Practice: Identify One Main Learning Goal

Determine if each of the following candidate statements represent a main learning goal

Candidate statement	Yes	No	Reason
1. Energy transformations			
2. Students draw system diagrams to show energy changes in a system.			
3. Motion energy can be transferred from object to object through collisions. The faster an object is moving, the more motion energy it has that can be transferred to another object in a collision.			
4. An object that is not moving has no energy.			
5. How do we detect and represent energy changes in a system?			
6. Energy can be used up or destroyed.			
7. Energy flows as it is transferred and transformed in various ways in between objects and in and out of systems.			

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ANALYSIS GUIDE A:
IDENTIFY ONE MAIN LEARNING GOAL

Record the main learning goal being analyzed in the space below.

CRITERIA FOR MAIN LEARNING GOAL	YES	NO
1. Is the learning goal stated in a complete sentence that represents a science idea that students could take away with them at the end of a lesson(s) (i.e., not a topic, phrase, activity, or question)?		
2. Do the students already know it? If yes, you need to make the learning goal more challenging.		
3. Is the main learning goal an important science idea? a. It is worthy of 50 minutes or more of time being spent on it. b. It has important connections to other science ideas and/or crosscutting concepts and can be used to explain a variety of phenomena. c. It is a "big" idea, a key concept, and not just a supporting fact, example, or detail.		
4. Do students have confusions or misconceptions about this science idea?		
5. Does this learning goal advance students' thinking and/or clarify misconceptions? If there is evidence that students already understand the learning goal, it is not a meaningful learning goal.		
6. Is the learning goal grade-level appropriate and matched to state and/or national standards?		
7. Is the learning goal scientifically accurate?		

Suggest how to improve the main learning goal:

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ANALYSIS GUIDE B:
SET THE PURPOSE WITH A FOCUS QUESTION

Record the main learning goal in the space below.

CRITERIA FOR STRATEGY B: SETTING THE PURPOSE	YES	NO
1. Does the focus question help students anticipate one main learning goal of the lesson? If yes, write the implied main learning goal here:		
2. Does the focus question use everyday language that students will understand at the beginning of the lesson? If no, what words need to be changed? Write them here:		
3. Is the focus question presented in a scientifically accurate way? If not, what is inaccurate? Write ideas here:		

ANALYSIS GUIDE I:
SUMMARIZE KEY SCIENCE IDEAS

CRITERIA FOR STRATEGY I: SUMMARIZING KEY SCIENCE IDEAS	YES	NO
1. Is there some kind of summary statement or activity in the lesson?		
2. Does the summary focus on conceptual understanding and is not just a listing of facts or procedures from activities?		
3. Do the science ideas in the summary match the main learning goal and the focus question or goal statement?		
4. Is the summary statement scientifically accurate?		
5. Are students engaged in making sense of the summary statement?		
6. Could the summary be improved? Write suggested modifications on the back of this page.		

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Candidate Focus Questions

for Grade 4 Energy, Every Day, Everywhere

MLG: Position energy (potential energy) can be transformed to motion energy (kinetic energy). The more position energy an object has, the more energy can be transformed to motion energy. As position energy is transformed to motion energy, the faster the object will move.

Candidate	Yes/No	Justification
1. What causes an object to increase its velocity and travel a greater distance and/or experience greater displacement?		
2. What happens when two objects collide?		
3. What happens to position energy when we increase the height of an object?		
4. What is the difference between energy transfer and energy transformation?		
5. How can we change the amount of motion energy of an object?		
6. How can we detect different forms of energy?		
7. Where in the system are energy changes taking place?		
8. How does the distance the rubber band is stretched in a toy car launcher affect the distance the toy car travels?		

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Candidate Focus Questions

for Grade 4 Energy, Every Day, Everywhere

MLG: Position energy (potential energy) can be transformed to motion energy (kinetic energy). The more position energy an object has, the more energy can be transformed to motion energy. As position energy is transformed to motion energy, the faster the object will move.

Candidate	Yes/No	Justification
1. What causes an object to increase its velocity and travel a greater distance and/or experience greater displacement?	no	Not written using everyday language that students will understand at the beginning of the lesson.
2. What happens when two objects collide?	no	Off topic (focuses on transfer instead of transformation from position to motion energy). Does not help students anticipate the MLG for the lesson.
3. What happens to position energy when we increase the height of an object?	no	Does not help students anticipate the complete MLG for the lesson.
4. What is the difference between energy transfer and energy transformation?	no	Off topic. Does not help students anticipate the MLG for the lesson.
5. How can we change the amount of motion energy of an object?	yes	
6. How can we detect different forms of energy?	no	Off topic. Does not help students anticipate the MLG for the lesson.
7. Where in the system are energy changes taking place?	no	Off topic. Does not help students anticipate the MLG for the lesson.

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8. How does the distance the rubber band is stretched in a toy car launcher affect the distance the toy car travels?	no	Does not directly connect to energy changes or amounts.

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Teacher/Video	SSUP_ET_KY GR4_SG3_L3_Norris_C1
Content Area	Energy Transfer
STeLLA Strategy	Strategy 1: Ask questions to elicit student ideas and predictions Strategy 2: Ask questions to probe student ideas and predictions Strategy 3: Ask questions to challenge student thinking Strategy F: Make explicit links between science ideas and activities
Context	This is lesson 3 of 5 in the Energy Everyday, Everywhere unit. In this lesson, students investigate the marble/ramp/styrofoam system. In this clip, students have finished collecting data, were introduced to position energy, and are now are sharing their ideas about the marble's energy when it is halfway down the ramp.

00:00:03	T	So my question was at this point in the ramp, we've- we've heard from (Tommy) that it still has motion energy. Not as much motion energy as it does at the bottom, but it still has motion energy. What about its position energy? Do we think yes or no?
00:00:16	SN	Yes?
00:00:17	T	(Colton), what do you think?
00:00:18	SN	(inaudible)
00:00:20	T	Is that your answer? I didn't think—what is your answer? Do you think it still has position energy?
00:00:27	S	Yes, it does because if I'm going slow and trying to go fast—so I'm gathering all that energy and (inaudible) move towards the ground.
00:00:37	T	And new question. Are position energy and motion energy the same thing?
00:00:42	SS/SS	No./Yes.
00:00:44	SN	Yes, it's energy.
00:00:45	SN/SN	No./Yes.
00:00:46	SN/SN	(inaudible) they're motion energy./They still have energy.
00:00:48	SN	Yes.
00:00:49	T	Let's go back to our definition of...let's go back to our definition of motion energy. What is motion energy?

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00:00:58	SN/SN	It's- it's the energy where something is moving./(inaudible)
00:01:03	T	Well, I heard- I heard it all right here. It's the energy something has because it's...
00:01:08	SS	Moving.
00:01:10	T	What is position energy?
00:01:12	E	(inaudible)
00:01:16	T	Why don't we turn and tell our neighbor that? We'll figure that one out first.
00:01:18	E	(inaudible)
00:01:26	T	Alright, L-I-S bring it back. I'm gonna call on Evelyn. What did you say it was?
00:01:27	E	T-E-N.
00:01:29	T	I'm gonna call on Evelyn. What did you say it was?
00:01:33	SN	Stored energy. Like, as it moves, it stores energy.
00:01:39	T	Oh, well, I heard her say stored energy. Can someone tell me more about what stored energy was?
00:01:47	SN	It's the energy that is in the marble (inaudible) that is stored in the marble.
00:01:56	T	Okay, stored. So it has energy, even though it's not moving, right?
00:02:00	SS	Yeah.
00:02:01	SN	Yeah, but the energy is inside the marble and when it's- when it goes down, the energy is gonna come out as it rolls.
00:02:10	T	So if I were—it does have some stored energy because of its...and this is where I need to go back to this from yesterday. Remember in our first system?
00:02:19	SN	Mm-hm.
00:02:20	T	The ruler was...
00:02:21	SS	Flat.
00:02:22	T	Flat. If I released this marble, was it gonna go anywhere?
00:02:25	SS/SN	No./No, it was flat.

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00:02:26	T	No. So relative to its position in the system, it really doesn't have any positional energy because if I let it go—
00:02:34	SN/T	It wouldn't move./ ...nothing's gonna happen. But when I raise one end of our system...
00:02:41	SN	It's gonna (inaudible).
00:02:43	T	This end is higher than the other and so that gives it some...what we call position energy. Because of its height within the system, it has some stored energy. And then, I have to hold this marble, so that it doesn't...
00:02:59	SN/SN	Roll./Roll down.
00:03:01	T	Roll or move.
00:03:01	SN	How did it get energy?
00:03:02	SN	So it doesn’t have any.
00:03:03	T	So right now it doesn't have any motion energy because I'm holding it back. There is no motion energy because it's still. But it has stored in its- it has the potential to move if I let it go. We call that positional energy.
00:03:18	SN	Yeah.
00:03:20	T	Because it's higher than the rest of the system. Remember the system is the ruler, the table, our blocks. In this case, still the Styrofoam. But this marble has positional energy because it's higher than the rest of the system. Now, if I let it go, it starts to—
00:03:41	SN	Move.
00:03:42	T	Move, which means—then, it starts to have motion energy. So let's consider this. When the marble is in the middle, is it still higher than part of the system?
00:03:55	SS	Yes.
00:03:57	SN	Because the bottom is on the floor.
00:03:59	T	Where is the lowest part of our system?
00:04:01	SS	The bottom.
00:04:02	T	The bottom of the...
00:04:04	SS	Ruler.
00:04:05	T	Ruler, right? Is this marble still higher than the bottom of the ruler?

00:04:09	SS	Yes.
00:04:11	T	So if I let it go, what will happen?
00:04:13	SN	It will- it will roll down.
00:04:14	SN	It'll pick up the energy and go fast.
00:04:16	T	It will still start to...
00:04:17	E	(inaudible)
00:04:18	T	...roll and have motion energy. So do I still have to hold the marble back to keep it from rolling?
00:04:24	SN	Yeah.
00:04:25	T	So turn and tell a neighbor now, does it still have position energy?
00:04:28	SS	Yes.
00:04:29	T	And tell them why.
00:04:30	E	(inaudible)
00:04:40	T	Alright, bring it back. I heard a lot of yesses. Who wants to tell me why? (Autumn)?
00:04:46	SN	Because (inaudible).
00:04:50	T	Say it louder.
00:04:52	S	(inaudible)
00:04:56	T	Well, it still has stored energy. And just think about this. How do we know it has stored energy?
00:05:01	SN	Because it's not moving.
00:05:02	SN	It's still on the top.
00:05:04	SS	It's in the middle.
00:05:05	T	Two reasons, because I still have to...
00:05:08	SS/T	Hold it./Hold it.

00:05:09	T	And because if I let it go, what's it gonna start to do?
00:05:12	SN/SS/SS	Move./Roll./Roll down.
00:05:14	T	That's stored- that positional energy is like the potential for what it could do if, like, I was to change one of the systems and let go. We call this positional energy still, and we agree now that it still has positional energy because if I let it go, it will—
00:05:30	SS	Move.
00:05:31	T	Move. It will start to have motion energy. Now, last question before we move on. In the center...I have a friend that can't see. Nate, I'm sad, come back.
00:05:46	SN	Oh.
00:05:49	T	So last question before we continue with this. Does this marble in the middle of the ramp have the same amount of position energy as it does at the top of the ramp?
00:06:01	SS	No.
00:06:03	T	I heard some nos. Turn and tell a neighbor why you think so.
00:06:06	E	(inaudible)
00:06:16	SN	If it's halfway down, it still has the same (inaudible) energy. I mean, not (inaudible) but when you let go, the (inaudible) position energy goes away, so it has the same (inaudible)—
00:06:34	T	Okay, what do you think? I need some friends to volunteer their answer.
00:06:36	SN	I will.
00:06:37	T	Some friends that I haven't heard from yet.
00:06:40	SN	Oh, man.
00:06:41	T	Nate.
00:06:42	SN	Um...
00:06:43	T	Do you think this marble in the middle of the ramp has the same amount of position energy as it does at the top?
00:06:51	S	Uh...no? But it does still have motion energy when it goes down.
00:07:06	T	Motion or...? I'm asking about position energy. So you said no, you think it doesn't have the same amount of position energy in the middle of the ramp as it does at the top. Do

you agree with that, you said no?

00:07:20	SN	Uh-huh.
00:07:21	T	Okay, so he believes no. Do you think—can you tell me why you think that? Do you think we could call in someone to help?
00:07:32	SN	Me.
00:07:33	SN/T	Yeah./Okay. Eden, why— if you agree with no, why do you think it does not have as much position energy here as it does here?
00:07:39	SN	Because it goes on the top, like, higher and, like, in the middle, its like a little lower.
00:07:43	T	Okay.

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Teacher/Video	SSUP_ET_L2_Parco_C2
Content Area	Energy Transfer
STeLLA Strategy	Strategy B: Set the purpose with a focus question
Context	This is lesson 2 of 5 in the SSUP Energy Every Day, Everywhere series. In this lesson students explore the marble/ruler system to develop ideas about what happens to motion energy when objects collide. In this clip, students consider their initial ideas about the lesson 2 focus question.

00:03	T	Our focus question for this lesson, if we take a look up on our board, is what happens to motion energy when objects collide? So on Friday when you had your substitute, you talked about different types of energy, correct?
00:18	SN/SN	Yeah./No.
00:19	T	Okay.
00:20	SN	Yeah, we did.
00:21	SN	Not me, ’cause I wasn’t here.
00:23	T	Okay, well, then that doesn’t apply. Motion energy, when something is moving. We talked a lot about different types of energy. But now our question is, what happens to motion energy when objects collide, okay?
00:39	T	So as we investigate that question today, it’s going to help us begin to answer some of our questions on our driving question board. And can someone share what motion energy means, please? Isaiah.
00:51	SN	The energy that something has when it’s moving.
00:56	T	The energy that something has when it’s moving, what do you think? Yeah? Does anyone else have something that they’d like to add to that?
01:09	T	I asked someone to share their thoughts about what you think happens when objects collide. Chloe, what do you think? Shh.
01:21	SN	When objects collide, the force from both pull back.
01:25	T	Ooh. Could you say that a little louder?

01:28	S	When objects collide, the force from both pull back.
01:31	T	When objects collide, the force from both pulls back. Okay, that's- sounds like some good thinking there. Bryce?
01:42	SN	When objects collide, they might ricochet off of each other, depending on the speed.
01:47	T	Ricochet, that's a very, very good vocabulary word. Can you explain that a little more for me, please?
01:54	S	Like the- it comes back after hitting something, like rico-
01:59	T	When they collide?
02:01	S	Like a ball ricocheting against a wall, it would be a ball coming off- against a wall.
02:04	T	It would come back at you? Okay. I like where these ideas are going. Liam.
02:09	SN	When an object's- when objects collide, it can make a different kind of energy.
02:15	T	Okay, you're telling me what could happen, but when objects collide, how does energy of an object change? Go back to that focus question. How does the energy of that object change? Payson, what'd you put?
02:32	SN	When objects collide, they are most likely to go from still to having forceful energy.
02:37	T	From- when objects collide, they go from still to having forceful energy. Could you tell me a little bit more about that forceful energy?
02:45	S	They push against each other forcefully.
02:48	T	They pu- when objects collide, they push against each other forcefully? Okay, John, what do you have?
02:59	SN	When objects collide…
03:07	T	Go ahead, your idea's- go ahead.
03:08	S	One can give another one more energy.
03:12	T	When objects collide, one object can give another object…
03:16	S	More energy.
03:17	T	More energy. Jude.

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03:19	SN	When objects collide, the- the objects bounces off the wall or something else. So, like-
03:29	T	And how does that change the energy of the object?
03:34	S	Like, I throw a baseball at the wall a couple of times sometimes.
03:40	T	Okay.
03:41	S	And, like- like when it- when it bounced off-
03:47	T	Uh-huh.
03:48	S	the baseball came back.
03:50	T	Okay, so you threw something at a wall, threw- threw a baseball at a wall and the baseball came back.

Teacher/Video	SSUP_ET_L2_Parco_C3
Content Area	Energy Transfer
STeLLA Strategy	Strategy 9: Engage students in making connections by synthesizing and summarizing key science ideas Strategy B: Set the purpose with a focus question Strategy I: Summarize key science ideas
Context	This is lesson 2 of 5 in the SSUP Energy Every Day, Everywhere series. In this lesson students explore the marble/ruler system to develop ideas about what happens to motion energy when objects collide. In this clip, students revise their initial ideas about the lesson 2 focus question.

00:03	T	Okay, so how does energy- there you go. Here's what we're going to do. I'm going to have you with colored pencils go through and if you feel that your initial responses there-
00:14	T	if you feel that your initial response was not thorough enough, now that you've had the opportunity to investigate motion and what happens to objects when they collide and how that energy is transferred,
00:30	T	if you feel like you could add a little more, make it even better, build on what you know, I would like for you to take this colored pencil, red or blue, I don't care, and cross out or add to your response.
00:46	T	I'm going to give you about three minutes to add to your response. So everybody right now, go through and read your response initially. Remember, this was what? Last week? Two weeks ago?
00:59	T	I would like for you now to look at it through a new set of lenses and add to or improve or change your initial response to reflect any new knowledge that you may have gained as we were doing these investigations.
01:21	T	All right, I'd like to have those of you that are willing to share with me or the class how your ideas have changed. How have your ideas changed?
01:31	T	Just tell me how they've changed and let's go around and share and help each other kind of think through this for a second. Jake.
01:39	SN	So mine changed. I didn't- I added stuff, I didn't take anything out.
01:44	T	Okay, how did it change, though? What did you add?

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01:46	S	So- so I added “To transfer energy from one to ano- to the other,” and my original was when objects collide, they cause energy to change and make other things move or to transfer energy from one thing to another.
02:00	T	Ooh, I love the fact- I heard two very important words. Raise your hand if you heard the words collide and transfer. Ooh. Now raise your hand if you’ve added those to your ideas as well. Awesome. Who else would like to share? Thank you for sharing.
02:14	SN	I used one.
02:15	T	All right, Bryce. I’ll get you in just a second. Bryce.
02:17	S	When objects collide, I think they could ricochet off.
02:20	T	I’m sorry, I can’t hear you because we’ve got some mutterings going on, so let’s try that one more time.
02:25	S	This was my first one. When objects collide, they could ricochet off of each other.
02:30	T/S	Okay./But now I have when objects collide, they could ricochet off of each other, depending on what size and speed. ’Cause we didn’t see-
02:41	T	So when you say “ricochet”…
02:44	S	Bouncing off.
02:45	T	Okay, when objects collide, they bounce off each other?
02:48	S	Yeah.
02:49	T	What- does that have something to do with any kind of transfer?
02:53	S	Yes, because-
02:54	T/SN	Three times./Sorry, sorry.
02:56	SN	Because the energy’s transferring and that energy might come back and then it bounces back.
03:02	T	And that was different from your original thinking?
03:04	S/T	Yeah./Okay, thank you for sharing that. Morgan.
03:06	SN	My original one was motion energy trans- transferred into your system to the red marble when you give it a lot of push. Or, like, just a push.
03:19	T	Okay, and how has that changed?

03:21	S	I wrote- well, I actually added onto it.
03:24	T	Okay.
03:26	S	I wrote when you give it a small or big push, it transfers- it changes the transfer. Like, it changes stages from, like, a big or small.
03:40	T	Okay. So it changes from energy transfer. Can you tell me a little bit more about that?
03:46	S	Like if you give it a tiny push like in the diagram, when you give it a tiny push, it transfers just a little bit, and when, like, you give it a, like, a larger push, it, like, it- they move farther.
04:05	T	So you’re saying the result depends on the amount of energy-
04:11	S/T	Yeah./before the collision? Okay. Wonderful. One more. Brianne.
04:18	SN	When motion energy collides, the energy will transfer. So in the example, when the red marble hit the blue marble in our marble system, the energy transferred from the red marble to the blue marble.
04:30	T	Okay. And I liked how you’re using the words “transfer” and “energy” because that’s different from the beginning, wasn’t it?
04:39	S/T	Yeah./Very- very different.

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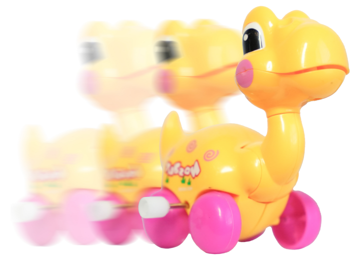
System Diagram

Wind-Up Toy

1. The toy is wound up.

2. The toy is released.



1. The toy is wound up.

2. The toy is released.

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System Diagram

Hand-Crank Flashlight

cranking slowly

cranking fast

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System Diagram
Noisemaker

noisemaker spinning slowly

noisemaker spinning fast

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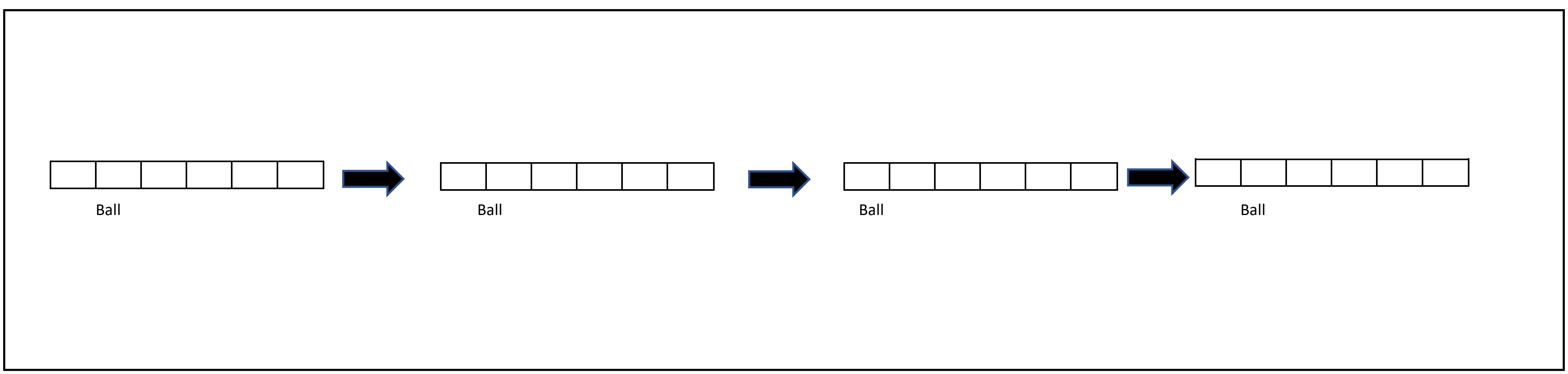
System

Rubber Ball

1. The ball is being held in the air
2. The ball falls halfway to the ground
3. The ball hits the ground
4. The ball bounces halfway back up



Reflection - Day 3 Name:___________________________

1. We are discussing the use of main learning goals, focus questions, and synthesizing/summarizing across a series of lessons. What is your current thinking about how the main learning goals and focus questions contribute to the development of a coherent content storyline for students? Please explain your thinking.

2. How did developing a system model (the system diagram) help you think about energy changes in a system?

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