Innovating education to educate innovators

Mercy College
Dobbs Ferry, NY, 23 May 2017
an illusion...
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)
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 (out of class)

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

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

think
question

think

poll
question

think

poll

discuss

repoll
question

think

poll

discuss

repoll

explain
question
think
poll
discuss
repoll
explain
thermal expansion
all of them
Consider a rectangular metal plate with a circular hole in it.
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 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
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When the plate is uniformly heated, the diameter of the hole

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3. decreases.
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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
Higher learning gains
Higher learning gains
Better retention
Instruction
how to effectively transfer information outside classroom?
but...
• transfer pace set by video
• viewer passive
• viewing/attention tanks as time passes
• isolated/individual experience
we’re simply moving this outside classroom!
• transfer pace set by reader

• viewer active
but...
isolated/individual experience & no real accountability
want: every student prepared for every class
want:

every student prepared for every class

(without additional instructor effort)
Solution

turn out-of-class component also into a social interaction!
every student prepared for every class
social learning platform
log in through social network
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 block slides for a longer time interval than if the surfaces are rough or sticky. This you know from everyday 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 decreases 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.

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 with a low-friction track—a track whose surface is dotted with little holes through which pressurized air blows. The air serves as a 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?
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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.

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...opens chat window
76

CHAPTER 4 MOTION

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

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The lever arm distances must now be determined relative to the left end of the rod. The lever arm distance of force $F_1$ to this point is zero, and so the torque caused by that force about the left end of the rod is zero. If I choose counterclockwise as the positive direction of rotation, $F_1$ causes a negative torque about the left end of the rod; the force $F_1$ exerted by the pivot causes a positive torque about the left end of the rod. The lever arm distance of $F_2$ about the left end of the rod is $r_1 + r_2$; that of $F_2'$ is $r_2$. Because the rod is at rest, the magnitude of the force exerted by the pivot is equal to the sum of the forces $F_1$ and $F_2$. Taking into account the signs of the torques, we find that the sum of the torques about the left end of the rod is $r_1(F_1 + F_2) - (r_1 + r_2)F_2 = r_1F_1 - r_2F_2$. This is the same result we obtained for the torques about the pivot, and so the sum of the torques about the left end is zero.

Exercise 12.1 shows that the sum of the torques about the left end of the rod is zero, just like the sum of the torques about the pivot. You can repeat the calculation for the torques about the right end of the rod or any other point, and each time you will find that the sum of the torques is zero. The reason is that the rod is not rotating about any point, and so the sum of the torques must be zero about any point. In general we can say:

For a stationary object, the sum of the torques is zero.

For a stationary object we can choose any reference point we like to calculate torques. It pays to choose a reference point that simplifies the calculation. As you have seen, we do not need to consider any force that is exerted at the reference point. So, by putting the reference point at the point of application of a force, we can eliminate that force from the calculation.

12.2 In the situation depicted in Figure 12.2a, you must continue to exert a force on the seesaw to keep the child off the ground. The force you exert causes a torque on the seesaw, and yet the seesaw's rotational acceleration is zero. How can this be if torques cause objects to accelerate rotationally?

Example 12.2 Torques on lever

Three forces are exerted on the lever of Figure 12.7. Forces $F_1$ and $F_2$ are equal in magnitude, and the magnitude of $F_3$ is half as great. Force $F_1$ is horizontal, $F_2$ and $F_3$ are vertical, and the lever makes an angle of 45° with the horizontal. Do these forces cause the lever to rotate about the pivot? If so, in which direction?
The lever arm distances must now be determined relative to the left end of the rod. The lever arm distance of $F_1$ to this point is zero, and the torque caused by that force about the left end of the rod is zero. If I choose counterclockwise as the positive direction of rotation, $F_2$ causes a negative torque about the left end of the rod; the force $F_2'$ exerted by the pivot causes a positive torque about the left end of the rod. The lever arm distance of $F_3$ about the left end of the rod is $r_1 + r_2$ that of $F'_2$. Because the rod is at rest, the magnitude of the force exerted by the pivot is equal to the sum of the forces $F_1$ and $F_2$. Taking into account the signs of the torques, we find that the sum of the torques about the left end of the rod is $r_1(F_1 + F_2) - (r_1 + r_2)F_3 = r_1F_1 - r_2F_2$. This is the same result we obtained for the torques about the pivot, and so the sum of the torques about the left end is zero.

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I don’t understand how this combination of factors tells you anything about direction? Aren’t magnitude and lever arm distance both scalar quantities? It seems like we would need to know some sort of direction to calculate torque.

I think you may be able to think about the direction separately. So, after multiplying this magnitude and distance, you can attach a sign to the torque based on the defined parameters of the system. In the following paragraph, they start to explain how to choose this direction.

This is a great question. To further elaborate on this, we can think of this in terms of the Torque equation. The equation for torque is \( \tau = r \times F \), with \( r \) being the level arm distance and \( F \) being force. We know that force is a vector vector from previous chapters, and in regards to \( r \) it can also be thought of as the radial vector. What this means is that this distance from the pivot points from the axis of rotation to the point where the force acts. In as previously mentioned, there is a general convention (the right-hand rule) that is used to determine the direction which happens to be perpendicular to both the radius from the axis and to the force.
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Oct 20 12:09 am

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Oct 20 12:38 am

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Oct 22 8:48 pm
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Brian Lukoff responded to a question in Mazur Chapter 4 Sample that you wanted to know the answer to:

21 minutes ago, you asked this question on Perusall:

No friction at all seems impossible. Isn’t there always some friction in any real case?

Brian Lukoff just responded to the question by saying:

Right - I think there will always be some friction due to the second law of thermodynamics.

If this helps your understanding, click the button below. If you want to respond, simply reply to this email to post to Perusall.
email notifications

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**option 1: reply**

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[View conversation] [This comment helps my understanding]
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21 minutes ago, you asked this question on Perusall:

No friction at all seems impossible. Isn’t there always some friction in any real case?

Brian Lukoff just responded to the question by saying:

Right - I think there will always be some friction due to the second law of thermodynamics.

If this helps your understanding, click the button below. If you want to respond, you can enter your comment in the box below.

[View conversation]

This comment helps my understanding.
email notifications

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option 3: mark as answered

View conversation

This comment helps my understanding
how to get students to participate?
use combination of intrinsic and extrinsic motivation drivers
rubric-based assessment

• quality (thoughtful reading & interpretation)
rubric-based assessment

- quality (thoughtful reading & interpretation)
- quantity (minimum 10)
rubric-based assessment

- quality (thoughtful reading & interpretation)
- quantity (minimum 10)
- timeliness (before class)
rubric-based assessment

- quality (thoughtful reading & interpretation)
- quantity (minimum 10)
- timeliness (before class)
- distribution (not clustered)
rubric-based assessment

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over 20,000 annotations!
rubric-based assessment

• quality (thoughtful reading & interpretation)

• timeliness (before class)

• distribution (not clustered)

how do you process all of that??
rubric-based assessment

- quality (thoughtful reading & interpretation)
- quantity (minimum 10)
- timeliness (before class)
- distribution (not clustered)

How do you process all of that??

fully automated assessment
fully automated assessment

- specialized machine learning algorithm
- assesses intellectual content
- exceeds intercoder reliability
Gradebook

Click on a grade to see details about the student’s assignment.

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Student ID</th>
<th>Chapter 1</th>
<th>Chapter 2</th>
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</thead>
<tbody>
<tr>
<td>John Smith</td>
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<td>Jane Doe</td>
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<td>Mary Johnson</td>
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<th>Chapter 3</th>
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</thead>
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<tr>
<td>Michael Lee</td>
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</tr>
<tr>
<td>Sarah Brown</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

**Total number of annotations**

- **Total number of annotations submitted on time**: 11
- **Average quality of top 10 annotations submitted on time**: 1.80
- **Distribution of annotations**: 3.8
- **Assignment score**: 1

Scores range from 0 to 3.
connect pre-class and in-class activities
Confusion report for Chapter 24

right hand rule (11 questions)

- Can someone in simpler terms explain the right-hand rule? (JB)
- Is there another way, besides the right hand rule, to find the direction of the magnetic field with a current? (WJ)
- Using the right hand rule, I believe the answer is D. Is that correct? (SB)

direction magnetic field (8 questions)

- Why is it that the magnet field points away from the north pole and towards the south pole? When on the previous page it stated that the direction of the magnetic field is the direction that the north pole of a compass needle points. (CP)
- How can you determine which direction the magnetic field will point towards? (AB)
- So whichever way the north pole faces is the direction of the magnetic field but that doesn’t always mean its pointing true north? (KH)

earth magnetic field (6 questions)

- Does that mean that the compass will be distracted from the Earth’s magnetic field and use the magnetic field that the current of the wire gives off? (CP)
- Can someone explain why this type of bacteria knows what direction the earth’s magnetic fields are facing? (AK)
- Does the circular loop of current have any similarities with the look of the earth’s magnetic field? They kind of look similar to me. (J)
motivating factors

Intrinsic:

• social interaction
motivating factors

Intrinsic:

- **social interaction**

- **tie-in to in-class activity**
motivating factors

**Intrinsic:**
- social interaction
- tie-in to in-class activity

**Extrinsic:**
- assessment (fully automated)
motivating factors

“I think the Perusall app and annotation system is way better than just reading a textbook normally… I’ve been reading for almost four hours now and haven’t gotten bored”

Harvard student
motivating factors

“It makes the book fun to read...

All the other students on my floor are disappointed their Prof isn’t using Perusall because they don’t read the book.”

Ohio State student
class test results

percent of students

number of chapters missed before class

0 20 40 60 80

0 1 2 3 4 5 6
class test results

close to 95%!
class test results
every student prepared for every class
additional research data

- Engagement: 81% spend 2–6 hrs/wk reading
additional research data

• **Engagement:** 81% spend 2–6 hrs/wk reading

• **Active reading:** 85% annotate as they read and 40% take notes while reading
additional research data

- Engagement: 81% spend 2–6 hrs/wk reading
- Active reading: 85% annotate as they read and 40% take notes while reading
- Performance: significantly higher scores
Benefits

- virtually 100% completion of assignments
- improved use of class time
Benefits

• virtually 100% completion of assignments
• improved use of class time

all at no cost & without additional instructor effort!
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!
ericmazur.com

Follow me!  eric_mazur