Exploring and Applying Physics

Facebook group

Posts by Eugenia Etkina from 2020

Eugenia Etkina
1. January 2020.

Hi all, Happy New Year! And we are on to chapter 18 - Electric field. First I will start with the new vernacular for physical quantities that we are using that are different from all other physics textbooks. We use the term electric and gravitational fields to denote the changes in space properties that occur due to the presence of electrically charge objects or objects with mass (gravitational mass to be precise). Then we invent several physical quantities characterizing points in that space. One quantity describes the "force-like" properties of a point in space, we call it E field (a vector) and the other one describes energy-like properties of a point in space, we call it a V field or electric potential (a scalar). Most textbooks use the term electric field for both - the altered properties of space and the quantity of E field. Consequently, the electric potential is not viewed as a different way to describe electric field but as a separate quantity which is abstract and difficult for the students. We have excellent ALG activities that work beautifully to help students come up with these two quantities - 18.1.6, 7 and 8 and 18.3.1-18.3.3.

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Eugenia Etkina
3. January 2020.

Hi all, this post is out of order - I am going back to chapter 15 (First law of thermodynamics). If you teach heating mechanisms (conduction, convection, radiation, evaporation) then the ALG Section 15.7 is full of activities with unique videoed experiments with the visible and infrared cameras (a few are simultaneous) which will be very exciting and useful for your students. Cannot believe I forgot about this important section! So if you have not taught the first law of thermodynamics yet, check this section of the ALG - it is cool!

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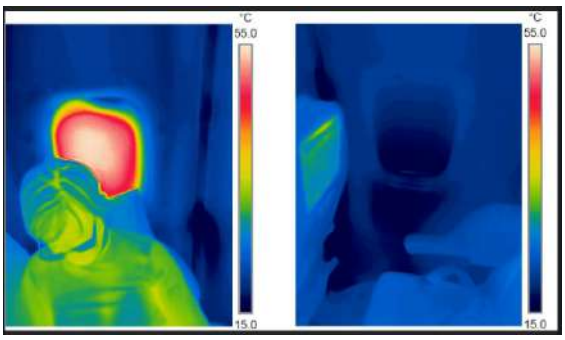
Eugenia Etkina
17. January 2020.

A small interruption in my postings about Chapter 19. We flew from Europe to Newark on Wednesday and I was sitting by a window with shades closed. I incidentally touched it and it was extremely hot. I asked Gorazd to use an infrared camera to take photos of a few windows. All shades were down. Why do you think is the difference? And on which side of the plane was I sitting - right or left if you look ahead and see the captain's cabin? These are great questions for those who are teaching Chapter 15.



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Eugenia Etkina
27. January 2020.

Hi all, we are starting Chapter 20 - magnetism. First I want to point your attention at Section 20.1. I always thought that a compass can help us determine the direction of magnetic filed but I did not pay attention to its behavior near a magnet. When you place a compass near a magnet it oscillates before it comes to the equilibrium. Try to place a compass near a magnet at different distances and you will see that the period of these oscillations changes. It is much smaller close to a magnetic pole than far away. Therefore the period can serve as an indicator of the strength of the magnetic field at a particular location. Remember, before using a compass, check how it is magnetized. During storage near strong magnets compasses tend to magnetize in different directions, so before you are using a compass, check if it is still ok. Tomorrow I will focus on the logical progression of a chapter which is different from traditional approaches.

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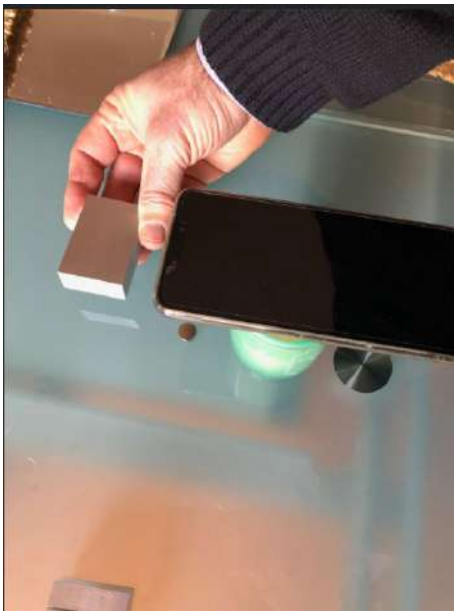
Eugenia Etkina
13. February 2020.

Hi all, sorry for not posting for a few days, busy week. To finish up Chapter 21 I want to point your attention to the AC section. We did not have it in the first edition as I always thought that it is too abstract for an algebra-based course. But we figured out how to do it conceptually using the ISLE approach. Check it out and try! Another thing that we just did is using the phyphox for eddy currents and Lenz law. All you need is a strong magnet, a piece of aluminum and the knowledge of where the magnetic field probe is in your phone. The set up is in the photo. Place the button magnet on the table and hold the phone steady above it, so that the magnetic field probe is right above the magnet (to figure out where the magnetic field probe is in your phone investigate the readings using a magnet with known poles, it is a fun activity in itself). Then take a piece of aluminum, hold it steady in your hands, make sure it does not shake, rest your hand on the table as seen in the photo. The piece should be above the magnet but below the phone. Then move the aluminum piece above the magnet, away or towards the phone. Change the speed to see different results. Let me know if it works. We also made a second piece with slits in it.



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Eugenia Etkina
25. February 2020.

As I said in my previous post, the main representation in Chapter 22 is a ray diagram and the main idea behind a ray diagram is that every point of an extended light source emits an infinite number of rays. After that students learn reflection and refraction using our ISLE process - moving from observational experiments (data) to their analysis and testing of the explanations/patterns. While doing all this they never question what is inside light beams and why they do what they do (form shadows, reflect and refract). This issue is addressed in Section 22.7 "Explanations of light phenomena: two models of light". Notice that we do not use the term particle model of light but instead use the term bullet model, to make sure that in this model of light is seen similar to a stream of very fast very light traveling bullets. This model successfully explains the shadows and reflection of light (those who played basketball or pool know if very well, see page 704 figure 22.20) and it also can explain the refraction (see page 704 figure 22.21). However, if one uses the bullet like model of light to explain refraction, the consequence of this explanation is that these bullets should travel faster in water and glass compared to air. As this consequence contradicts the measurements of the speed of light, the bullet model can be rejected. But the ray model where we do not question the nature of light works pretty well. How do we explain refraction then? Here is when the wave model comes in - only briefly in this chapter but very importantly! It explains refraction (see figure 22.23) but says absolutely nothing about the nature of this wave. What is waving? To answer this question the students need to learn some more... This last section in this chapter is a very important summary and reflection and "the need to know" for future chapters. Similar to section 21.8 in Chapter 21 "Mechanisms explaining electromagnetic induction". Both of these sections represent our goal to frame physics as a detective story, that starts with observations (usually accidental) and then develops and develops with new mysteries uncovered every day. Do not skip those sections, as they make physics not only an exciting adventure but a coherent picture that many students miss.

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Eugenia Etkina
8. March 2020.

Hi all, I am interrupting my posts for Chapter 23 as I want to propose a possible sequence of actions in case your university/school is closed and you need to teach online. This is a long post, please be patient. Here is goes:
Hi people, in light of a possibility of all of us teaching remotely I would like to share my approach to this. Luckily, our system (textbook, ALG, IG and lots of videos) are perfectly suited for this. Here is what I suggest you do (I assume you are working with the second edition of the textbook, current ALG and IG).
1. For the unit you are planning to teach, READ the textbook chapter carefully, EVERY WORD, as if you never studied physics. Imagine that you are your student - what words could be difficult? What logical connections might be unclear? Make note of all of those. Watch all of the videos.
2. Do the same with the ALG activities- for each think if a student can do this one alone, or you need to assign groups, do they need equipment, or this is just a reasoning activity. Watch all of the videos.
3. Read the chapter in the Instructor Guide and note the parallels between the ALG activities and Experiment tables in the textbook.Make sure you focus on the activities that have videos - these are the easiest. You can supplement videos with phet simulations if there are relevant.
4. Make a plan of which ALG activities students will attempt first and what OETs and TETs in the textbook will help them with the answers. (again, do not forget to specifically assign the videos). Then assign them the activities first, then the textbook part that explains how to do the activities (it needs to be small, not longer than a page) and then a few key questions (Review questions or End of Chapter questions/problems) to assess what they did. Break down their work to one-two ALG activities-textbook reading-assessment questions sequences so that they can post their answers and you can see whether they read the stuff. You can ask them to work in groups and submit group responses with the note who did what or individual. Whatever platform you use this sequence should work For textbook reading, as you know every sentence in the book by now, you can also provide them with help in the places where you think they might stumble.
5. Most important! Before you go into online teaching (if ever) you need to teach your students read the textbook the way experts read science papers - I mean interrogation. Take 20 min of your Monday class to model to them how you read the textbook. Specifically, choose two paragraphs for this exercise from the chapter that they just worked on. Give them a minute to read the first sentence and then read it aloud and say what you are thinking about every work and logical connections. For example, on page 574 in the textbook we have a section: Fluid flow and charge flow. The first sentence in the section reads: "A fluid flow analogy may help us better understand the electric potential difference and conduction pathways of these electrical processes." Let your students read it and then say to them: "Hm, analogy - what does it mean? analogy is when we try to explain something new using

something that we already understand. They are telling us that if we understand how fluids flow, we will understand the relationship between potential difference and how current flows. Do I understand what makes fluid flow? Fluid - something like water, right? So what makes water flow from one place to another - or, it is pressure difference. So i guess this is what we will learn in this section." This is what flies through your head when you read this one sentences. Will it fly through the heads of your students? It must - so show them how to think about this sentence. And then the next one, and then the next one. Do it for 2 paragraphs and then ask them to read the third one on their own and tell you what they think as they are reading it.
6. After the students experience how reading should be done, you can start following the progression I outlines above making sure that the online tools you use allow your students to ask questions in real time and when you answer -everyone sees your answer - google classroom allows this easily. Hope this helps a little, please post your questions here.

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Eugenia Etkina
10. March 2020.

Hi all, I started putting together ALG activities that can be run as labs at home (I am attaching a document for chapter 4 as a n example). You can go through the ALG files and do the same - pull out activities that have videos for data analysis or photos (there are plenty)! And make labs out of them. We have lots of videos in the book and ALG and an additional video resource at http://islephysics.net/pt3/ and we have an ISLE youtube channel (google isle physics on youtube). We are perfectly positioned to weather this storm.

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Eugenia Etkina
12. March 2020.

One more post - teaching students how to read a textbook. It is a short document that contains a text for them if this is an assignment and instructions for you if you are doing it with them (repeat of what I sent before).

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Eugenia Etkina
18. March 2020.

Hi people, I am posting another example of an online lab using the materials that we have created. This one is for magnetism, I will keep posting the labs that we run. Please post here if you need a specific lesson, a lab or anything else. I will resume posting about the chapters as soon as I get a handle on my home situation.

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Eugenia Etkina
22. March 2020.

Hi all, next week is the first week of on-line instruction at Rutgers. At Rutgers-Newark where we have two ISLE-based courses that use our textbook we have two large room meetings (LRMs) a week (80 min each), one problem solving session (Small room meeting - SRM) for 55 min and a 2-hour lab. I was trying to put all materials in the zipped file but Facebook does not want to attach it, so i will be posting them one by one. The Handout word document is for the students to follow during the on-line synchronous meetings for the LRMs and to work on during the SRM, the ppts that the professor uses in LRMs are labeled I and II. I posted the lab before, it is lab 9 Magnetism. Please ask questions! The next week will be on chapter 21.

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Eugenia Etkina
24. March 2020.

Today my post is about students simple experiments at home when they are in class. For example, today I taught lessons on mirrors - plane and curved. I asked my students to go to the kitchen and get a big knife, a table spoon and a pencil. And voila - everyone had a plane mirror and a concave mirror and a convex mirror! First they read the book and did ALG activities in chapter 23 and then they could find virtual images of the pencil in the plane mirror (the knife) and discuss the change in its size (apparent), observe real and virtual images of the tip of the pencil in the spoon and, as it is non symmetrical, they could see upright and inverted images. They could also determine the focal distance of the concave mirror using two methods! and compare the ray diagrams that they draw for the ALG activities with the real life situation. If you are going to use the spoons, do not use your face as an object to determine the focal distance, use a small object.
What other topics can the students learn in your synchronous lesson? Definitely lots on air pressure - they just need a straw and a cup of water, if they have a plastic bottle - even better. They can study vibrational motion using a string and a set of keys attached to it, they can conduct experiments on static electricity using scotch tape and plastic combs and other objects. They can also study acceleration of whatever they attach their phone to and use phyphox, they can measure magnetic field of Earth, luminosity of different sources, study the sounds they produce and so forth. It is important that you are there - on the screen, talking to them and guiding through the experiments. However, it is also important that they learn to read the textbook - for guidance on this see the document that I posted 2 weeks ago - How to read the textbook. Based on the responses of my students this document helped them change they way they work with the textbook, so - please try!

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Eugenia Etkina
25. March 2020.

Hi all, we have an influx of new members as Jane Jackson posted on the Modeling listserv about our facebook group and the people who have been accepted might not know about ISLE or use our textbook. First I want to welcome them, second I want to explain who this group is for. Welcome to our community, people, we are happy to have you!
This is what you need to know: When I post my suggestions here I assume that the members are using our textbook College Physics: Explore and Apply, the Active Learning Guide (ALG) and the Instructor Guide. The Instructor Guide is posted here among the files, I could theoretically post selected ALG files here too (but I need to

know which specific chapters you need), however without the textbook it will be hard to follow as we have a very specific approach to learning physics in every chapter. It is close to Modeling Instruction but the details are very different. If you really wish to follow, you need to ask your Pearson rep to send you a copy of the textbook. We have lots of free websites with materials that you can use without the textbook, I am pasting them here again. Please go through the posts in the past three weeks and through the posted documents to see what we do. Below is the list of useful websites with materials:
http://pum.islephysics.net/
http://islephysics.net/pt3
https://sites.google.com/site/scientificabilities/
https://media.pearsoncmg.com/aw/aw_etkina_cp_2/videos/
I will continue to post but please go through the old posts to take advantage of everything we have here and please post your questions and suggestions. Specifically, please read the paper that I just posted about what ISLE is (file called Etkina_AJP_ISLE). Welcome again, Eugenia Etkina.

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Eugenia Etkina
26. March 2020.

Hi all, I just saw that facebook deletes files to make room for the new files and the Instructor Guide file got deleted. I am reposting it and I also deleted all papers which I posted a long time ago, I am trying to only leave the files relevant to our online teaching work for now, so please scroll through all the files, open them and see what is useful. And no one e-mailed me about needing ALG files, does it mean you have them?

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Eugenia Etkina
29. March 2020.

Hi all, it is a Sunday and I am not going to post any big time physics stuff but I just wanted to remind you to post questions and ideas here and to look around the house for possible experiments for your students. Are there any mechanical toys in the house? They are great to studying energy conversions and how work changes the energy of a system. Are there people wearing glasses in your house and do you

have a ruler? What kinds of glasses? These are great to studying lenses. Do you have any cooking thermometers and styrofoam cups? You can do calorimetry experiments and determine the specific heat of all possible liquids and even solids if you put a solid object into boiling water to know the initial temperature. Do you have an electric kettle? You can study Joules law and the efficiency of the kettle as the power rating should labeled. Got any big bars of plain chocolate? You can study the wavelength of microwaves in your microwaves. Got any strings? You can study properties of pendulums. Bottom line - there are endless possibilities for your students to study physics at home. Let them suggest experiments - those can work for projects that we discussed above. How can they convince you that they understand a specific physics topics using the materials at home? The list goes on indefinitely. Did I say at the beginning that I am not going to do any physics in my post? Sorry... I cannot stay away from it as physics is indeed the love of my life, I am sure it is yours too. 🙂 Stay safe, wash your hands and I am going to post our next week's materials tomorrow morning. They will be about electromagnetic induction.

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Eugenia Etkina
31. March 2020.

Hi all, I have not posted anything yesterday as there were two posts on Sunday and I do not want to overload you. But today I wanted to explain a few things that we are doing especially because we have an influx of people who are not familiar with ISLE or our textbook. So prepare for the long post!
The ISLE approach (Investigative Science Learning Environment approach) is a comprehensive approach to learning physics when the students learn the normative content by participating in the practices of physics and at the same time grow as learners as they do collaborative work in groups, are allowed to resubmit their work without punishment and use a myriad of tools that are designed to help them be successful. ISLE is the only approach to learning physics so far that consistently matches the elements of Universal Design for Education - all students have an opportunity to be successful independently of their level of preparation. There are tons of things that we do differently compared to other educational approaches (including the physics) but today I will focus on one - the logical progression of activities that help students think like physicists. This progression is reflected in the sequence of activities for each chapter in the Active Learning Guide and in the textbook text. Students start every unit by observing very simple experiments (or analyzing videos or data tables) from which they infer patterns (these are Observational Experiment Tables (OETs) in the textbook), they then learn how to devise multiple explanations for those patterns (again shown in the OETs) and then they design experiments to test those explanations (in the book these experiments

are in Testing Experiment Tables, TETs). The students need to predict the outcomes of the testing experiments using the explanations under test, NOT their intuition, that is why having multiple explanations is so important. The prediction is "right" if it is based on the explanation under test and NOT if it matches the outcome of the experiment. If it does not match the outcome of the testing experiment but it is based on the explanation under test, then the explanation is questioned not the prediction. The text in the tables is turned into activities in the ALG. The students can work on those collaboratively and then tread the book (not before they try). This sequence is used in the handouts that I have been posting here.
NOTE: We DO NOTask students to predict the outcomes of the observational experiments, EVER. We do not use elicit-confront-resolve approach or predict-observe-explain approach. We use observe-explain-test your explanation approach. I will go into the reasons for these choices in my next message. But for now, if you do have our textbook, please look at how we use Experiment Tables in the textbook and how they match activities in the ALG and if you do not have the textbook, contact your Pearson rep to get access, I am sure they will give you access to an e-book instantly.

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Eugenia Etkina
9. April 2020.

Hi all, I have not posted in the last couple of days to give you a break. 🙂 Today I want to channel your attention to a part of our website with videos. http://islephysics.net/pt3/index.php David Brookes and I started this website in 2002 and since then thousands of teachers used it. While there are lots of ISLE-based video sequences for different units (Motion, Newton, circular and rotational motion, etc.), there is one section with Puzzles and surprising data. These are experimental problems/videos that you can assign as they are without making any special handouts and the students can work on them as labs - an example is in Mechanics puzzles, Finding height of a table, application experiment. There you watch two videos from which you can estimate the height of a table - a pendulum and a dropped ball (http://islephysics.net/pt3/experiment.php?topicid=13...). The heights come out slightly different based on the number of frames you use - so the question of experimental uncertainty comes naturally. The puzzles are all application experiments and the surprising data pages are with the videos that make students question their assumptions, not the physics models themselves. There is tons of stuff there ready to be used. Please reply here with your favorite. And in general, PLEASE REPLY HERE! When we post something and very few people reply it becomes unclear whether the posts are needed. Thank you!

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Eugenia Etkina
17. April 2020.

Hi all, I wanted to talk today about group work. Research in brain activity shows that one has to actively test their own ideas to learn anything (see J. Zull, The art of changing the brain - I recommend this book strongly!). Note that here the word testing does not mean assessment of the learner by the teacher but the learner actively testing their own ideas. The active testing involves motor function. A person needs to move to engage in active testing (this is how our brain works, that is why sitting passively in a lecture - think of a million colloquia that you attended - does not lead to learning). In the ISLE process we have active testing through students designing and doing testing experiments as a part of constructing concepts. But this is just one form of testing. Another form is working in a group and speaking about your ideas - this is also active testing (speaking involves motor function). Writing them on the white board - is also active testing (writing your own thoughts involves motor function). This means that when students are working by themselves on assignments during our online learning they have fewer opportunities to test their ideas. Therefore it is crucially important that they work in groups, share ideas, argue about them and so forth. Collaboration is also a natural part of doing physics. So, what I am trying to say is that it is really important that students are assigned to functioning groups (this means that they really work together) during our online learning times. Personally, when I post the assignment for my students for the upcoming week, in the assignment, all students in the class are grouped in groups of 3 and they submit only one assignment per group before class, I then read all their submissions and decide what activities (these are usually ALG activities) require a group discussion as the answers differ or wrong. The activities for which everyone submitted the right answer and reasoning we do not discuss but instead talk about how these activities help them achieve the learning goals. The learning goals for each unit are in the Instructor Guide and I share them with the students.

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Eugenia Etkina
23. April 2020.

Hi all, I apologize for not posting for a while, but my own teaching and homeschooling of two of my grandchildren are taking up all my time and energy. Today, I would like to continue the conversation about group work. Research says that on average heterogenous groups (students of different levels are together) are better for learning as the best students become better from helping others and weaker students learn better from their peers than from a teacher. The question is: is this true for online learning? Talking to my teachers (the graduates of my program) I came to a conclusion that in the times of on-line teaching we might want to group students homogeneously. This means that one group will have strong students, another group - medium and another - weaker. This way as a teacher you can spend more time with the groups of students who need more help, while those who do not, will move forward on their own and eventually all groups will be in a some kind of similar place. Another idea that came from my teachers is that group work should resemble the common think-pair-share approach. In think-pair-share a teacher asks a question, students work on it individually, then pair with the neighbor, discuss their answers, come up wot ha consensus and then share with the class. In the online environment it can be the following: each student works on the assignment individually first, then the group gets together and discusses their findings and submits a common document to the teacher. During the class meeting (synchronous or asynchronous) the teacher shares different solutions (approaches, etc.) and summarizes the findings (or the students do it if the set up allows). The summary needs to clear all good ideas and the mistakes so that he students leave wit h a clear understanding of a correct thought process and methods (I am not emphasizing the right answer here, just the thinking!) At the end the teacher has both versions of work - individual and group and the students have an opportunity to think for themselves and be responsible, share with the peers and test their ideas (remember my post about active testing?) and then have a closure at the end. This closure is very important (in educational theory it is called "Time for telling"). Please post your questions! Thank you for reading such a long post.

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Eugenia Etkina
6. May 2020.

Hi all, this is a short post about one aspect of the beginning of the school year. There are many, but I will start with one, and then I will do a post on Chapter 25, then i will post on the new school year and then on 26 and will alternate. Hope this plan satisfies both groups. But all my posts will be tied to the textbook Exploring and Applying Physics for which this group was created, therefore if you do not have a copy, please get one (your Pearson rep will provide it for free) as well as access to the ALG and IG thought Mastering Physics (they are both free to download).
So, the first issue with starting school year on-line. Content. This is about content only. I am sure that many of you start with mechanics, specifically kinematics, in normal circumstances. I think it is a good topic to start (Chapter 2 in the textbook and ALG) with as it provides conceptual foundations for the rest of mechanics and for the rest of the course. It allows students to take many videos of moving objects and analyze them qualitatively and quantitatively as well as to do simple experiments. It is a kinestetic topic too. Adding to our materials is the option for "Acceleration only" on Phyphox app that allows the students to investigate the motion fo their phone to themselves with the phone or any object to which the phone is attached. So kinematics might be a way to go. However, there is another topic (the only one other topic) that is not based on anything else - it is geometrical optics (Chapter 22). Studying light and shadows and reflection/refraction can make students connect to their everyday experiences even more than studying motion. Check out the materials in Chapter 22 and see how you can apply them online. We have had so many great posts here related to geometrical optics on-line that you should have lots of home experiments for the students in addition to the materials in the textbook and the ALG. You could then proceed to 23 or go back to 2 (kinematics). What will be important is that the interest of the students is captured for the rest of the semester. Please comment on these ideas!

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Eugenia Etkina
8. May 2020.

Today my post is about the models of light - Chapters 22 and 24. The ISLE approach allows us to arrive to these models through a systematic exploration of the evidence concerning light that we slowly accumulate. Chapters 22 and 23 use the ray model to explain and predict phenomena. But what is a ray model? It is an interesting question as one can see the ray as the direction of the travel of the "material" - and these will be the light "bullets" in the particle-bullet model of light (see see section

22.7 Explanation of light phenomena: two models of light). Or the ray can be the direction of the propagation of energy in the wave model of light. Interestingly that both models use rays but in a completely different way!
Another issue that is important is the language. When we talk about light waves we need to be very careful about the language, emphasizing continuously that light is not a wave, but sometimes (but not always!) its behavior can be explained using a wave model. It is true for the bullet model too - it explains perfectly many observed phenomena - reflection, shadows, pinhole camera effects and so forth. We should not say that light "is" something. We should always carefully say that "light behaves like something" to emphasize that all models of light are just models, and the models that introductory physics uses are not all of the models that science has for light.
Finally, the wave model of light never says what is "waving" in the "wave". The answer to this question comes in Chapter 25 (Electromagnetic waves). Notice that the chapter starts with polarization of light. Theoretically, polarization belongs to the chapter on wave optics, why did we put it into electromagnetic waves chapter? The answer is that every chapter in our book and the ALG tells a story. It starts with something that is missing in our previous knowledge and ends with another question that we attempt to answer as we go. You can see it in the text on every chapter opening page - it is especially interesting for Chapter 25 (page 784), bottom right. Do not miss!
And stay healthy, people, do jumping jacks and pushups, and go for walks, or maybe even run. I do all of the above and it helps me stay sane. I also do it when I have a class. We take periodic 5 min breaks for jumping jacks or squats or pushups. I do not turn off my video when I do mine 🙂

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Eugenia Etkina
13. May 2020.

Hi all, I did not post anything yesterday as I did not want to distract your attention from Gorazd's post. Today, as promised I will talk about pedagogical issues related to starting school year online. Now we all are reaping the benefits of knowing students personally before switching to online learning. What if we did not know them and they did not know us? How would we create a positive learning environment where they see us as human beings and where they would not be afraid to make mistakes, express their ideas without worrying of being wrong and where they can eventually form a learning community? All of the above needs to happen while they are learning physics and, by physics, I do not mean only the concepts and laws but, most importantly, the ways of thinking like a physicists or the engagement in science practices according to the language of NGSS. It is a long

conversation and today I will focus on one aspect - how do they get to know us as people and at he same time engage in the process of thinking like a physicist? I strongly recommend using the idea behind activity
1.1.1 Tennis rackets in Chapter 1 of the Active Learning Guide (I will post it here) but modify it to fit your interests. Read the activity below and think how you can change it to introduce yourselves to the students and to make them think of multiple explanations fo the same phenomenon and testing these explanations experimentally.
Imagine that a new acquaintance (Miha) invited you to his house. You walk in and notice that he has 10 tennis rackets in the hall way. You wonder WHY Miha would have those rackets. Unfortunately, Miha does not speak English and cannot answer your question directly.
Work with your group members to come up with a plan to find out why Miha had 10 tennis rackets.
You read the activity above. Now imagine that instead of doing this activity on the first day of class you post a video of your self going through your house and showing some weird stuff there. I play tennis so I would place my tennis rackets (I have a few and will borrow from my friends) and make a pile in the closet. I will do a tour of my house and tell them a few words about myself - who I am and what I love doing. And then I will open the closet and show a bunch of tennis rackets. This way the question of why I have those rackets will come naturally and the video will end with the request for them to come up with three different explanations (or crazy ideas) for why I have those rackets. I will post this video on google classroom and send an e-mail to my students to view it before class. Then in class I will group them in groups of 3-4 to discus their crazy ideas, they will share them with the rest of the class and then we will move to how to test them. This way the students will get to know me, see my house (or whatever you wish to show them, maybe your yard, your desk, anything personal) and they will start learning that physicists come up with multiple explanations of the same phenomenon and then try to reject them by experimental testing. I welcome your ideas here - how will you start your school year online?

https://www.facebook.com/groups/320431092109343/posts/684630975689351/

Eugenia Etkina
19. May 2020.

Good morning, everyone! Today my post is about the Investigative Science Learning Environment approach that is the foundation of our textbook, Active Learning Guide and the Instructor Guide. I know that many people who joined this group later have not been trained in using this approach and many who have, were trained to use it in in-person instruction. Not on line. What are the foundational ideas behind this

approach and how can we implement them in the new conditions and later when we return to normal? In order to help, Gorazd Planinsic and I are offering you an on-line workshop (or maybe a series of short workshops to address many different features of ISLE - the logical process, assessment, multiple representations, community and confidence building, specific new content approaches and many others). Before I post a link to the registration form, I wanted to know how many people approximately would want to participate. The workshop(s) will be during the week of June 1st. Please reply here if you are interested in attending such a workshop(s). It is absolutely free, it will be through zoom and we are doing because we want to help you learn what the ISLE approach is, as you need to know it if you are going to continue to be the members of this group and are going to benefit from our numerous posts. Please reply to this post, thank you.

https://www.facebook.com/groups/320431092109343/posts/689137131905402/

Eugenia Etkina
15. June 2020.

Hi all, The Physics Teacher last issue is dedicated to diversity in physics and I chose one paper that I especially liked to post here. I am sure that many people in our group will share the experiences described in the paper. The paper provides specific advice on how to improve the situation, please read!

https://www.facebook.com/groups/320431092109343/posts/708152410003874/

Eugenia Etkina
29. June 2020.

Hi all, we have been preparing a really interesting and very new ISLE workshop for the AAPT virtual meeting. Even if you attended an ISLE workshop before, you will learn lots of new things. Please sign up! Here is the announcement, the time is fixed now.
W01: Learn Physics While Practicing Science: Introduction to ISLE
Date/Time: July 11, 2020 from 11:00 AM to 3:00 PM (EDT) and July 12, 2020 from 11:00 AM to 3:00 PM (EDT)
(This is a two day workshop)
Organizer: David Brookes/Co-Organizers: Eugenia Etkina, Yuhfen Lin, Gorazd Planinsic, and Yuehai Yang

Participants will learn how to modify introductory physics courses at any level to help students acquire a good conceptual foundation, apply this knowledge in problem solving, and engage them in science practices. The framework for these modifications is Investigative Science Learning Environment (ISLE). We provide tested curriculum materials including: (a) The second edition of College Physics Textbook by Etkina, Planinsic and Van Heuvelen, the Physics Active Learning Guide and the Instructor Guide; (b) a website with over 200 video experiments and activities for use in the classroom, laboratories, and homework; (c) a set of innovative labs in which students design their own experiments. During the workshop the participants will learn how to use the materials in college and high school physics courses to help their students learn physics by practicing it. We will focus on preserving the spirit of ISLE in an online environment.

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Eugenia Etkina
14. July 2020.

Hi all, it is great to see more and more people joining our group (about 40 in the last 2 days). Welcome all new members and thank all old members for being here! Many of you indicated that you either already use or will start using our textbook "College Physics: Explore and apply". Even without our new materials (which we are working on like crazy now) for the on-line learning, the book and the Active Learning Guide (ALG) are very easy to use when teaching online as they have lots of videos and simple experiments that students can do at home. We are making more of both and the Kinematics Labs on line document that I posted yesterday is an example - all labs came form the OALG - the ALG for Online teaching that we are making now. Thus, if you have the book and the ALG (which is FREE) on Mastering Physics, you already have lots of stuff to use next fall. However, as I wrote many times here, our book and our whole approach to teaching physics is so unique that to appreciate it one needs to read the book as if they NEVER studied physics. I know this sounds crazy, but if you do not do it, you will mess lots of important innovations, ideas, problems, details, etc. Most importantly, our textbook is the only textbook that has a unifying philosophy (ISLE) that goes through every chapter which allows the students to develop habits of thinking like a physicist. To see this philosophy (if you have not attended our workshops) you need to read every chapter (including Chapter 1) with the eyes of your students. Please, if you have any questions, ask here or send me a personal e-mail. Welcome again and please go through the files in the Files folder, there is lots there.

https://www.facebook.com/groups/320431092109343/posts/728545611297887/

Eugenia Etkina
15. July 2020.

Hi all! As you know, on July 11-12 we ran an 8-hour AAPT workshop "Learn physics by practicing science: Introduction to ISLE". We had 26 participants and most of them stayed after 4 hours of the workshop each day to ask questions.
I want to share some aspects of the workshop that are applicable to teaching in the fall. The workshop was run on zoom.
Prior to the workshop we sent an e-mail to the registered participants with the homework. The homework consisted of the preparation of materials for simple experiments, experiments, reading of papers and of doing some activities. We did not put the participants in groups for this part, but if I were doing it for my class, I would. This would create the seeds of the community.
Then, during the workshop, we used their pre-class work for discussions and continued with the activities. Some of them we whole-class activities and some were in groups. We used break out sessions where the "students" worked on the activities and used the whiteboard function to record their work, then they took screen shots of their whiteboards and put them into whole class google powerpoint slide show that we prep-prepared. Each group had a slide marked for each activity. After the group work was finished, we all came together and the groups presented their slides to the class for the discussion. Sometimes they typed directly into the slides.
We also created a group google doc for the questions that the participants asked and we answered. All documents for the workshop and followup readings were in the group google folder that everyone could access. In short 8 hours I think (I hope) we managed to create a community.
I am writing you all this as the template of the workshop can be used for running your course on-line if you have a synchronous course with whole class meetings on zoom or using some other platform. I could share the workshop folder here so that you can see all of the activities and readings but I am afraid it would be overwhelming.
I am asking workshop participants to share their reflections on the format - what is suitable for your classes?

https://www.facebook.com/groups/320431092109343/posts/729058074579974/

Eugenia Etkina
17. July 2020.

Hi all, as you know the beginning of the school year is key to set the tone in your course, to establish community, to start building physics identity in your students, to make them feel capable and welcome. Creating a mistake-rich environment where everyone can learn if puts effort is crucial for the ISLE approach. I am sharing the new first chapter of the Instructor Guide that discusses the first day in class. It does not matter whether it is in person or on line synchronously (zoom or something like it). I am not sure how to do it for an a-synchronous environment, I welcome your suggestions. I will also post the first chapter of the on-line ALG - OALG as we say. It is written in a way that a student can (theoretically) progress on their own. But, of course, it is best to create a community as I described in my previous post. I think facebook only allows to add one file to a message, so I will do two.

https://www.facebook.com/groups/320431092109343/posts/730400121112436/

Eugenia Etkina
17. July 2020.

And here is the first chapter of the OALG.

https://www.facebook.com/groups/320431092109343/posts/730400507779064/

Eugenia Etkina
22. July 2020.

Hi people, here is OALG Chapter 5 - circular motion. As I already said, Chapter 3 is delayed (unfortunately) because of one missing video, it will be coming soon. If you did not get the textbook yet, I suggest you try to get a copy from your Pearson rep, as many activities refer to specific parts of the book, as well as reading assignments that I talked about yesterday. The word documents (or individual activities) can be pasted into google docs for students to work on online.

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Eugenia Etkina
24. July 2020.

Hi all, I am posting the lab experiments for circular motion. You can choose which ones to include into your lab, depending on how long it is. At Rutgers we have 3 hour labs and 2 hour labs, the numbers of the experiments that the students do are different but they all use rubrics for self-assessment. In an on-line environment, we put students in groups to work on the experiments. They submit their lab report via google docs. They can do the experiments asynchronously or synchronously, during the time designated for the lab. They share their results via whiteboards or by pasting them into class google slides - whichever method you like best. The whole class discussion of the findings is really important. As a teacher you can give them hints in their google docs.

https://www.facebook.com/groups/320431092109343/posts/735520297267085/

Eugenia Etkina
29. July 2020.

Hi all, we are continuing our journey into online teaching! Today I am posting OALG Chapter 7 - this is energy. I am reminding those who do not use our textbook that our approach to teaching energy is very different from traditional.
We: 1) define the system before we do any energy analysis. Objects inside the system do not do work, but they possess different kinds of energies depending on their interactions and motions; 2) We do not use conservative and non-conservative forces. ALL external forces that do work on the system lead to the change of energy of a system, this can be a change in some of mechanical forms or a change in internal energy. Thus our energy analysis is not constrained to conservative forces, it includes all interactions! 3) We use work-energy bar charts to represent the processes from the energy point of view. These bar charts when used correctly are absolutely invaluable and they help analyze ALL possible processes - literally, no exceptions (we use them later in at least 9 more chapters); 4) We differentiate between CONSERVED and CONSTANT. Energy of any system in conserved in ANY process but it is not necessarily constant. It might change but it does not mean that it is not conserved, as we can always redefine the system to account for the missing/extra energy. 5) We include the surfaces in the system when analyzing processes involving friction between surfaces or stopping (reasons too complicated to explain here unless somebody is really interested and asks). After this long introduction, I am attaching new Chapter 7 for the OALG. The set of labs will follow (probably on the weekend).
I would like people who read these posts to react somehow so that I know thatI I am not posting into a black hole. I see the likes of 2-3 people per post but with over 350

members there must be more people who view the posts and download the documents. So, please if you read the post - say something. Otherwise I am not sure if what I am doing is helpful. We are working non-stop producing the materials and it would be good to know that they will be used.

https://www.facebook.com/groups/320431092109343/posts/739241236894991/

Eugenia Etkina
2. August 2020.

Hi all, I am posting chapter 8 OALG - Statics. We have a few things in the chapter that make it different from more traditional approaches. Through experimentation (that students can do at home) We explicitly define the center of mass as a one point through which the lines of forces that do not rotate the object pass. Students can do simple experiments at home to find this point for many objects that they can lay flat on a table. We later come back to this definition quantitatively and help students learn that the mass is NOT evenly distributed around the center of mass of an object. In fact, it is a very confusing term as this point is not the center around which the mass is evenly distributed but the CENTER OF TORQUE. The second difference is that we spend a significant amount of time helping students learn about the stability of equilibrium (the topic missing in many books but very important in everyday life). Check out Chapter 8 in the textbook after you go through the activities in the OALG.
Thank you all who responded to my question about the posts being useful. Please post your questions and your ideas.
https://www.facebook.com/groups/320431092109343/posts/742087793277002/

Eugenia Etkina
3. August 2020.

Hi all, here is Chapter 10 OALG - Vibrational motion. Our approach to vibrational motion is focused on multiple representations - motion diagrams, force diagrams, kinematics graphs, energy bar-charts and many others. Seeking consistency of representations makes the topic easier to comprehend, allows the the students to review all of the previous physics they learned and see the coherence of physics - a small number of tools work for a large variety of physical phenomena.

https://www.facebook.com/groups/320431092109343/posts/742952363190545/

Eugenia Etkina
4. August 2020.

Hi all, I am posting belated Chapter 3 of the OALG. This is linear dynamics chapter, 3 Newton's laws basically. Again, there are many things we do differently in this chapter compared to other textbooks and curricula, I will focus on 3 (but there are LOTS more in the textbook):

1) Concept of a system. We choose a system (in this chapter usually one object) and the rest is the environment. The objects in the environment interact with the system and one of the physical quantities characterizing these interactions is force.

2) Forces are labeled with two subscripts indicating what object is exerting a force on the system and what the system is, for example if you are holding a ball in your hand and the ball is the system, F sub E on B indicates the force that Earth exerts on the ball, F sub H on B indicates the force that the hand exerts on the ball. We do not have F sub g or W (weight) because these notations do not allow our students to see two interacting objects and worse, weight (as well as tension) as they are spoken about indicate forces belonging to single objects. To draw force diagrams students first choose their system, then list objects interacting with it and only then draw forces to represent these interactions.

3) When students draw force diagrams for objects (accelerating and non-accelerating) they first draw motion diagrams (as they are more intuitive). The motion diagram allows them to see the direction of the velocity change arrow (same as acceleration) and thus allows them to draw the relative lengths of force arrows on the force diagram correctly to make sure the object accelerates in the direction matching the motion diagram. This consistency of representation is the main sign of expertise and our approach helps develop it very efficiently.

Now - you go and read the OALG chapter 3 and see how these ideas are implemented through the activities. 🙂

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Eugenia Etkina
5. August 2020.

Hi all, it looks like I could not replace the file with the original post for Chapter 2, kinematics. So I copied the post and pasted it below. I just wanted to say before I paste it that it is in chapter 2 that we start building the Physics Tool Box with the students. Traditionally, the main tool our students use in physics is algebra. Those who are not quick with it are left behind. One of the two intentionalities of our approach is to help ALL students be successful in physics. For this we help them learn more tools. These are called multiple representations They serve as a bridge

between phenomena, language and mathematics. The first of those, the first tool is a motion diagram. See the OALG activities that help students develop it. I would say that being able to draw good motion diagrams is one of the most important skills in kinematics as later in dynamics (see my post yesterday), students will use those diagrams to draw correct length of force vectors on force diagrams. I posed a few years ago how make learning of motion diagrams easier - find the file with the photos of cardboard arrows and the corresponding post. Below is the old post about chapter 2 and the revised OALG file is attached here.
Below is my original post:
Hi all, this is OALG Chapter 2 - kinematics for learning online. It is designed in a way that a student who has our textbook can study kinematics independently if you teach asynchronously. It is also good for working in groups for synchronous work. If you do not have a textbook, there is plenty for you and your students to use as most of the activities use home equipment for experiments and videos that are free for everyone. Eventually, we will replace youtube video links with Pearson links (which will be free too), but I wanted to post this chapter for you to see what is coming. We are almost done with chapters up till 9, but waiting for a few videos to be edited and made. I hope by August 10 we will have the first half year completely covered. Or maybe even more. I will be posting experiments for labs separately. So far I posted labs for kinematics. Please check out the files posted in chronological order.

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Eugenia Etkina
6. August 2020.

Hi all, I am posting Chapter 11 - Waves. As in the previous chapters, there are many things that we do differently. The major one is the relationship between the three physical quantities in a traveling wave - frequency (property of the source), speed (property of the medium) and wavelength (the result of both). Traditionally , the relationship is written as speed= wavelength X frequency. While correct in principle (the same way as Fnet=ma is correct in principle), when written this way, the relation gives students the idea that the speed depends on the wavelength and frequency (the same way as when written as Fnet=ma, the relation gives students the idea that the sum of the forces depends on the mass and acceleration). In fact, the frequency and the speed are independent variables, and the wavelength depends on both. Therefore writing this familiar relation as wavelength=speed/frequency communicates the cause-effect nature of the relation (the same way as we writing Newton's second law as acceleration=the sum of the forces/mass). There are many other things that we do differently - please read textbook chapter 11 and do the activities on the OALG 11 that I am posting. Without doing the activities yourself, it is difficult to see all the innovations that we included in this chapter. And of course, it

adheres to the ISLE process the same way as all other chapters. Students construct all ideas going through observational experiments-patterns-explanations-relevant physical quantities-testing experiments (with the predictions before those based on the explanations under test) and finally - applications.

https://www.facebook.com/groups/320431092109343/posts/745085986310516/

Eugenia Etkina
7. August 2020.

Good morning everybody, I am posting lab experiments for chapter 7 - Energy.
https://www.facebook.com/groups/320431092109343/posts/745673826251732/

Eugenia Etkina
8. August 2020.

Hi all, I am posting OALG Chapter 12. We have LOTS of new and unusual ideas and approaches in this chapter. The first one is the way HOW we help students construct the idea that stuff is made of small particles that move randomly. Most books just state it, but we have students go through a series of investigations and reasoning that allow them to invent these particles and their motion (see OALG activities 12.1.1-12.1.5). The unique experiments help students reconcile their prior ideas with physics (I will not tell you what those are).
Another one is the use of graphical analysis to connect microscopic and macroscopic understanding of gas processes. The approach we use is not used in any other textbooks or curriculum materials. Check out OALG 12.7.1 (and some others in the chapter).
Also, I finally figured out how to see how many people view posts. The good news is that it is a high number - about 200-250 people per post, but taking into account how big our group became (370 members), it could be better. I am looking for ideas for how to make these two numbers closer to each other.

https://www.facebook.com/groups/320431092109343/posts/746505822835199/

Eugenia Etkina
11. August 2020.

Hi all, I am posting Chapter 15 - First law of thermodynamics. This chapter is TRULY different from what you are probably used to. We continue to consistently apply our systems approach to the analysis of phenomena and thus we only have work done ON the system, not by the system. This leads to only one version of the first law for thermodynamic processes: W+Q=deltaU, where U is internal energy of the system (assuming that the mechanical energy is not changing). Work done one the system is -PdV (as the work is positive when the volume decreases). And we do not use the term "heat", we use the term "heating" or "transfer of energy to the system by heating". In this case "heating" does not mean "warming" but means the mechanism of energy transfer. This small change in vernacular helps students learn that heating and work are not state functions and depend on the process. While the internal energy is the state function. I strongly recommend reviewing chapter 7 (Work and Energy) with AP2 students before going into the first law of thermodynamics, if you use our systems approach. And of course, we continue to emphasize the difference between "conserved" and "constant" - see my posts about Chapter 7.

https://www.facebook.com/groups/320431092109343/posts/748610235958091/

Eugenia Etkina
18. August 2020.

Hi all, I have been posting lab activities for the first 15 chapters of the textbook - all documents are in the files. Pivot interactives experiments are included there. These files should cover your needs for all of the mechanics, fluids and thermo. We are working on Static electricity, DC circuits and magnetism now. LOTS videos of new experiments! Stay tuned.

https://www.facebook.com/groups/320431092109343/posts/754386985380416/

Eugenia Etkina
22. August 2020.

Hi all, I have not posted for a while as we have been working on E&M. Here is the first E&M chapter (Chapter 17) - Electric charge and force. Check it out! We have tons of new videos (some are for pretty complex experiments) and we continue to follow the ISLE process with the tools, we have extensive use of force diagrams and energy bar charts. The bar charts help students understand the nature of negative

electric potential energy. This concept was found to be very difficult for students but the bar charts and the system approach (of course) make them very easy and natural. I cannot say enough about the role of bar charts and systems approach in helping students understand and operate with energy. If you have not learned our approach yet, start with chapter 7, then go to 15 and only after that to Chapter 17. I am reminding you that all the lab files are posted here as well as all OALG chapters 1-15. If you open a file and see track changes where equations are, just accept them and stop tracking, I do it before I post the files but Word2019 on a Mac has this terrible issues with tracking changes and I cannot get rid of them. There are only very few and they might not show on your computer, but if they do - just accept. Enjoy the chapter, we had lots of fun working on it!

https://www.facebook.com/groups/320431092109343/posts/757079395111175/

Eugenia Etkina
2. October 2020.

Hi all, it looks like I never posted OALG Chapter 20 - Magnetism (Thank you Dedra Demaree for noticing!). It is attached here. Please take a look, we have TONS of cool stuff there. Remember, if the file opens with file code changes for equations, just accept them. They are all accepted on my computer but every time I open the file, they show up again.

https://www.facebook.com/groups/320431092109343/posts/789738298511951/

Eugenia Etkina
11. October 2020.

Hi all, I am going to post OALG Chapter 25. Thank you, Irene Ning-Lee for proofreading! The chapter is for electromagnetic waves and as always, our approaches to the material are quite different. See some cool experiments with microwaves and chocolate. I am reminding all members of the group that this group was originally created to support the users of the textbook College Physics: Explore and Apply by Etkina, Planinsic and Van Heuvelen, published by Pearson (including the AP edition). It is written in the "About" the group on the right side of the home page. Please read it so that you know that all chapters relate to this textbook (it is the second edition of our College Physics textbook). The activities follow the textbook sections in each chapter and references for "Read and Interrogate" and "Practice" activities correspond to this second edition. Reading and interrogation strategies are described in the first chapter of the OALG posted here, in the files. Each posted file,

when you click on it, connects you to the post about it. The OALG chapters are useful by themselves as they contain a ton of activities that you can do now when teaching remotely and later when we go back to normal, but the real benefit comes from their use with the textbook. If you do not have the textbook, contact your Pearson rep and they will send you an examination copy. If you do have, read it as if you never studied physics. Only when you read it as a completely new text you will see all the gems and innovations we put there. There are tons and once you find them you will not be able to go back.

https://www.facebook.com/groups/320431092109343/posts/795949681224146/

Eugenia Etkina
18. October 2020.

Hi all. I am posting OALG Chapter 27. Quantum optics. Thank you for proofreading, Christine Russell! This is an absolutely unique chapter. Did I say about every chapter I posted? Maybe. But this one is for sure.
You NEVER saw experiments that we present there (thanks to the ingenuity of Gorazd Planinsic). They address so many ideas that the students might have and the technical implementation is unprecedented. I will not spoil your pleasure reading and watching but I will only say that this chapter makes students think like scientists like no other. And we have lots of materials on LEDs - to appreciate, do not forget to read relevant sections in the textbook.
This will be our last OALG chapter. For the rest of the material you can use the existing ALG chapters - they are free on Mastering Physics. If you need them, please let me know and I will post them here.
I strongly recommend (again and again) that you download all OALG chapters and the files for online experiments (labs) before you start planning your lessons for a specific topic. This will save you lots of time looking for questions, experiments, videos, etc.
I also recommend checking out our other websites - specifically http://islephysics.net/pt3/ for videos and cool experimental problems (scroll down to puzzles and surprising data) and https://sites.google.com/site/scientificabilities/ - for labs, formative assessment rubrics and many other ideas.

https://www.facebook.com/groups/320431092109343/posts/801858943966553/

Eugenia Etkina
19. October 2020.

Hi people, as you know I use the existing OALG files to make files for lab experiments that can be done while learning online. So far we have them up to Electric fields and I have been swamped and did not move any further in the last month. But yesterday I finished the DC circuits experiments. You can use them without using the OALG. They address all major experimental issues with DC circuits. I am working on magnetism lab experiments, they will be ready soon.

https://www.facebook.com/groups/320431092109343/posts/802887353863712/

Eugenia Etkina
20. October 2020.

Hi all! Here is the file with magnetism lab experiments. No electromagnetic induction yet, just magnetic fields and forces. Electromagnetic induction experiments will be in the next file.

https://www.facebook.com/groups/320431092109343/posts/803637777122003/

Eugenia Etkina
26. October 2020.

My phone is wrong about the weather again. It says that it is not raining outside but it is. It has been wrong much more often lately than before. Why is that? An answer might be in the application of the ISLE process (Investigative Science Learning Environment, the foundation of our textbook and the ALG and OALG). Think about weather forecasts as predictions. They are based on the models of complex systems of fluids in the atmosphere. To make these models, scientists use data for the atmospheric conditions collected by satellites, weather stations on Earth and airplanes - these continuously collect atmospheric data during their flights (we call those patterns). As the number of flying planes reduced drastically during the pandemic, the meteorologists have fewer data to input into their models to make predictions about future weather. Thus the models become less accurate and therefore the predictions become less accurate. This is just a "crazy idea", if you know what I mean (see Chapter 1 OALG). 🙂

https://www.facebook.com/groups/320431092109343/posts/808375346648246/

Eugenia Etkina
27. October 2020.

Hi all, here is the file with lab experiments for electromagnetic induction. There is a really cool new experiment for Lenz's law - I thought I would post the link here so that you could watch it. You can use it as a testing experiment, or an application experiment. I used it for both purposes and it works great. And there are lots of other experiments, of course for students to observe, analyze, predict, etc.
https://youtu.be/TikiH3WR54E

https://www.facebook.com/groups/320431092109343/posts/809527939866320/

Eugenia Etkina
9. September 2020.

Hi all, this is chapter 19 of the OALG - DC circuits. Thanks to PhET students will be able to do all of the experiments with resistors and bulbs but I had to remove all of the experiments with LEDs as it is will take us a very long time to video them and we do not have this time now. PhET unfortunately does not have LEDs simulations. I still strongly recommend discussing the textbook material related to the LEDs that we have in this section. It is pretty unique. The chapter was proofread and edited by Elizabeth Tozour Lafargue. Not only that she did the proofreading, she also managed to put working links to the PhET simulations, thank you, Elizabeth! These OALG work is really becoming a group effort!
Concerning the chapter, note a few activities that are important if you wish your students to really understand what is happening in a circuit. Some of them relate to an open switch and some to the nature of Ohm's law. Some mistakenly think that Ohm's law is only applicable to ohmic resistors and the resistance of an element is equal to the slope of the delta V-vs- I graph. We explain why Ohm's law only tells us how to find the resistance of an element if the current through it and potential difference across it are known (it is a ratio of delta V over I) and it is not limited to ohmic resistors in this interpretation. It is applicable to all elements (including an open switch). The current through an open switch connected to a circuit with a battery is not zero because the potential different across it is zero, but it is zero as its resistance is infinite. This brings me to the discussion of how to write Ohm's law. We write it as I= delta V/ R to underscore the cause-effect nature of the relationship. Please read Chapter 19 to see all the nuances that we discuss there and then work through the activities in the OALG before assigning them to your students.

https://www.facebook.com/groups/320431092109343/posts/771535280332253/

Eugenia Etkina
13. September 2020.

Hi all, we have a huge number of new members today as Matthew Blackman posted about the group on the AP physics group. I welcome all new members. The group was originally created for those who use our textbook (College Physics: Explore and Apply) but in March it was opened up for all physics teachers who were looking for the materials to teach online. While our textbook and the Active Learning Guide (ALG) were originally perfectly suited for remote teaching, since March we created a new set of materials for only on-line instruction. These materials, called OALG "Online ALG", are posted here. They go with the textbook but you can use them as stand alone materials. They have questions, activities, videos and experiments that students can do at home. We also have documents that are for lab activities only. They are supported by self-assessment rubrics. To gain advantage of all these infinite resources all you need to do is to go to FILES and download everything. It is all free. ALL MATERIALS ARE POSTED IN THE FILES SECTION HERE. If you decide to share, please ask new users to join the group. And, please read the posts too - many people contribute and I always underline what is new and important in each chapter. Download and use it, people! We created it for you! Welcome again!!!

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Eugenia Etkina
14. September 2020.

Hi people, wow, our group almost doubled in size in one day. What an effect a twitter post can have... Today I will share my thought about a very important aspect of student learning - the 'NEED TO KNOW". How do we create the 'need to know" for each lesson? The "need to know" is the code for something that motivates students to learn - a cool thing, an answered question, or whatever you think is going to motivate them. Every good lesson has the need to know - you probably noticed it.
How do we create it for a unit? Today I will focus on a unit. If you are using our textbook, then you probably noticed that every chapter starts with "Chapter Opening", or a CO as we call it. It is a VERY IMPORTANT part of the chapter. It has 4 types of the "need to know" - the main one that is related to the big photo, two other ones posed as questions - they usually have three different foci: something related to health and safety, something related to an interesting phenomenon and something related to cool physics. And finally, some text that shows the gaps in our

previous knowledge - something that we learned about but not completely. These four "needs to know" can be used as big ones for the unit or when appropriate during a particular lesson. All of them are eventually addressed in the chapter. I have a few favorite ones - Chapter 7 and Chapter 8 are good examples. You tell me why I love them. 🙂
But what you do not like the ones we offered or you are not using our textbook? Then you can invent your own. I am posting two links here and challenge you to use them to create the "need to know" for your students to learn kinematics. In our textbook one need to know in kinematics is safety - we systematically investigate why it is important to keep the distance behind a car in front of you while driving. This is a HUGE need to know as one day the understanding of why will save your students' lives. Do we have some other interesting and important ones? So, here are the links, please post here what questions you will pose for the students to motivate them to study kinematics. And if you have your needs to know for kinematics, please share! tomorrow, I wish share some "needs to know" for individual lessons.

https://www.youtube.com/watch?v=ridS396W2BY

https://www.youtube.com/watch?v=vvbN-cWe0A0&t=282s

https://www.facebook.com/groups/320431092109343/posts/775383589947422/

Eugenia Etkina
14. September 2020.

I have to write another message today welcoming new members. We had an influx of over 200 people in one day. WELCOME!!!
As you all know, to join the group you need to answer a questions, so I read all of the answers. I always read every answer before I let people in. It looks like about 40% of those who joined today are already using our textbook. This is great news and rather sad as our group has been in pace for a long time and I am sorry that you missed all the resources and discussions we had. But you can slowly catch up by reading the posts and I strongly recommend downloading all of the files that say OALG and Lab experiments for online instruction and organizing them by chapters. The OALG files are VERY different from the ALG. Not only that they have LOTS of new ingenious experiments that we videoed (thank you, Gorazd Planinsic!) and the students can use them to observe phenomena, and collect data, and test hypotheses, and solve experimental problems but we created new activities for at home experiments. I also added reading assignments inside the activities so that the students who use our textbook can go to the text and compare their reasoning to what we do (they can use OALF files and progress at their own pace). Chapter 1 teaches them to READ AND INTERROGATE the text, a very specific skill, do not miss the activities in Chapter 1. In addition, I put recommendations for practice problems at the end of each section in every chapter using end of chapter problems right into the OALG chapters, so that you can assign those as a part of the OALG but the students will get the text from the book. YES, one can use all our materials posted here without adopting the textbook but those who use our book can say how it will enhance your students' experience. We have new approaches to learning physics, new language, new representations, new types of problems, that are consistent with the problems on AP exams and most importantly - the nature of science is naturally embedded in everything we do. I did not mean to convert you but as a person who gave this book 20 years of my life, I cannot help but share what we have created. It is like my own child for me. Welcome again and what a day it has been! While I was writing this, more people asked to join. Thank you, Matthew Blackman for your plug-in on twitter and AP physics group, you gave an opportunity to so many people to have access to our materials!

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Eugenia Etkina
15. September 2020.

Yesterday I posed about the importance for the "need to know".
Nobody responded to my challenge to say how they would use the videos I posted links to to create the need to know, so I decided that I would do it myself.
I suggest showing "The need to know" video with Felix Baugartner falling when you are starting kinematics unit. Let the students watch it and ask them what data they are seeing displayed in the video.
They would say: the timer showing time and the estimate of speed. The question is - how did they do the estimate of speed?
Neither you nor they will answer this question at the moment, so you say: WE are going to learn how they did it and in 2 weeks you will be able to answer this question.
As the unit progresses, you go back to the video - the students can check whether the readings show that Felix was falling at constant speed. Once they get to acceleration, they go back and plot the data - time and speed to find out how the numbers are changing. And finally, they can use the data to find out whether Felix was in free fall when he started.
This way this one video becomes the silver thread uniting all lessons in the unit. The other video I posted - with the truck. You can do the same. How did the computer in the auto braking system know what to do to stop the truck?

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Eugenia Etkina
18. September 2020.

This is a long post about having a good lesson. Be prepared.
A long time ago my student, a future physics teacher, Heather Heather E Patel was doing student teaching in a high school physics classroom of my
Richard Therks, my former student and a great physics teacher. Rich would teach a lesson, Heather would copy and teach the next one. And while Rich's lessons were all great, some of hers were and some were not. Why? She wondered...
Heather set out to figure it out. She sat in all of Rich's lessons and took notes. And what she discovered was really interesting. In every lesson Rich had three elements: he had the "need to know", he made sure that his students tools mastered the tools to be successful (force or motion diagram, energy bar-charts, and so forth) and he specifically told his students what tools to use, and, most importantly, he provided opportunities for the students to feel successful in the lesson (at some point). Heather started planning her lessons keeping these three things in mind and her

teaching became stable and successful. Now she is an amazing physics teacher in New Jersey.
Since then, every physics teacher who I prepared (and the number is around a 100) learned these three elements of a successful lesson: the need to know, the tools of success and opportunities for success. In my previous posts I talked about the need to know. The tools for success are in every chapter in the textbook and in the OALG files I posted (ask me if you need help with them) but how do we provide opportunities for success for our students? How do we make a lesson plan so that every student has an opportunity to feel good about themselves in the process? This is the topic for my next post.
Wait for the Electromagnetic Induction OALG chapter - it is coming soon. Irene Ning-Lee is finishing up proofreading it. I am looking for 3 more volunteers for proofreading. Please send me an e-mail if you are interested in helping. eugenia.etkina@gse.rutgers.edu

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Eugenia Etkina
20. September 2020.

Hi all, thanks to Irene Ning-Lee who proofread the chapter, we have now OALG Chapter 21 - Electromagnetic induction.
As all other chapters, it is very different from traditional approach. We let students figure out how to induce current in a coil that is not connected to a battery and then lead them through a series of reasoning+experiments to revise and improve their answers (true ISLE cycles).
We also have an empirical method of them devising Faradays' law.
But most importantly, we encourage them to explain why changing magnetic flux through a coil induces electric current through it. Specifically, we want them to come up with the idea that changing magnetic field creates electric field with the field lines that are closed loops unlike the lines of the electrostatic field that they are familiar with.
This leads to a conceptual discussion of Maxwell's equations - they are represented in the textbook on page 677, figure 21.27 (not present in the OALG but leading to it). Most calculus based students who study Maxwell's equations memorize them as formulas without any connection to empirical evidence. We have a simple way of talking about them conceptually and connecting the equations to the experiments that students did before. Do not miss!

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Eugenia Etkina
26. September 2020.

Hi all! We have new people joining - welcome our new members! Today my post is for those who teach AP 1 and 2 and are using our textbook.
Based on your responses to the question when joining the group we have a huge number of participants who are using the textbook, and most importantly, the second edition. How is the second edition different form the first?
We added new content, new approaches and new videos (and many more in the OALG) but most importantly, we added lots of end of chapter problems and questions that match AP problems and questions. I suggest that you study carefully every single worked example in the chapters and all of the end of chapter problems and questions. About 50 % of them are completely non-traditional and matching the types of problems given on AP exams. We had many of them in the first edition but for the second edition we went through published AP problems, classified them into categories and created problems of similar categories. They require students develop new types of reasoning skills. The classification is in the Instructor Guide (the file for it is in the files here and on Mastering Physics).
We systematically teach students to reason conceptually, linearize data, and analyze data and graphs with non-traditional sets of axes. I strongly recommend that all textbook users study end of the chapter problems and questions before proceeding to the next chapter.
However, many problems can only be solved if students are familiar with the chapter content and approaches. Thus, reading and interrogating the text is crucial for success. We have two activities in the OALG Chapter 1 teaching students how to interrogate the text and Allison Daubert created a screen cast teaching students how to do it. Please study OALG Chapter 1 and watch Allison Daubert's screen cast to learn what we mean by interrogation. It is a skill that ALL students will benefit from.
I am willing to have a workshop for textbook users on zoom. If you are interested, please post here and we will schedule time (or several times) to meet and study what we do differently in the textbook. And it is a LOT - not only problems but new approaches to content (forces, friction, energy, first law of thermodynamics and many many others). I write about these differences in my posts all the time but it is probably difficult to go through all the posts. So, I am willing to help you in person. Please reply here.

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Eugenia Etkina
28. September 2020.

Hi all, I am posting the OALG Chapter 23 - Mirrors and lenses. As always, there are lots fo new things in this chapter but most important are the concepts of secondary axis and focal plane.
In most American textbooks when the students draw images in curved mirrors and lenses they use three convenient rays, the principal axis and the focal point. Such approach limits our ability to solve problems, especially when the source of light is point-like and is located right on the principal axis. The secondary axis and the focal plane become incredible useful tools then. And in many other situations.
We also have lots of non-traditional problems in this chapter, some of them involve source/image jeopardy problems that, again, do not exist in any other textbook. Use this OALG chapter and read the corresponding textbook chapter to find the gems that we put there.

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Eugenia Etkina
1. November 2020.

Hi all, Gorazd Planinsic made a better (actually, an excellent!) video of a cart vibrating on a spring, so I am adding REVISED versions of lab experiments for vibrational motion and of the OALG Chapter 10 as it uses this video in many activities. Our approach to vibrational motion unifies all of the mechanics and allows the students to apply all of the tools that they have learned so far.

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Eugenia Etkina
7. November 2020.

Hi all, in these stressful times physics might the only thing that can distract us... I am writing to welcome our new members and to tell them and remind the old members that ALL materials that we produced since COVID started are FREE and available for all of you if you click on the FILES on the top of this page.
Every file you click on will bring you you to the related post that explains what the file is about. We have materials from the first day of class till the end of quantum optics that will allow you to teach physics online in a very specific way - following the ISLE approach (Investigative Science Learning Environment).

One of the major goals of this approach is that students learn physics by engaging in activities that mimic the activities pf practicing physicists. And this is truly important today. Physicists base their models on data (not conspiracy theories) and test them experimentally by using these model to predict the outcomes of the new experiments that they have not seen before. They test trying to reject the model not trying to find evidence to support it. If a model cannot be rejected experimentally, if there is no experiment that can rule out the model, then it is not scientific (intelligent design is one example, there is no experiment that can rule it out).
So, what I am trying to say, is that when students learn physics by following the ISLE process (that is outlined in all activities that are in our documents), and the students REFLECT on how they know what they know and why they consider something true, then they will develop habits of thinking like a scientist and grow to be citizens that value scientific approach to "facts".

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Eugenia Etkina
12. November 2020.

Hi all, I am posting the document with lab experiments for quantum optics. This is it for our work on producing materials for on-line teaching.
The next step will be to video experiments that we do with LEDs (and we have lots in different chapters) and post them as a separate document if you wish to have a unit on LEDs. We published a series of papers on LEDs in different topics of a physics course and they are integrated in the textbook and the ALG chapters. But we did not figure out how to do exciting stuff that we do "in-person" with LED when teaching online. This is the next adventure - we will do it during the winter break.
If you are using our materials and have any questions, please post them!

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Eugenia Etkina
20. November 2020.
Hi all, it looks like I forgot to post the Wave optics lab experiments. Here is the file.

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Eugenia Etkina
21. November 2020.

I have been thinking of how we keep students motivated and engaged in these difficult times. Why should they even learn physics? Well, if the physics consists of concepts, laws and equations to memorize and apply, then probably there is no reason for it, except if you wish to be a professional physicist. But what about the rest?
The answer is that we are trying to teach much more than "normative content". We are trying to teach people to think and reason from the data - this is the heart of the ISLE approach, our textbook and all materials that we produce and everything that you can download here, in this group. We also teach them to feel smart and accepted and a part of the learning community of physicists.
Why would this be important - to reason based on the data? The current political situation in US shows it again and again. If everyone reasoned based on the data (for COVID, global climate change, election process, you name it) our lives would be so very different. But - as we all agree on this, the next step is to think how do we motivate our students to think like this? How do we make sure that they experience thinking like physicists even if they do very few real experiments when learning on-line? How do they form learning communities when they do not meet their peers in person? How do they persevere in their learning when sometimes (or most of the time) life seems completely hopeless and out of our control? How do we help them feel happy and content?
I have some answers to these questions, but before I begin to share my ideas, I would like to hear yours. This is actually my approach in class - I do not share my opinions or validate students' responses until they have a chance to express their own ideas and opinions. So - please share!

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Eugenia Etkina
23. November 2020.

Hi people, as you know, in our lab experiments we use scientific abilities rubrics (see any file for lab experiments and you will a link to the rubrics). A long time ago we found how they help students develop scientific abilities. We have lots of publications about this. But now a new study came out - it describes how using rubrics cuts feedback time that the instructor needs to invest if they wish their students to improve, and not only do they cut the time but they also increase the quality. I am attaching the paper here, enjoy!

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Eugenia Etkina
26. November 2020.

Hi all, I am sharing this video that underscores a very important idea. We think the way we talk. This idea is based on the field of cognitive linguistics. We might mistakenly think that we talk the way we think, but this is not true. It is the other way around. Why is this important for physics teachers?
It is VITALLY important because just by using one bad word we can confuse students forever. I will take the word "weight" for example. In physics, the word weight means a force that Earth or another planet exerts on an object that is near it. It is a force, so it describes an interaction of TWO objects. Right? But we talk about a weight of an object, our weight, etc. As if it belongs to us. No wonder that our students think that objects carry forces, we carry our weights for sure.
It is the reason why we do not use the word "weight" in our materials. We tell our students once what it means and then NEVER use it again - we use the words "The force that Earth exerts on an object" (if the object is on Earth). Watch the video and start looking at the language we use in our textbook College Physics: Explore and Apply. EVERY word is chose carefully there because of cognitive linguistics. Thank you, David T. Brookes, for introducing me to it!

https://www.facebook.com/groups/320431092109343/posts/833245257494588/

Eugenia Etkina
3. December 2020.

Hi all, today I will continue with language. You read before how language shapes our thought. So, in our textbook and all supporting materials we pay serious attention to it. I already wrote about weight. This brings me to the language about forces. We never say that "force acts". Why?
This language assumes that force is an entity, that it is a thing. An active external thing. In fact, a force is one of physical quantities that describes an interaction of two

objects (according to Newton). How should we talk about it to communicate the real meaning of force?
We chose the passive external language - the force that an object A exerts on object B (where B is our system of interest). Therefore the force does not act, it is exerted by one object on the other!
Always underscoring the meaning of force through the language makes our students think of an interaction while thinking about a force not about a thing by itself.
However, the force is not the only quantity describing an interaction. A potential energy is another one. That is why talking about gravitational potential energy we never say "The GPE of an object is XX". We say the GPE of an object- Earth system, or in case of electric potential energy, it is the energy of the interaction of particle A and particle B. This way, there are no energies of an electron in an atom, but instead, the energies of an atom as a system. Does it make sense?

https://www.facebook.com/groups/320431092109343/posts/838489686970145/

Eugenia Etkina
10. December 2020.

Here is the paper about the ISLE approach. It just came out in Physical Review Physics Education Research.

https://www.facebook.com/groups/320431092109343/posts/843203003165480/

Eugenia Etkina
18. December 2020.

If you are teaching projectile motion and independence of horizontal and vertical motions, this is a perfect video! (not as crazy as quantum teleportation but still)...

https://www.facebook.com/groups/320431092109343/posts/848418049310642/
