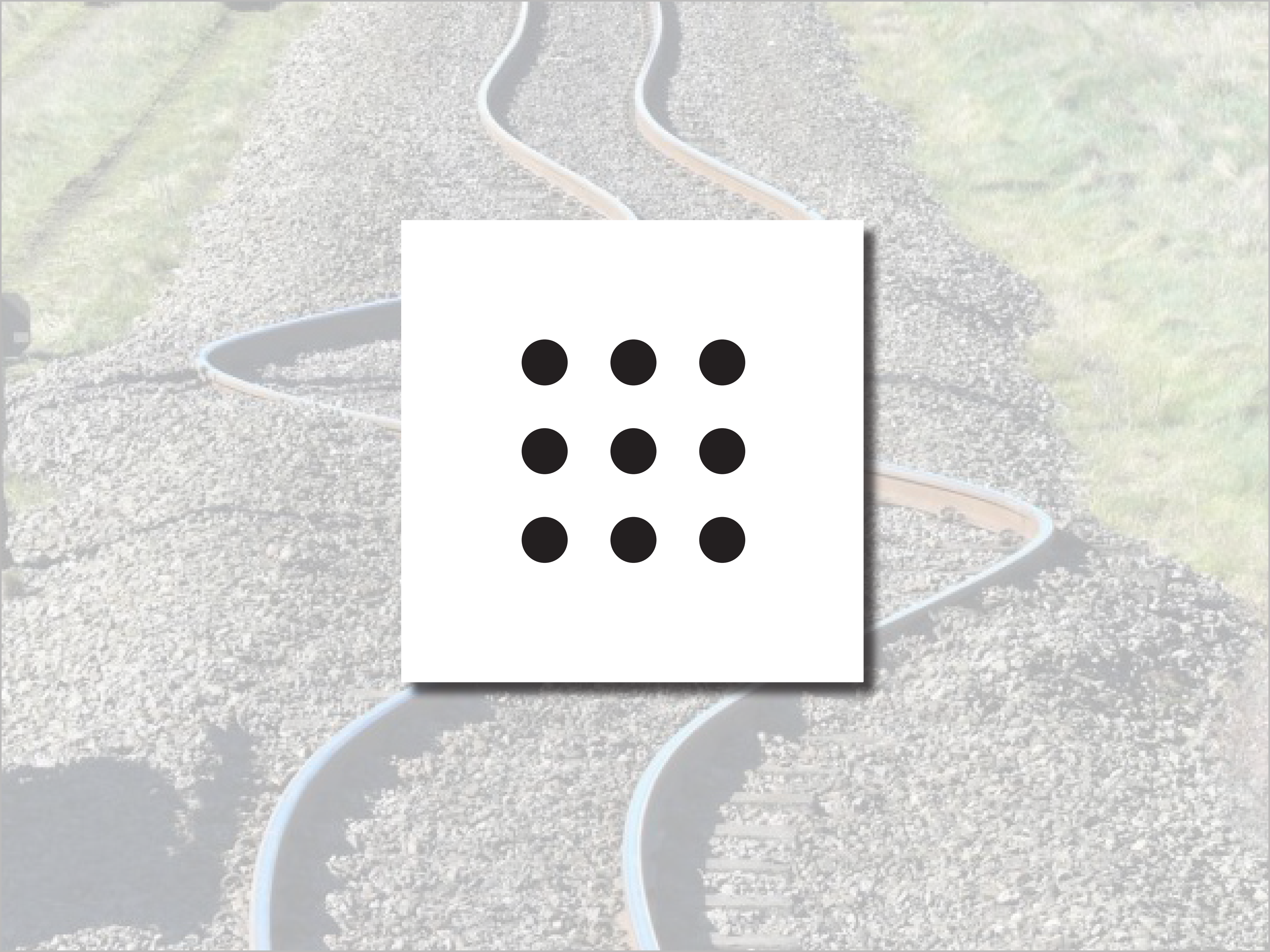
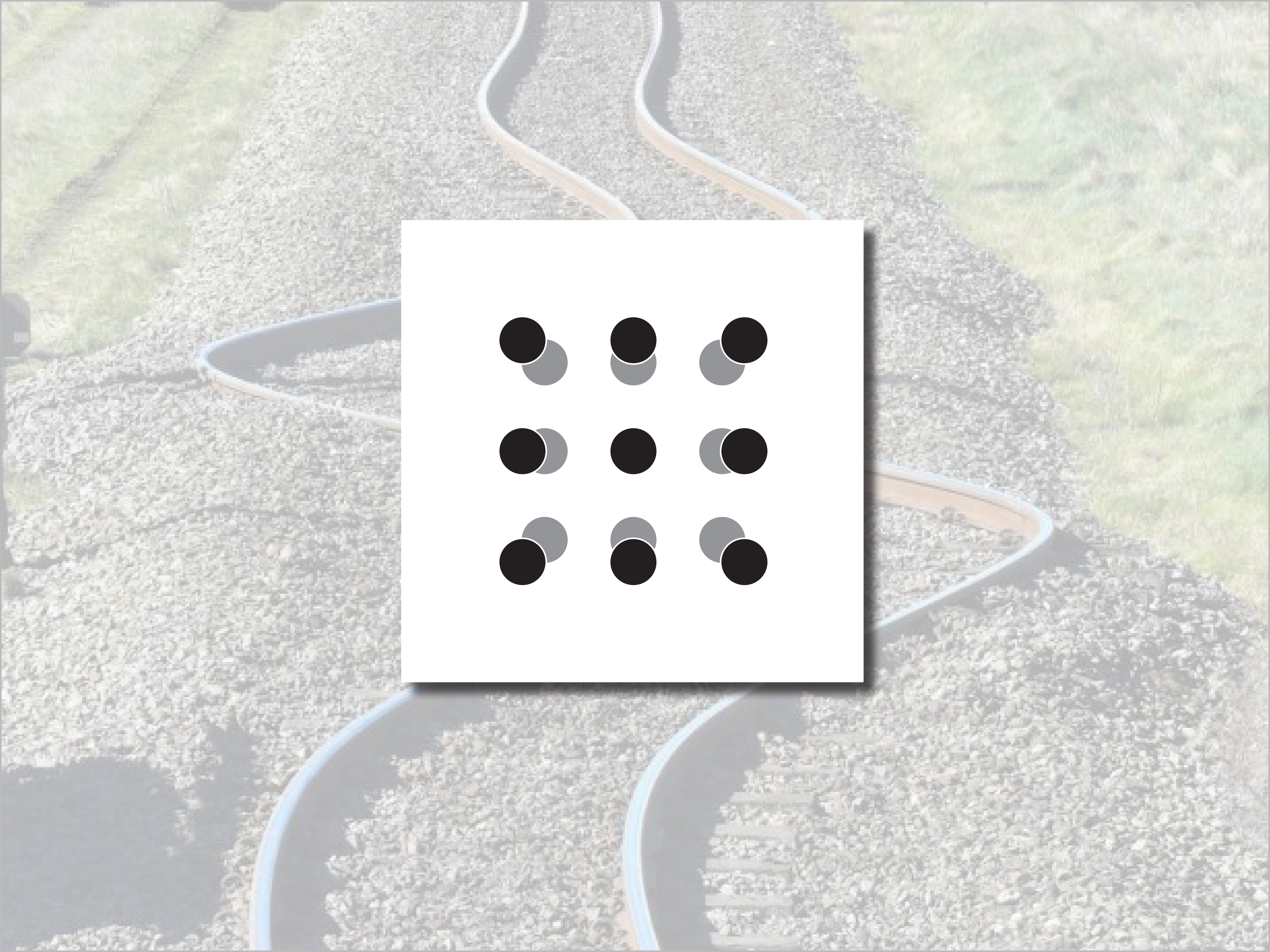
an illusion. . .

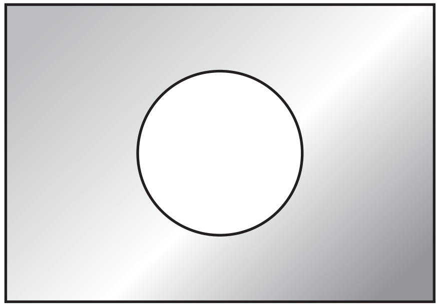

thermal expansion






all of them

Consider a rectangular metal plate with a circular hole in it.



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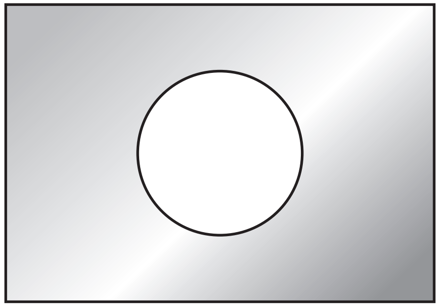
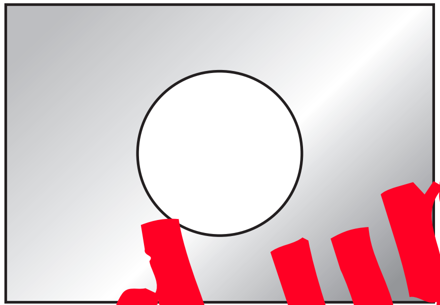


When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.

Consider a rectangular metal plate with a circular hole in it.

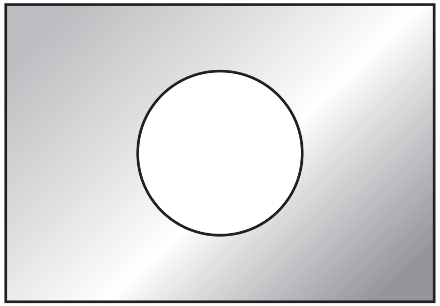


When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.

you got all fired up!

Consider a rectangular metal plate with a circular hole in it.



When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.

Before I tell you the answer, let's analyze what happened.

Before I tell you the answer, let's analyze what happened.

You…

Before I tell you the answer, let’s analyze what happened.

You…

1. made a commitment

Before I tell you the answer, let's analyze what happened.

You…

1. **made a commitment**
2. **externalized your answer**

Before I tell you the answer, let’s analyze what happened.

You…

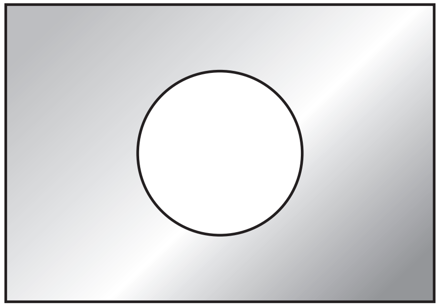
1. made a commitment
2. externalized your answer
3. moved from the answer/fact to reasoning

Before I tell you the answer, let's analyze what happened.

You…

1. **made a commitment**
2. **externalized your answer**
3. **moved from the answer/fact to reasoning**
4. **became emotionally invested in the learning process**

Consider a rectangular metal plate with a circular hole in it.



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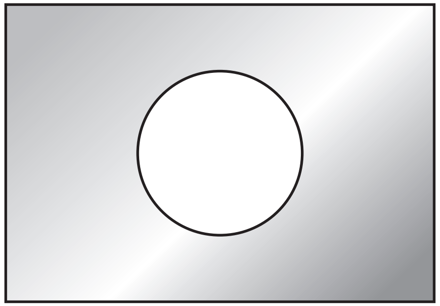
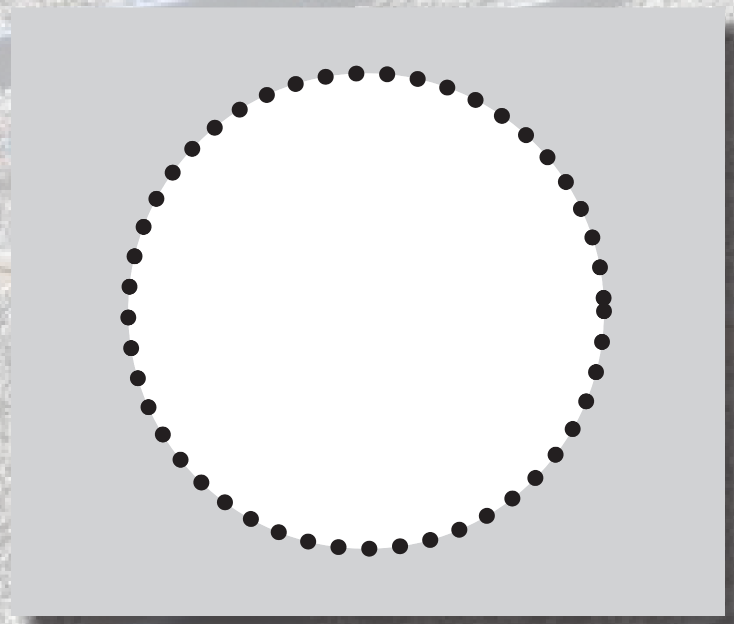
Consider a rectangular metal plate with a circular hole in it.



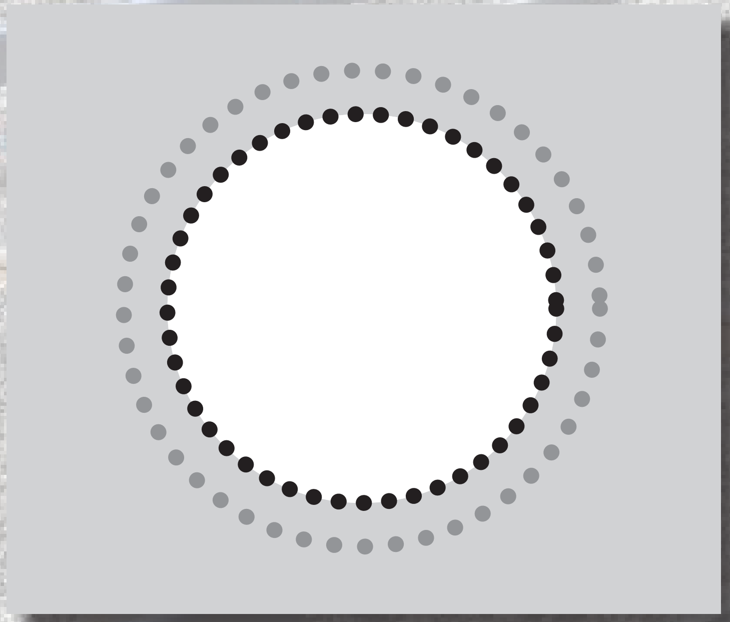
When the plate is uniformly heated, the diameter of the hole

1. increases. ✔
2. stays the same.
3. decreases.

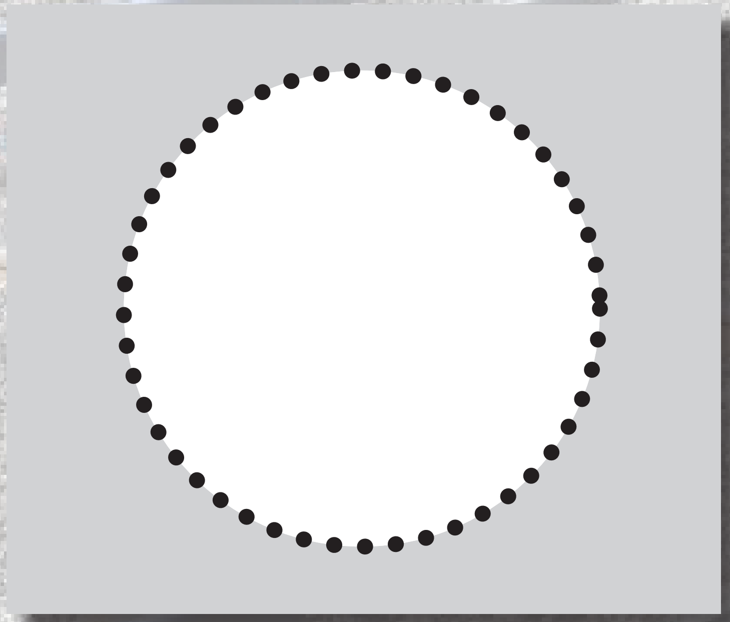
consider atoms at rim of hole



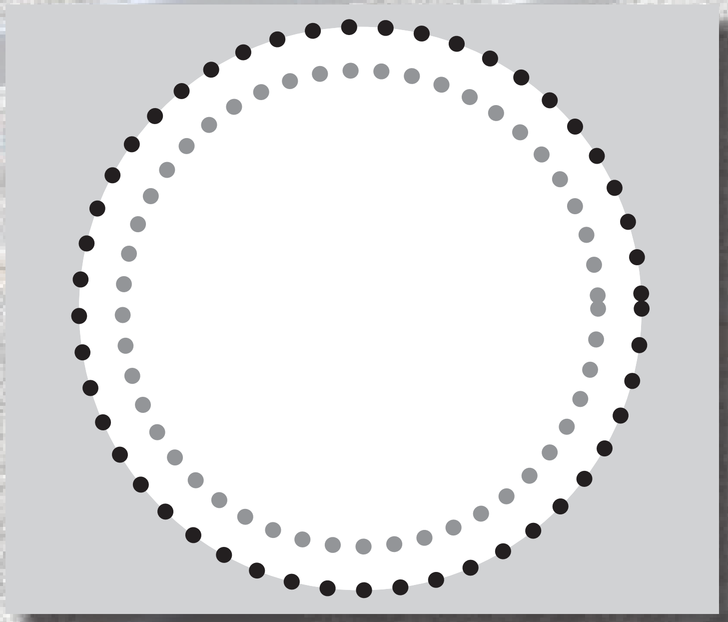
consider atoms at rim of hole



consider atoms at rim of hole



consider atoms at rim of hole

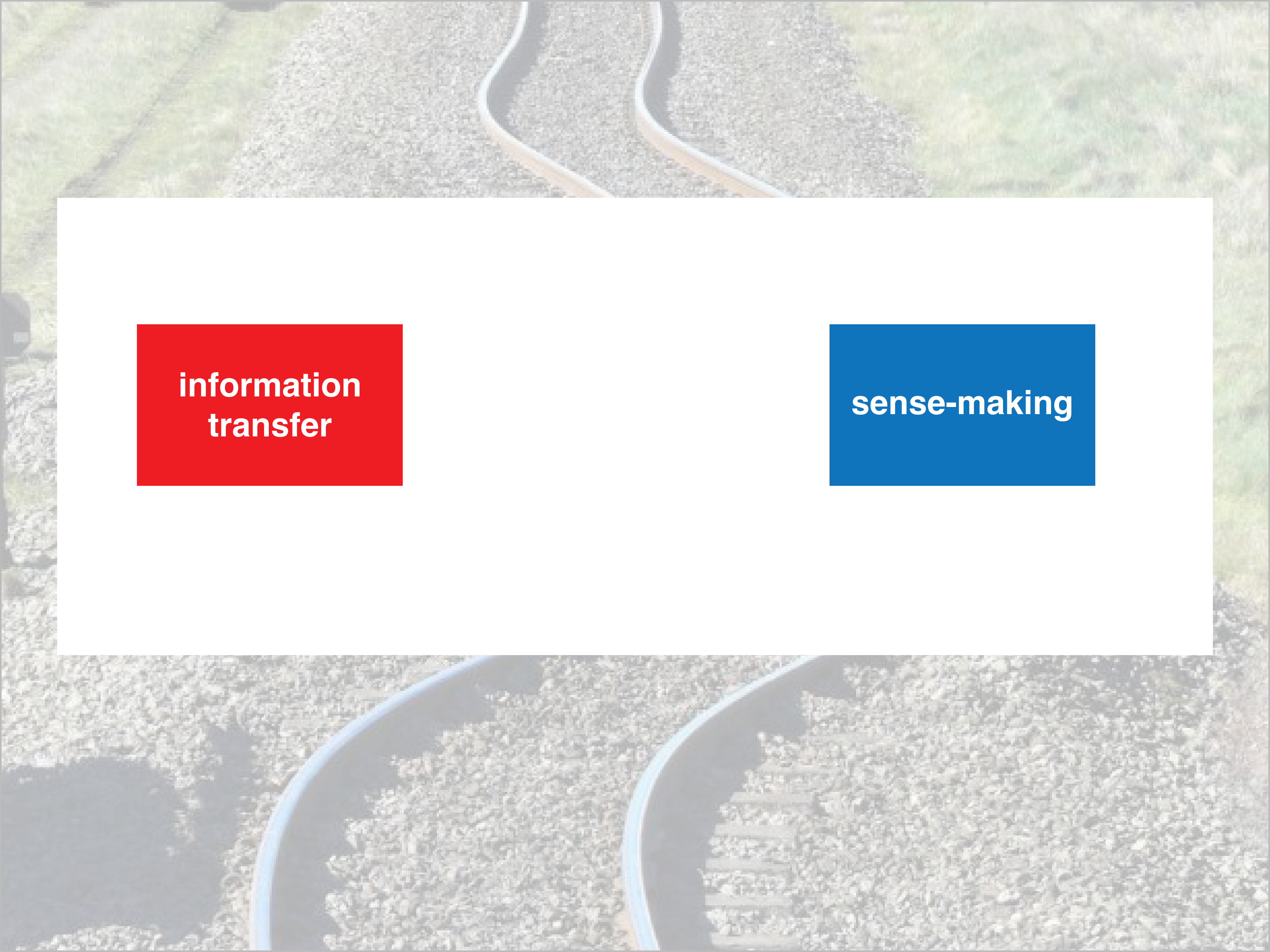


consider atoms at rim of hole

you won't forget this

points worth noting

- my “clear” lecture wasn’t very good
- discussion promoted “aha” moments



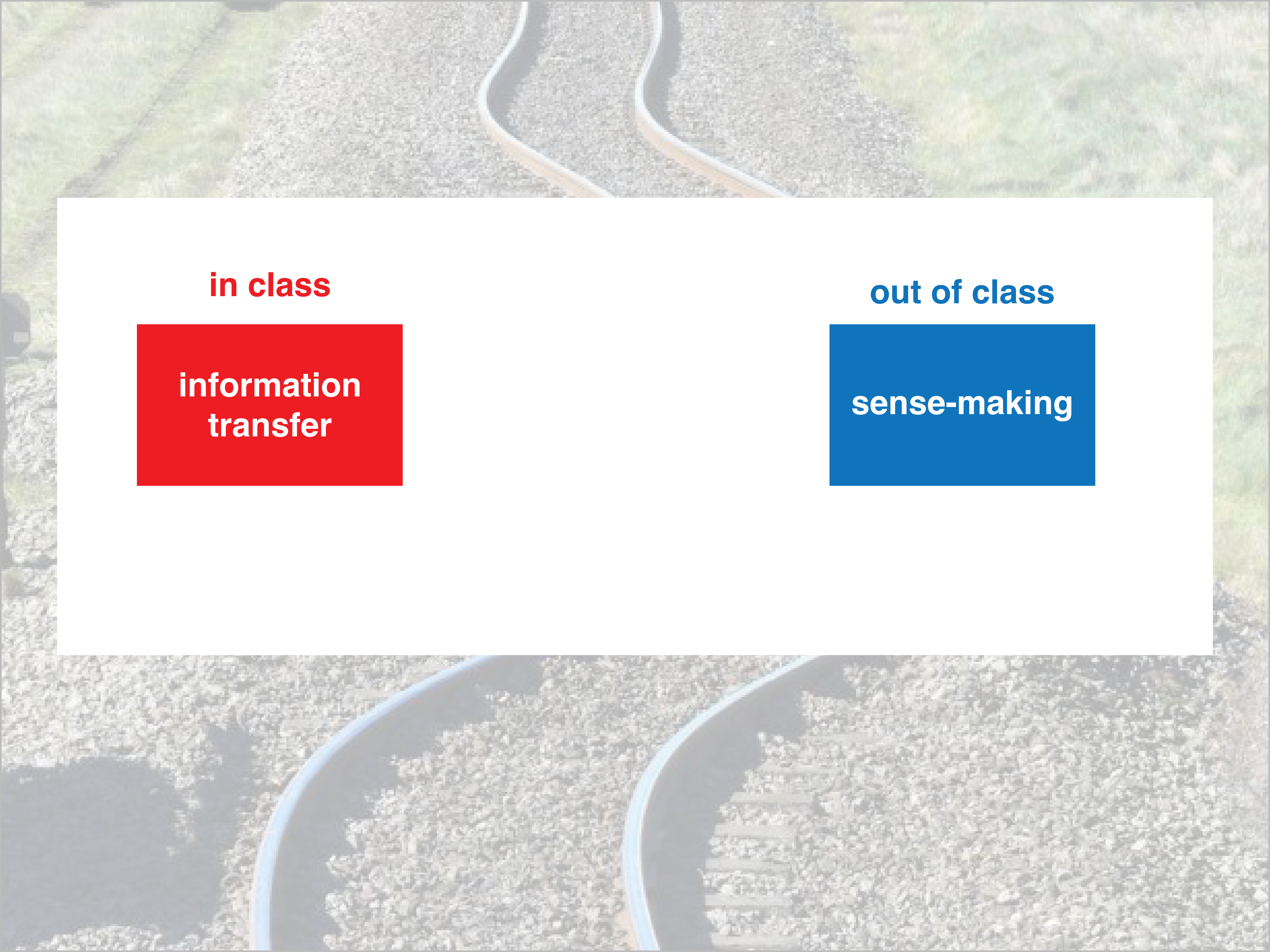
information transfer

sense-making

in class

information transfer

sense-making



in class

information transfer

out of class

sense-making

Should focus on THIS!

in class

information transfer

out of class

sense-making

out of class

information transfer

in class

sense-making

out of class

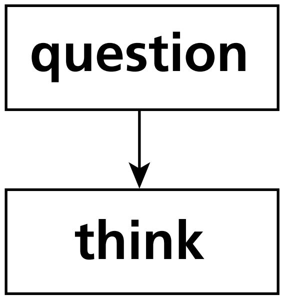
information transfer

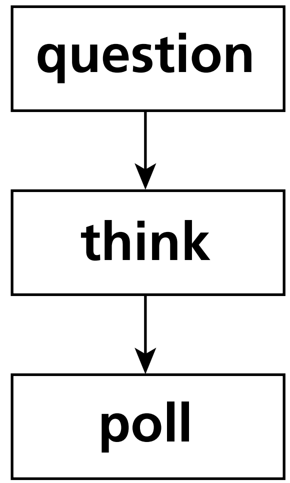
in class

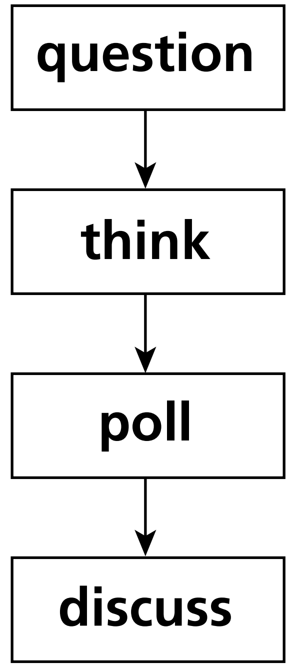
sense-making

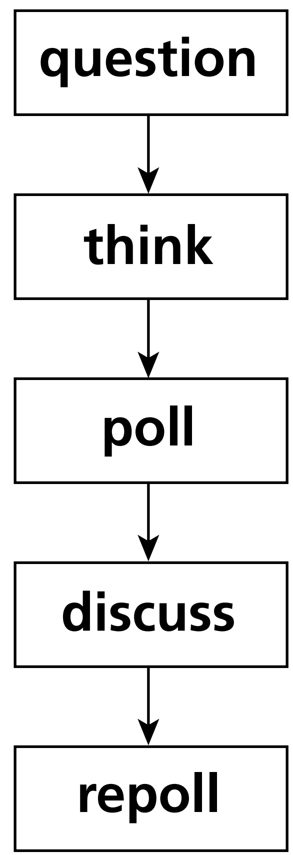
Peer Instruction

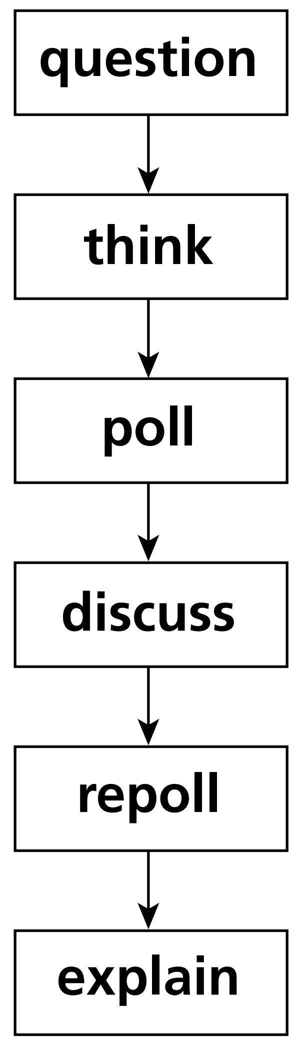
question

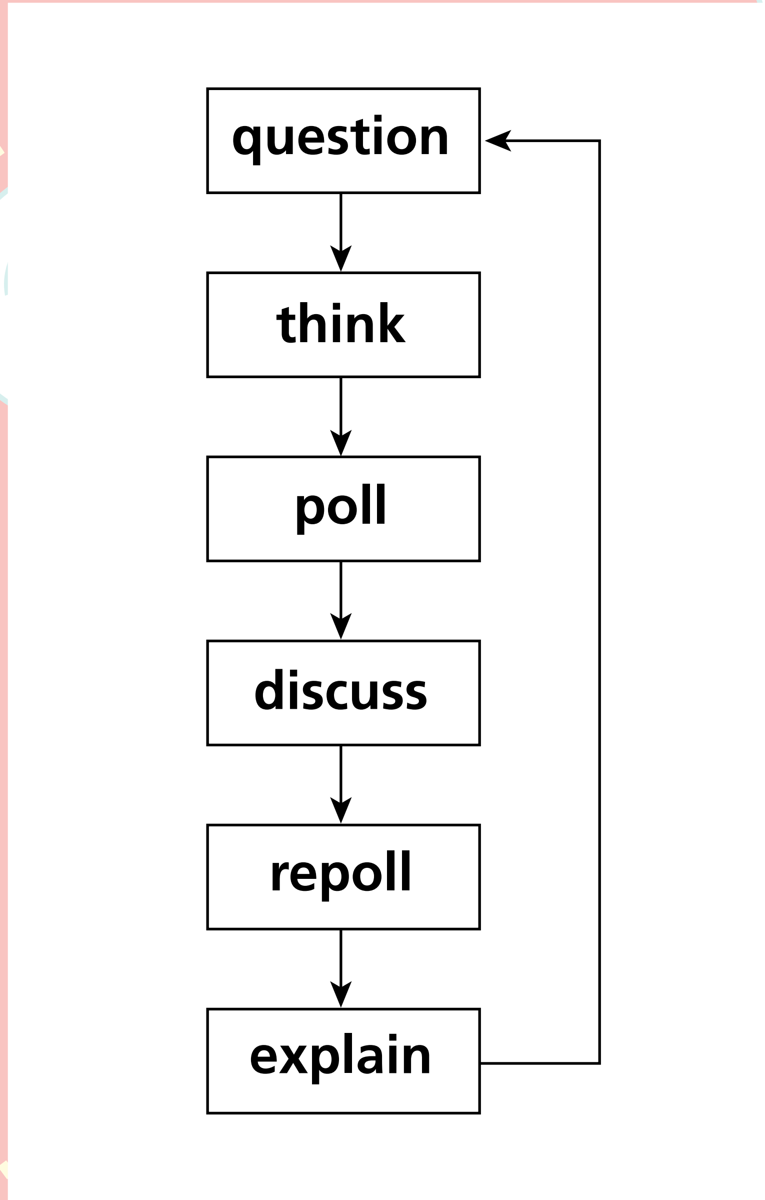

question
think

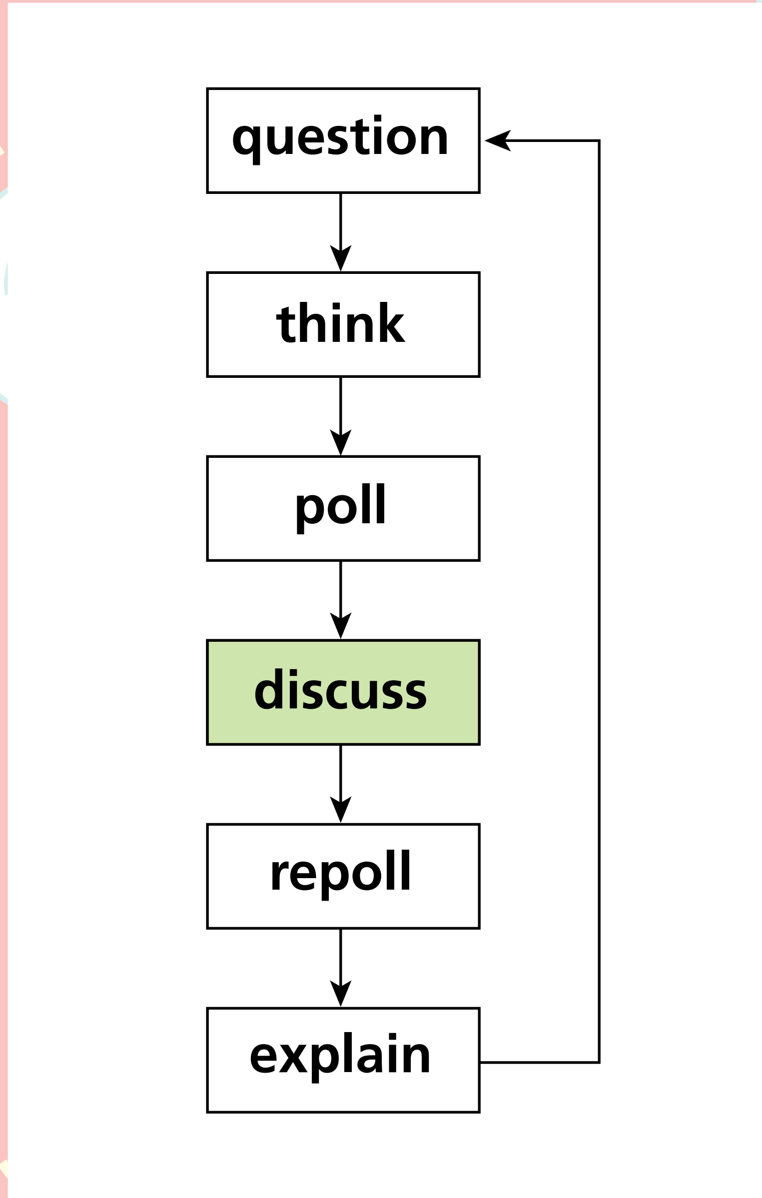

question
think
poll


question
think
poll
discuss

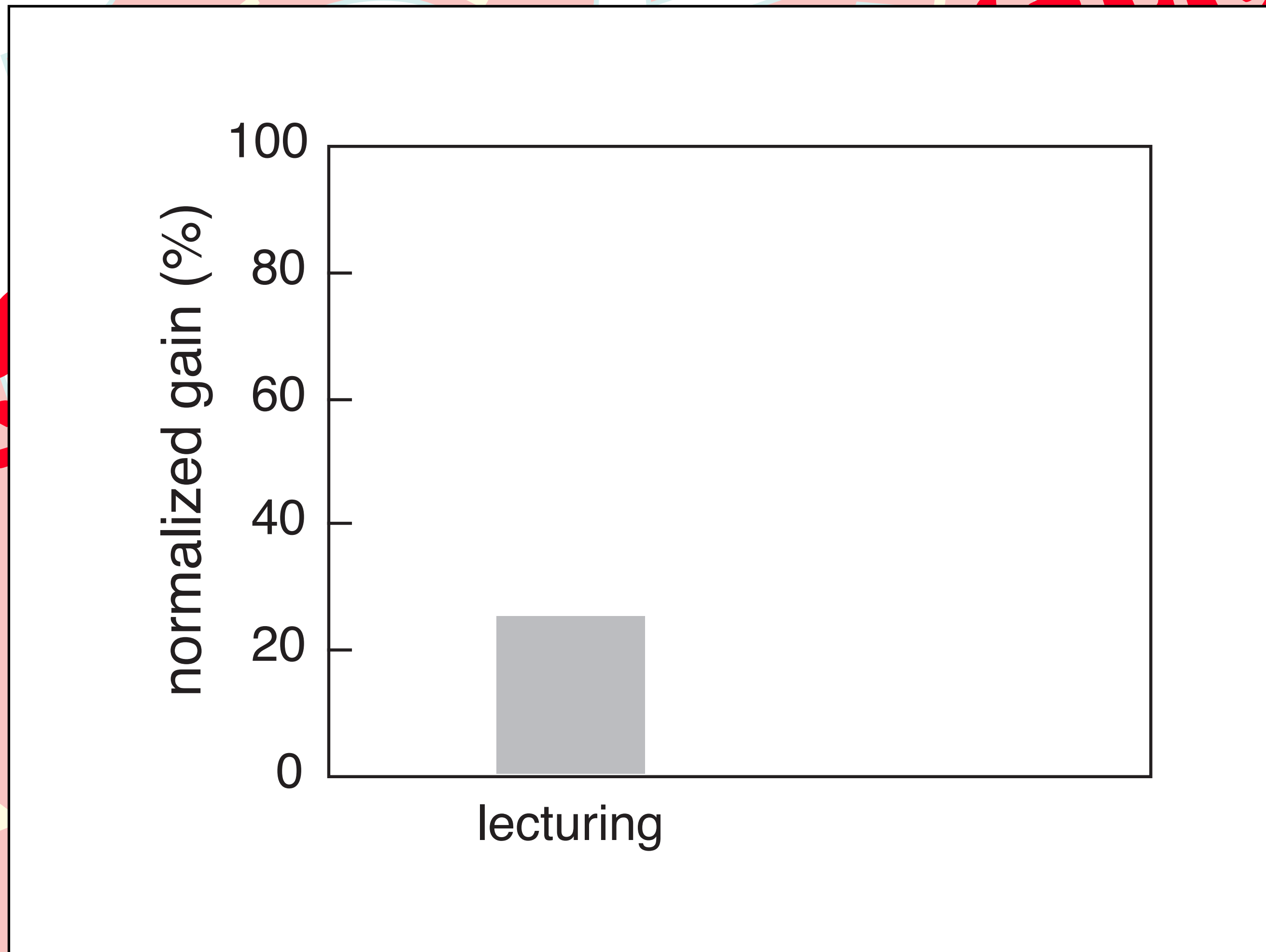

question
think
poll
discuss
repoll

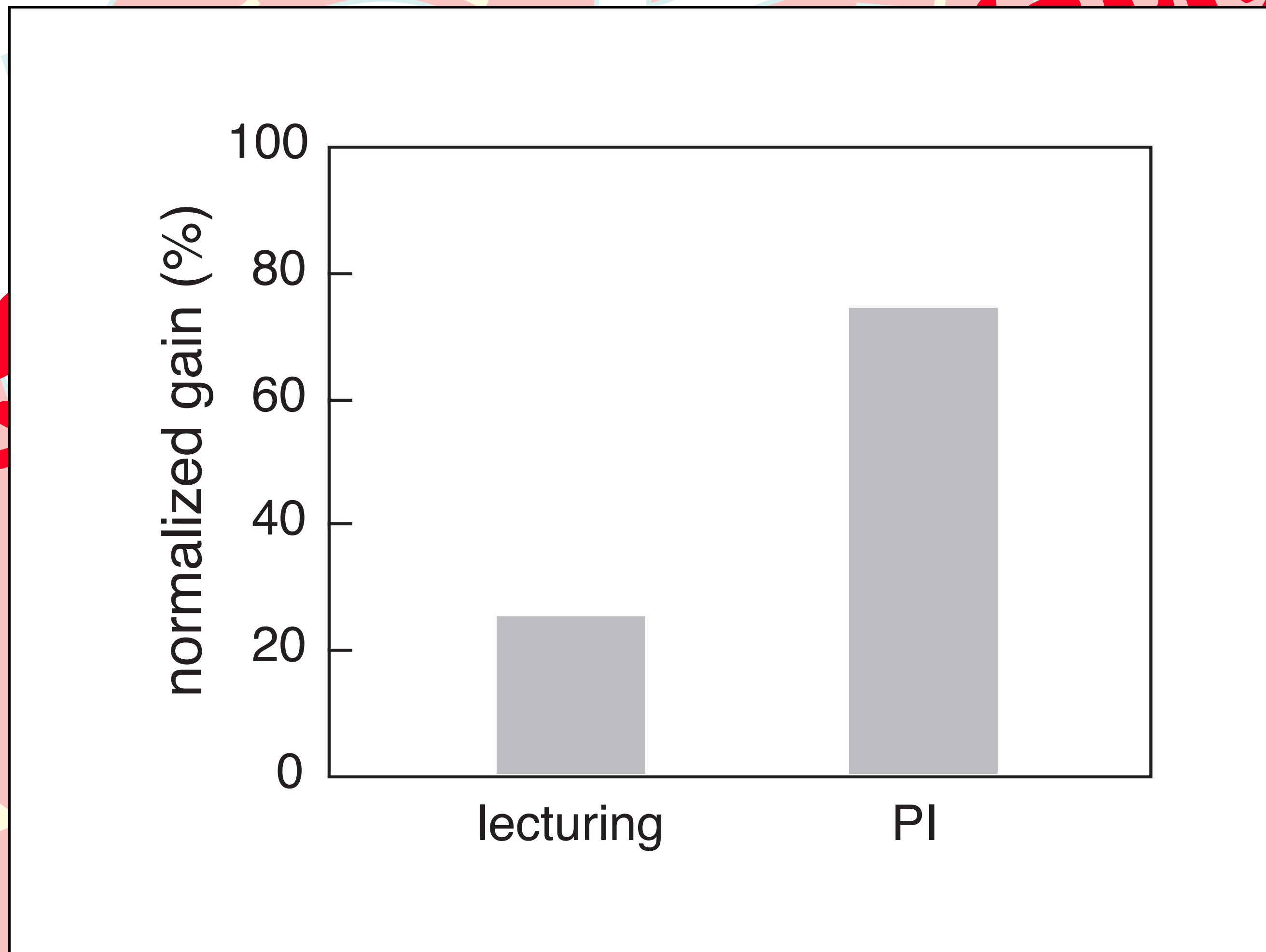

question
think
poll
discuss
repoll
explain


question
think
poll
discuss
repoll
explain


question
think
poll
discuss
repoll
explain


Peer
INSTRUCTION
Higher learning gains


normalized gain (%)
100
80
60
40
20
0
lecturing

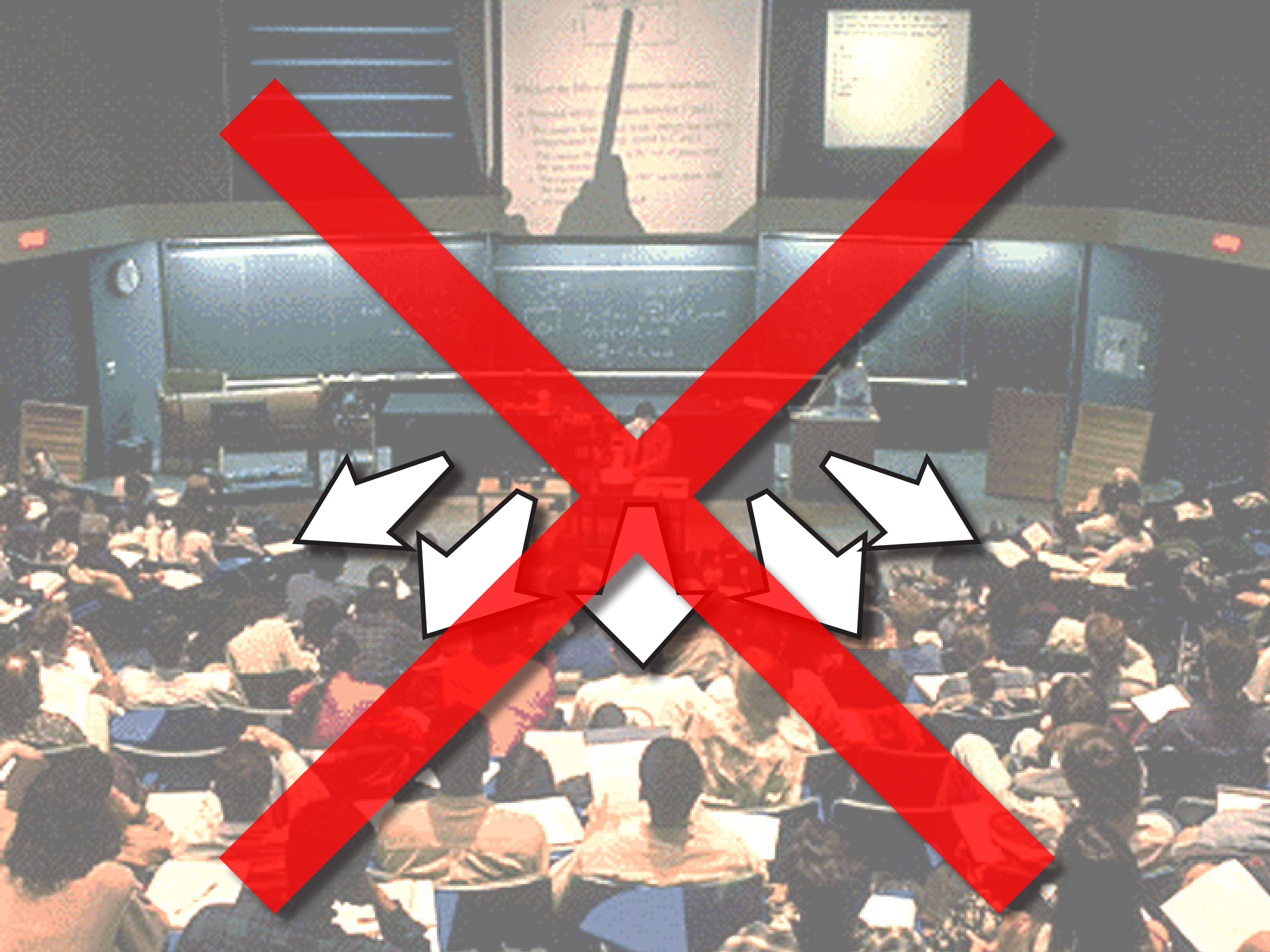

normalized gain (%)
100
80
60
40
20
0
lecturing
PI

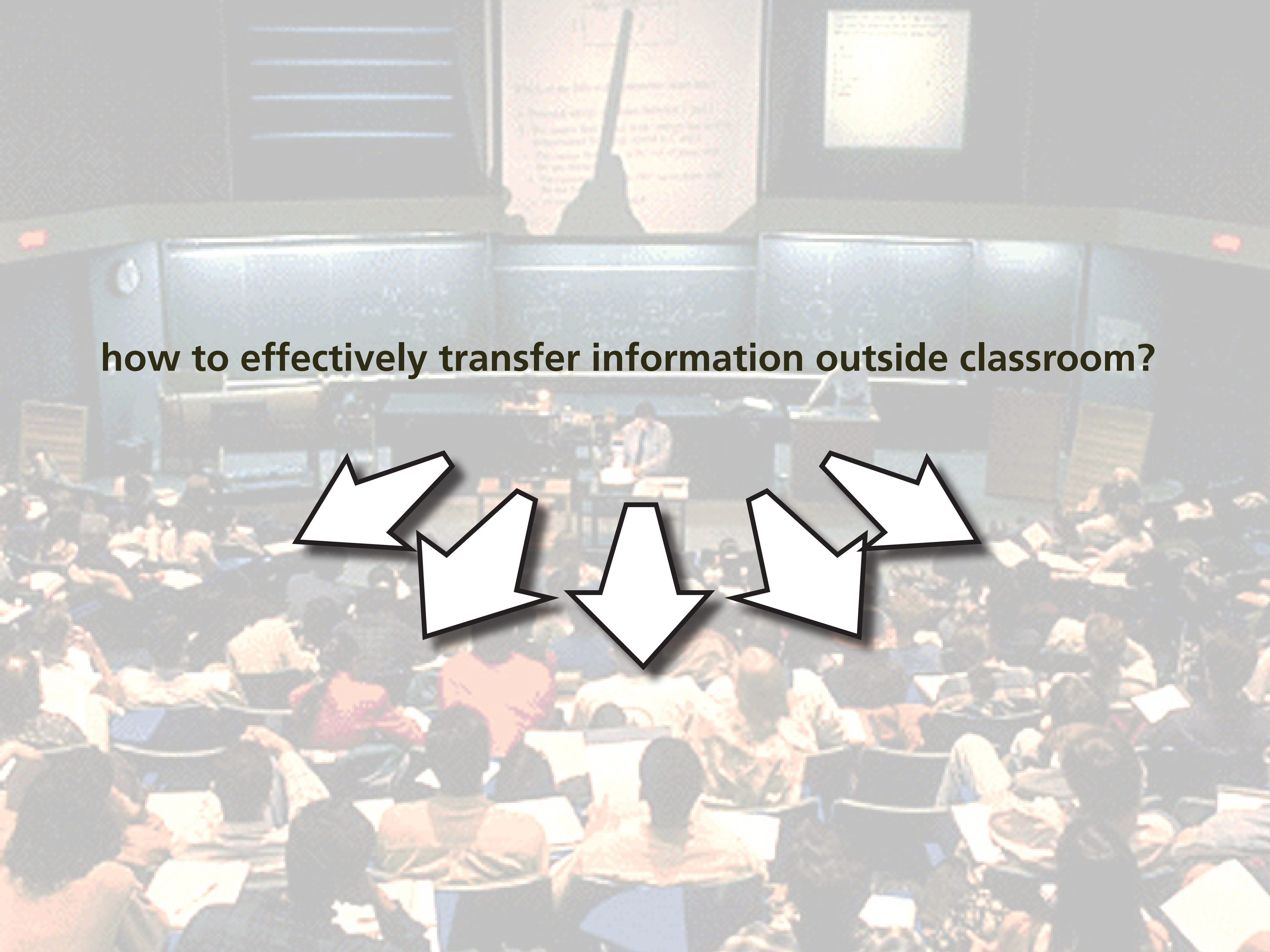
Peer

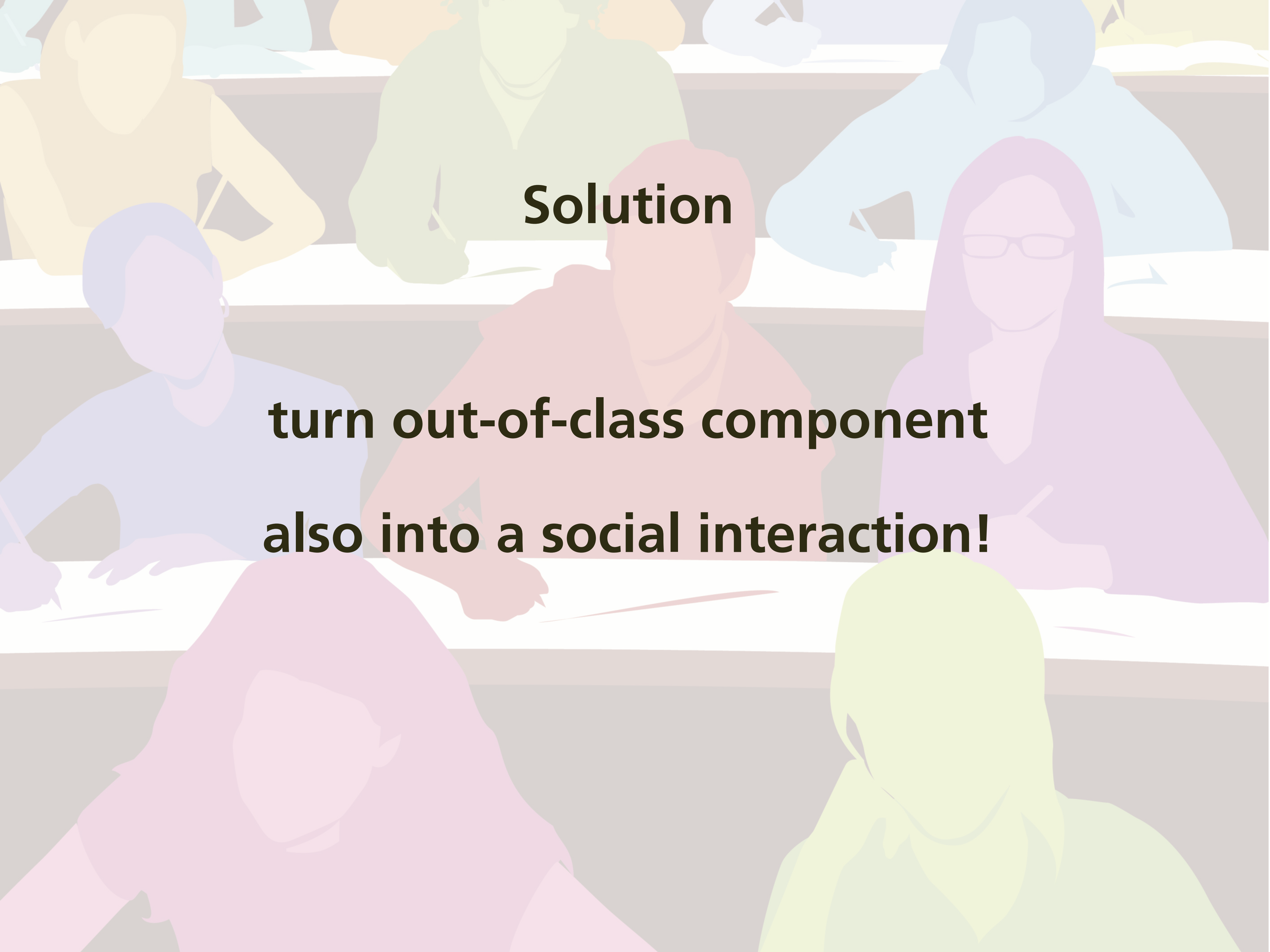
INSTRUCTION

Higher learning gains

Better retention



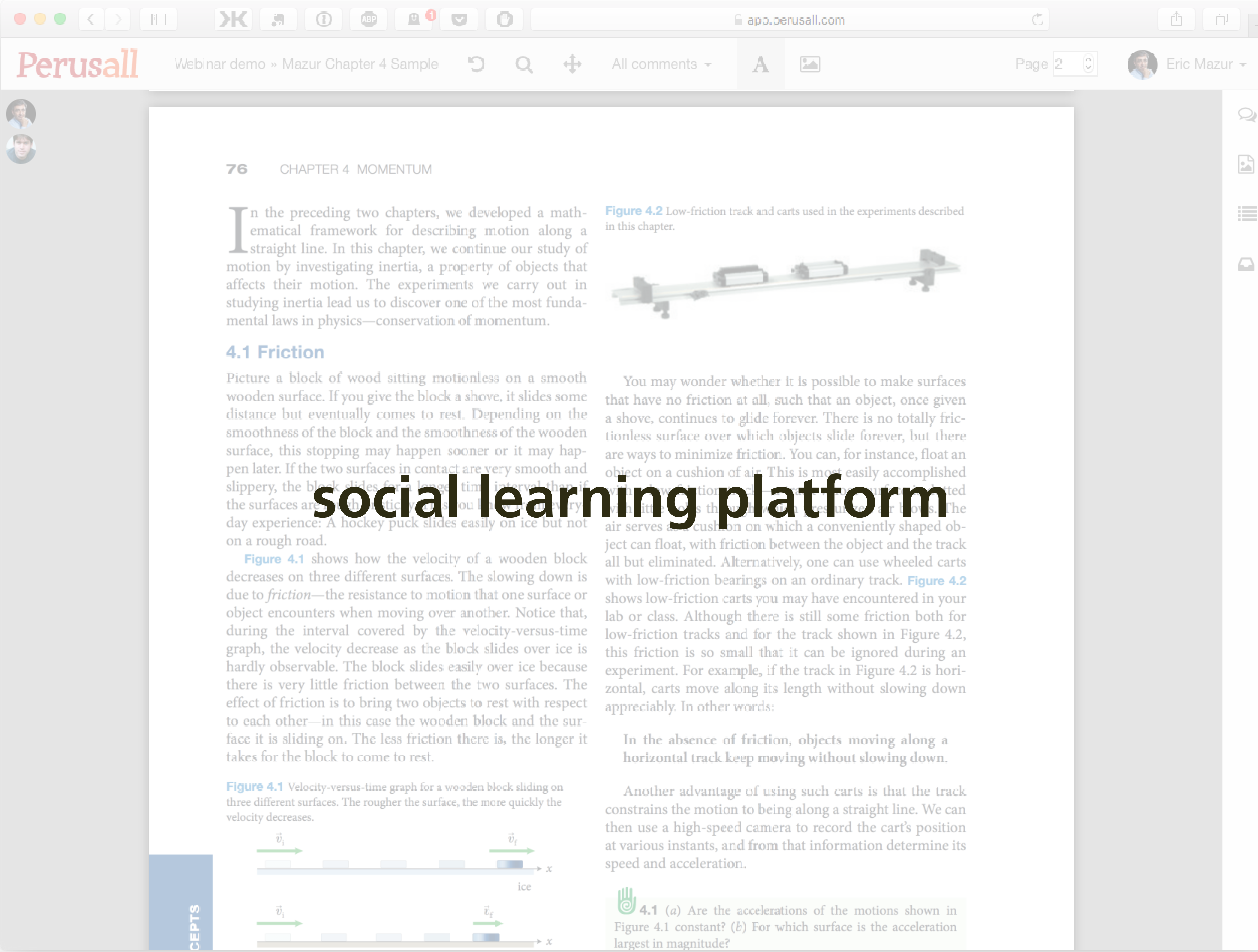

how to effectively transfer information outside classroom?



Solution

turn out-of-class component

also into a social interaction!



76 CHAPTER 4 MOMENTUM

In the preceding two chapters, we developed a mathematical framework for describing motion along a straight line. In this chapter, we continue our study of motion by investigating inertia, a property of objects that affects their motion. The experiments we carry out in studying inertia lead us to discover one of the most fundamental laws in physics—conservation of momentum.

4.1 Friction

Picture a block of wood sitting motionless on a smooth wooden surface. If you give the block a shove, it slides some distance but eventually comes to rest. Depending on the smoothness of the block and the smoothness of the wooden surface, this stopping may happen sooner or it may happen later. If the two surfaces in contact are very smooth and slippery, the [illegible] the surfaces are [illegible] day experience: A hockey puck slides easily on ice but not on a rough road.

Figure 4.1 shows how the velocity of a wooden block decreases on three different surfaces. The slowing down is due to *friction*—the resistance to motion that one surface or object encounters when moving over another. Notice that, during the interval covered by the velocity-versus-time graph, the velocity decrease as the block slides over ice is hardly observable. The block slides easily over ice because there is very little friction between the two surfaces. The effect of friction is to bring two objects to rest with respect to each other—in this case the wooden block and the surface it is sliding on. The less friction there is, the longer it takes for the block to come to rest.

Figure 4.1 Velocity-versus-time graph for a wooden block sliding on three different surfaces. The rougher the surface, the more quickly the velocity decreases.

Figure 4.2 Low-friction track and carts used in the experiments described in this chapter.

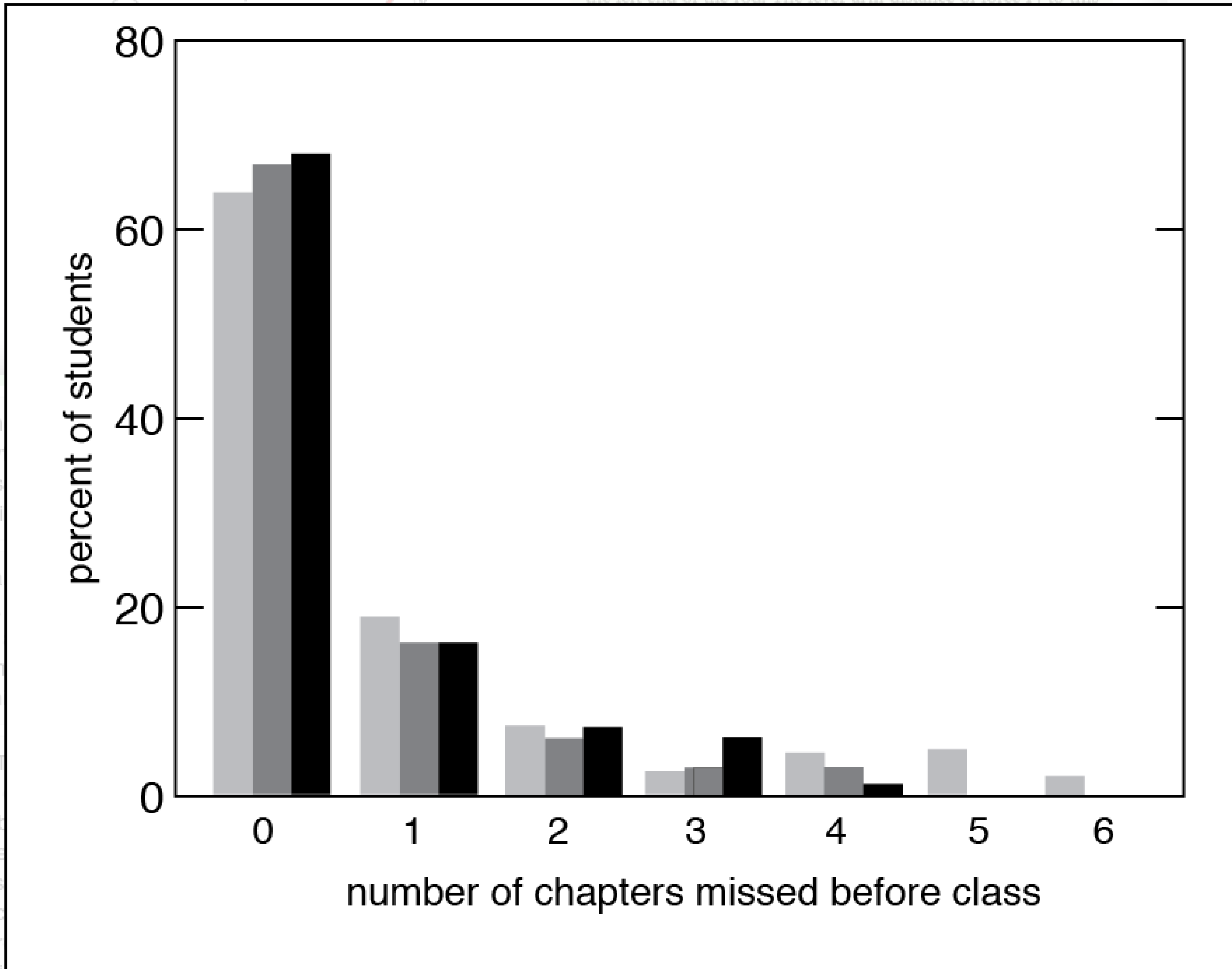
You may wonder whether it is possible to make surfaces that have no friction at all, such that an object, once given a shove, continues to glide forever. There is no totally frictionless surface over which objects slide forever, but there are ways to minimize friction. You can, for instance, float an object on a cushion of air. This is most easily accomplished [illegible] air serves [illegible] cushion on which a conveniently shaped object can float, with friction between the object and the track all but eliminated. Alternatively, one can use wheeled carts with low-friction bearings on an ordinary track. Figure 4.2 shows low-friction carts you may have encountered in your lab or class. Although there is still some friction both for low-friction tracks and for the track shown in Figure 4.2, this friction is so small that it can be ignored during an experiment. For example, if the track in Figure 4.2 is horizontal, carts move along its length without slowing down appreciably. In other words:

In the absence of friction, objects moving along a horizontal track keep moving without slowing down.

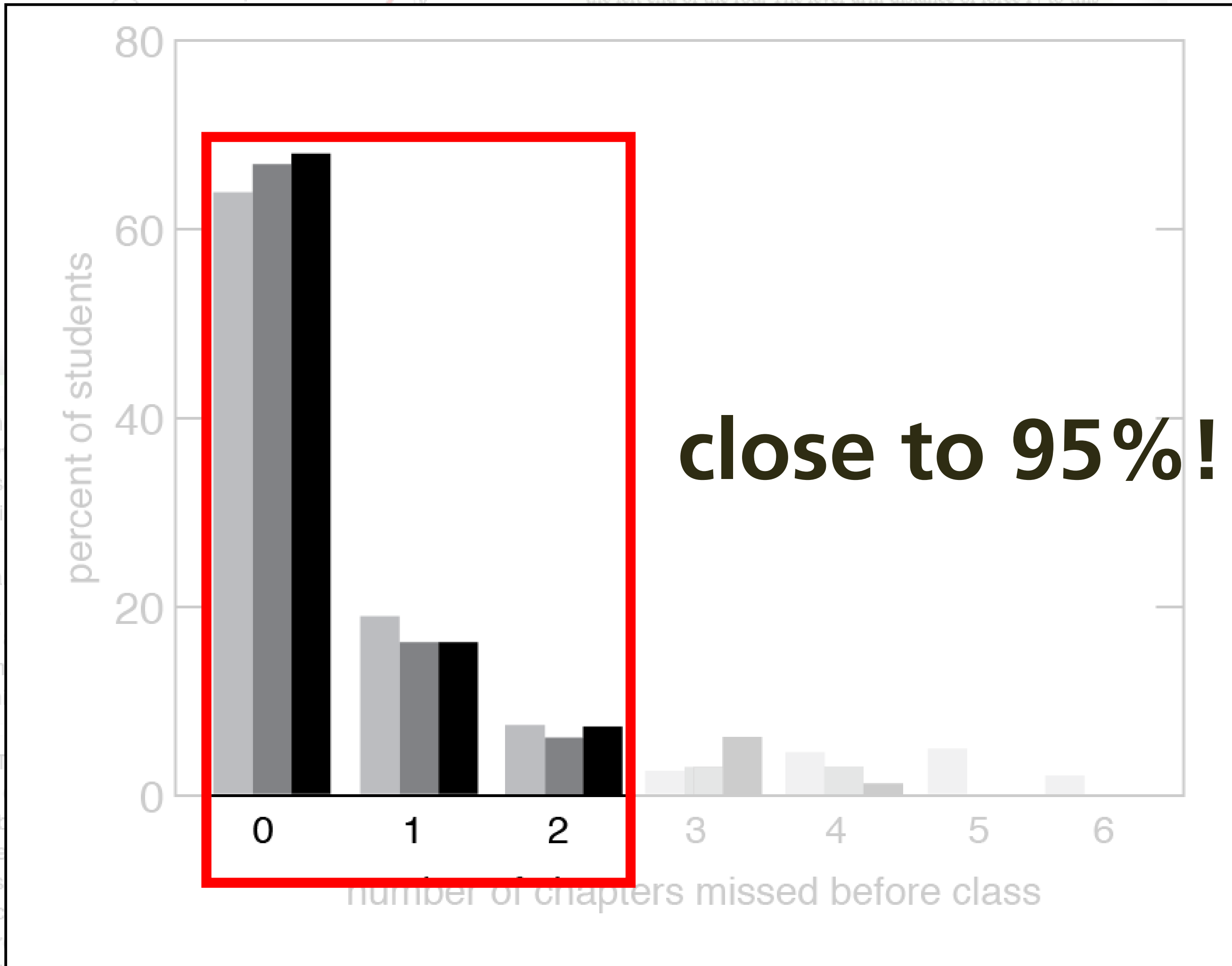
Another advantage of using such carts is that the track constrains the motion to being along a straight line. We can then use a high-speed camera to record the cart's position at various instants, and from that information determine its speed and acceleration.

4.1 (*a*) Are the accelerations of the motions shown in Figure 4.1 constant? (*b*) For which surface is the acceleration largest in magnitude?

class test results



class test results



out of class

information transfer

Perusall

in class

sense-making

Peer Instruction

Works online!

out of class

information transfer

Perusall

in class

sense-making

Peer Instruction

Education is not just about:

- transferring information
- getting students to do what we do

Education is not just about:

- transferring information
- getting students to do what we do

active engagement/social interaction a must!

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mazur.harvard.edu

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