Title:
Talking Turkey: Using a short story to facilitate learning and appreciation of energy flows through ecosystems

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Abstract:

Human beings are storytellers. Through stories, we entertain, educate, learn, and connect. This exercise uses the universality of storytelling to engage undergraduate students in ecological science. Students read a fictional narrative that connects scientific principles of ecology to their daily life. The narrative helps students become more personally engaged in the scientific material and more interested in analyzing and evaluating the role of science in society.

The submitted story "Talking Turkey" is about a college student's interactions with her family when she informs them at Thanksgiving of her decision to stop eating meat for ecological, not ethical reasons. To appreciate her decision, students have to understand food chains, energy flows, the first and second laws of thermodynamics, and ecological efficiency. These basic concepts are covered in all ecological and environmental science textbooks but often in an esoteric manner. My story puts a human face on these concepts and students actually enjoy critically analyzing the character's decision. Students are assessed on their understanding of the underlying science and engagement with the material during online discussions and on short answer questions.

Learning objectives:
1) To demonstrate understanding of energy flows through an ecosystem.

2) To critically analyze and evaluate how an understanding of energy flow can be used to make personal life choices.

3) To engage with one's peers about how science should or should not influence personal and societal decisions.

Timeframe:
As the activity is a supplement to one's typical coverage of energy flow through an ecosystem, the activity can be conducted entirely outside of scheduled class time. I suggest giving the students a week to read, discuss, and answer questions concerning the assignment. One could devote a lecture period to a discussion of the story if one chooses.

Class level:

I have had the most success with students in an undergraduate upper level (junior/senior) course. First-year and sophomore students could also benefit from the assignment but the instructor's expectations may have to be adjusted. The story itself is suitable for any undergraduate class.

List of materials:

1. The story "Talking Turkey."

2. The assignment and associated questions.

3. The means for either an online discussion (e.g. Blackboard Discussion Board) or an in-class discussion.

Procedure and general instructions (for instructor). REQUIRED.

The assignment can be easily adapted to fit one's own teaching style and needs. I post the story and assignment in a classroom management program (e.g. Blackboard) and verbally discuss my expectations for the assignment. I then devote two 50-min lecture periods to covering the scientific topic of energy flow through ecosystems such as food chains, trophic levels, net primary production, the first and second laws of thermodynamics, and ecological efficiency. Covering these materials can be done in whatever method the instructor has found to be effective. The story and its associated discussions are meant to be a supplement to course material, not a replacement.

The assignment has the following three parts: 1) read the story, 2) individually answer a short answer question, and 3) participate in an on-line discussion. The story is roughly 2100 words and so does not take long to read. The short answer question is written to assess knowledge and comprehension of the underlying science. It is as follows:

"Please explain in detail Kristi Roberts' scientific rationale for becoming a vegetarian. Your explanation should be in much greater detail than what Kristi said in the text."

Answer:

Kristi's decision to not eat the Thanksgiving turkey is based on how energy flows through a food chain. Primary producers such as plants use solar energy, water and carbon dioxide to fix carbon into organic compounds such as glucose. Glucose stores chemical energy. The total amount of energy fixed by the primary producers in an ecosystem is called the gross primary production. The primary producers use some of that energy for maintenance via cellular respiration and that respired energy is lost to the ecosystem. The remaining energy called net primary production can be stored and used for growth and reproduction. It is the net primary production that is available to be consumed by the next trophic level, the primary consumers.

The primary consumers ingest some of the net primary production, which is then either lost via feces (egested energy), used for cellular respiration, or is used to grow biomass (growth and reproduction). All told, about 10% of the energy in the net primary production gets incorporated into biomass of the primary consumers. The amount of incorporated energy is called the ecological (or food chain) efficiency. The primary consumers can then be eaten by secondary consumers and again only about 10% of the energy in the primary consumer trophic level is incorporated in the secondary consumer trophic level. The same would be true for the tertiary consumers.

For example, assume 1000 Calories are available in the net primary production of corn. If people are the primary consumers that consume the corn, then approximately 100 Calories get incorporated into the biomass of people. If turkeys are the primary consumers of the corn, then approximately 100 Calories are incorporated into the biomass of turkeys. If people then eat the turkeys (i.e. are secondary consumers), approximately 10 Calories are passed to the biomass of people. Thus, people get more of the energy contained in the net primary production if they are primary consumers than secondary consumers.

This question should be due and graded in advance of any examination. As an assessment tool, the student's answer can reveal their knowledge of specific terms (e.g. primary consumer, net primary production, trophic level) and comprehension.

Many students get confused between the amount of energy that a person derives from consuming food and the amount of energy that gets transferred between trophic levels. Students sometimes think that an apple containing 80 Calories must have more energy than a ham slice of 80 Calories because the apple is from a primary producer and the pig is at least a primary consumer. If their answers demonstrate an error, we carefully discuss the correct answer in class.

For the online discussion, I tend to give little guidance on what topics the students should focus. The only requirements are to give two thoughtful posts, one of which must be a reply to another person's post. This "open discussion" facilitates engagement with the material by the students. It allows them to analyze and evaluate aspects of the story that are of most interest to them. The story is sufficiently rich that students have, in each semester that I have used the assignment, discussed different aspects of the story, not all of which needs to be science-based. Students have also been very good at policing the discussion and offering corrections when someone makes a scientifically questionable claim. Students are more willing to discuss and debate online than in the classroom. If the discussion and answers to short answer questions makes it clear that students do not understand the science, then I devote additional classroom time to address the confusion. In this way, I informally can assess student

knowledge and comprehension. I monitor but do not directly participate in the online discussion. The discussion is not worth many points (~ 1% of total course grade) and my rubric is quite loose. I give full credit if a student makes two posts that demonstrate thought was given to the comments. I have given extra credit to the student who makes the first post and those who give more than two comments. I have found 15 students is the optimum size for an on-line discussion and subdivide a class if necessary.

Topics that students have discussed in the past include:

Why would eating a vegetarian diet be more energetically efficient?

How is energy efficiency used in this context versus other, more typical ways (e.g. fluorescent bulbs)?

Would harvesting wild game be more ecological sound than eating domesticated animals?

What are the pros and cons of eating meat beyond ecological considerations?

Should a vegetarian waiter be allowed to not serve meat on moral grounds?

What would be the economic consequences of fewer people eating meat?

How is energy flow connected to human population size?

What changes in land use would occur if more people ate a vegetarian diet?

What are the nutritional consequences of a plant-based versus a meat-based diet?

What are the roles of tradition and societal norms in diet?

The instructor could pose any of these questions to their students, thereby more formally directing the discussion. This may be more appropriate in a non-majors science course.

After the online discussion, I do make time available in class for any additional discussions that they students may want. I also ask the students why I assigned the story. Inevitably, someone says it is to turn them into vegetarians. I make sure they know that this is not the case, that I am personally not a vegetarian. The assignment is about being able to critically analyze information and evaluate material in a way that leads to informed decisions.

Talking Turkey

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Kristi Roberts sat on her bed, staring at the closed bedroom door. She knew she would soon have to pass through the doorway and inform her parents of her decision. They were not going to like it. "Come on, Kris," she said to herself. "Toughen up – you're not a child anymore." She looked at the princess posters that adorned the pink walls of her bedroom, a far cry from the edgy décor of her dorm room. She jumped up and ripped down the posters. Okay, she thought as she stood among the decapitated and dismembered cartoon characters of her youth, now I'm ready.

Delores Roberts closed the oven door and quickly turned to face her daughter. "What do you mean you're not eating the turkey? You love turkey."

Kristi answered from her perch on the kitchen counter. "I do, I mean I use to, but I decided to give it up."

"Well, I wish you had told me before Thanksgiving Day. What are you going to eat now?" Kristi's mom sighed heavily as she opened the refrigerator. "I guess I could heat up some ham leftovers."

"No, mom, I don't …"

"Ham just doesn't seem like Thanksgiving," Delores said as she stared at the plastic-wrapped ham in her hand. "Easter, yes, maybe Christmas, or Fourth of July. Do you remember that maple glazed ham I made last summer? Mmmm. That was good. Your father talked about it for weeks."

"Mom."

"I just never thought of ham for Thanksgiving. I mean, did the Pilgrims even have pigs?" Delores paused as she unwrapped the ham. She stared into space. "I never thought of that before. Would they have left England without pigs? How would they have known if America had them? But they do eat a lot -the pigs, not the Pilgrims." She laughed at her little joke. "Kristi, be a dear and look it up for me. I'm sure you can find it out on the internet. You wouldn't believe the stuff I learn on it. Just the other day, I read that the President hates asparagus."

"Who hates asparagus?" Kristi's dad asked as he entered the kitchen.

"The President," replied Delores.

"I don't blame him. It's about the only thing we can agree on."

"But Frank, asparagus is good for you."

"Maybe, but it makes your pee stink." He chuckled. "Maybe that's why the President doesn't like them."

"Oh Frank. I'm sure that's not it."

"Yeah, you're right." Frank said as he grabbed a beer from the refrigerator. "Everything else about him stinks – why would that little thing bother him."

"Mom, I like asparagus." Kristi said as she jumped off the counter. "A meal of asparagus would be great."

"I don't have asparagus. I made a three bean casserole."

"The one with bacon?" Kristi asked.

"Yes."

"I love that bacon," her dad said.

"But I don't want bacon." Kristi said.

"Too much pork?" Delores asked. "What with the ham and all."

"I thought we were having turkey," Frank asked as he downed the brew.

"We are, but Kristi doesn't want it."

Her dad looked at her as he wiped the foam from his mouth with the back of his hand. "But you love turkey."

"I do like turkeys, just not on my plate."

"Since when?" her dad asked.

"Since last week."

"Last week?" Frank sniggered. "What, did you get something foul at the dining hall?"

Kristi groaned. "No, dad. I'm just giving up meat – all meat."

"Even ham?"

"Yes, mom, even ham."

Her mom looked at the ham she was about to place in the oven. “But what are you going to eat for ….”

“She’s eating turkey, just like the rest of us,” Frank said.

“Dad, I’m...”

“You’re eating the turkey that your mom prepared and I paid for with hard earned money. Jeez, you’re off at college for three months, and you come back all screwed up. A vegetarian? I thought my little girl had more sense.” He shook his head. “The junk they fill your brain with.”

“But dad, I’m …”

“That’s the end of it.” He heard a roar from the television in the living room. “Damn, someone musta scored.” He walked out of the kitchen into the living room and yelled, “Oh crap!”

Kristi approached her mom. “Mom, dad can’t make me eat meat if I don’t want to.”

“But why don’t you?” She walked up to Kristi and caressed her cheek with an oven mitted hand. “You were always my meat and potato girl.”

Kristi moved her head away. “Girls grow up mom. We grow and make decisions for ourselves.”

“I just don’t understand why you suddenly made this decision.”

“It wasn’t sudden. I’ve been….” Kristi was interrupted by a knock on the front door.

“That must be your Uncle Jack,” her mom said. “Would you let him in?”

Kristi was both annoyed and relieved to have their conversation interrupted. She knew the topic was not yet finished, but at least it was broached. And with Uncle Jack here, maybe he would be on her side. Uncle Jack often took a view opposite that of his big brother, but who knew where he stood on vegetarianism. Kristi opened the door and gave her uncle a big hug.

“Look at you,” Jack said. “College looks good on you. How are classes going?”

“All right I guess. It’s harder than I expected.”

“Everyone has to adjust. I remember being freaked out with chemistry my freshman year and considered dropping my pharmacy major. But I stuck it out and made it through. You will too. Hang in there.” He tapped her lightly on the chin. “Now where are your mom and dad?”

“Take one guess.”

Jack smiled and headed to the kitchen to first say hi to Delores.

Jack, Frank, and Kristi spent the next hour in front of the TV, watching the football game. The aromas from the kitchen diffused throughout the house. They seemed to intensify with each passing minute and Kristi had to admit, they smelled good.

"Smell that turkey, Jack," Frank said, looking at Kristi. "Man, doesn't it smell good."

"What, yeah, it smells great." Jack replied without taking his eyes off the screen.

"Yes, sir, Delores makes the best turkey - soft, tender, and juicy."

Jack muttered "Uhuh, that's right."

"And stuffing. Dolores does it the old-fashioned way – jam that bird full of bread. Let the juices soak in. It's the only way to make stuffing in my book." He continued to look at Kristi. "And then there's the gravy."

"Frank, what's with the meal play-by-play? Let's focus on the game."

"I'm just saying a Thanksgiving turkey dinner is the best meal of the year. That's all." Frank continued to look at his daughter.

"I agree but, hey Kristi where are you going?" Jack asked as Kristi got up from her chair. "They're in the red zone."

"I've lost my appetite for football," she said and walked to her bedroom.

When the game ended, the family sat around the table. Frank said grace and carved the turkey. He gave the first cut to Jack, the next to Delores, and then a particularly thick slice to Kristi. Through squinted eyes, she saw him half smile as he placed the meat in front of her.

"Dad, you can put it on my plate but it'll just go to waste. I am not eating it."

"Kristi, I thought we agreed…"

"No, dad, we didn't agree on anything. You dictated."

"Kristi, that's no way to talk to your father." Delores said from across the table.

Kristi turned to address her. "Then he should stop telling me what I can or cannot put into my body."

Her father pointed the carving fork at her. "Now listen here Kristi, we're not having this conversation …."

Uncle Jack chimed in. "What Kristi, you giving up turkey?"

"Yes."

"But that's not all Jack," her dad said and then motioned to Kristi. "Go ahead Kristi. Tell him everything."

"I gave up all meat."

"Cold turkey?"

Kristi couldn't help but smile. "Exactly. Haven't touched meat in a week."

"Have you ever heard such nonsense?" asked her dad to his brother.

"Frank, it's no big deal. Lots of people are vegetarians."

"Yeah, but lots of people don't live in my house."

Frank ignored him. "So Kristi, why the switch - animal rights? Health concerns?"

Kristi beamed at her uncle. "No, neither really. It's more environmental and social."

"What the hell are you talking about?" Frank interjected.

"Frank!" Delores exclaimed.

"Come on Delores. I'm supposed to stay quiet while my daughter talks nonsense."

"It's not nonsense, daddy. If everyone ate less meat, there'd be a lot more food for everyone."

"But meat is food," Frank said.

"Yes, but it takes a lot of food just to raise that cow or pig, or turkey. If we ate that food ourselves instead of feeding it to animals, we'd save a lot of energy," said Kristi.

"I'm all for saving energy," said her mom. "Did you notice the new fluorescent bulbs? They cost more but they pay for themselves in just a few months."

"They're nice mom, but I'm talking about a different kind of energy."

"Total gibberish," said her dad. "Is any of this making sense to you Jack?"

"Sure, eat corn directly instead of having a turkey process that corn into meat. Cut out the middleman, er rather, middle-turkey."

"Exactly, Uncle Jack. See dad, it does make sense. If we eat at lower trophic levels, we'd be able to feed more people. Just think of all that grain that could feed hungry people but instead is going to livestock."

"But humans eat meat – that's what we do. You wouldn't ask a tiger to go vegetarian"

"What, do you have less control over what you eat than a mindless tiger?"

"Kristi, did you just call your father mindless?"

"No, mom, he called himself it."

"Okay, that's it," her dad said. "I'm not going to have my Thanksgiving meal ruined by your attitude."

"But dad…"

"Enough."

The room grew quiet as everyone settled into eating. Kristi ate sweet potatoes and picked out the beans from beneath the bacon. Her mom ate a little bit of everything. Frank went back for a second helping of turkey. Uncle Jack sculpted mashed potatoes into a crude cow and then ate it. He finally broke the tense silence.

"So do you think a vegetarian could refuse to serve someone meat?"

"What?" Frank asked.

"Like at a restaurant. If a waiter is a vegetarian, for you know religious reasons, could he refuse to serve someone a steak?"

"He wouldn't get a very good tip," Frank grumbled.

"That's not the point. Could he refuse to do it on ethical grounds?"

"Can't I eat in peace?"

"What do you think Delores?" said Jack.

"I don't think so. Isn't serving meat a part of his job?"

"Well then how is it okay for a pharmacist to refuse to fill someone's birth control prescription on the grounds that it violates his religious views?"

"Jeeze, now it is birth control. Can we please go back to eating?" Frank said.

"I'm just asking." Uncle Jack winked at Kristi. They all went back to eating. "So any luck with the bow this year, Frank?"

"Nah, almost got a nice doe, but she jumped as soon as I pulled back." He ate another piece of turkey and looked at Kristi. "Are we still allowed to talk about hunting?"

"I don't have a problem with hunting, dad."

"I don't get you."

"Dad, I said I'm not a vegetarian because of animal rights. I don't object to killing animals, just the energy and land wasted in raising them."

"So you won't nag me about hunting."

"No, dad. Hunt away."

"Well that's the best news I heard all day," he said as he sat up straight in his chair.

"In fact," Kristi said, staring at the beans as she pushed them around her plate. "I'll eat game animals."

Delores raised her hands in frustration. "Now I'm confused."

"Mom, game animals are feeding off the bounty of nature. They're using resources that people don't use. But domestic livestock are different. We're giving them resources that we should be using to feed starving people. It's just so unjust and inefficient."

"Makes sense to me," said Uncle Jack.

"I guess I get it," Delores said, with a side glance at her husband.

"So let me get this straight. You'd eat a wild caught turkey, but not a Butterball."

"Yes."

"Okay I can deal with that. Next Thanksgiving, I'll shoot our bird. Happy now, Kristi."

"Yes, dad." She felt very mature – standing her ground while still finding common ground. "Thanks."

"Alright, it's settled," Frank said with a triumphant grin.

"But I don't like wild turkey," Delores said. Everyone stared at her. "It's too gamey."

Frank rested his hands in his face. It was no use. "Someone pass the cranberry sauce."

Procedure and general instructions (for students).

The procedure and general instructions for the students will depend on how the individual instructor chooses to use the supplemental exercise. Simple instructions that I have included in the past are as follows:

Please read the short story "Talking Turkey" that is posted on Blackboard under Assignments and complete the following assignment.

1. Please explain in detail Kristi Roberts' scientific rationale for becoming a vegetarian. Your explanation should be in much greater detail than what Kristi said in the text. (HAND-IN THIS ANSWER TO THE INSTRUCTOR).

2. Using the DISCUSSION feature on Blackboard, please comment and debate the questions raised by Kristi and her family concerning her decision to not eat meat. What are your views on the subject? You need to make at least two thoughtful posts, one of which must be a reply to someone else's post. In order to allow time for discussion, you will not receive credit for any post made within twenty-four hours of when the assignment is due. (COMMENT ON BLACKBOARD).

OPTIONAL SECTIONS (other sections you can add if applicable)

Suggestions and materials for assessing student learning

This exercise falls most strongly in the cognitive learning domain of Bloom's Taxonomy (Bloom, 1956). Within the cognitive domain, student performance in the following learning categories can be assessed:

1. Knowledge. Students can be tested on their ability to define and describe scientific concepts such as energy, trophic levels, first and second laws of thermodynamics.
2. Comprehension: Students demonstrate comprehension by explaining the concepts that led to Kristi's decision. The short answer question is designed to assess comprehension.
3. Application: Students could be asked to apply the first and second laws of thermodynamics to the flow of energy through an ecosystem. They could apply their knowledge and comprehension to explain why energy flows but matter cycles.
4. Analysis: Students critically analyze Kristi's decision based on their knowledge and comprehension of the science. Do her decisions make sense from a scientific perspective?

5. Evaluate: Students take the learning manifested in each of the other categories and then make judgments about Kristi's decision and their personal decisions. For example, one of my students commented on the burden that the harvesting of game animals would have on wild populations if Kristi's decision to eat wild animals became more prevalent. Others students, years after my course, confided in me that they tried to be a vegetarian because of this story. That diet choice did not last long, but it is still an example of their evaluating the merits of the material.

Student data

Here is an example of one exchange between students during the on-line discussion.

Student 1:

Prior to reading this short story, I was only aware of the ongoing major ethical concern of animal rights and why some individuals refuse to eat meat because of the "unjust raising and killing of animals" for food. I believe the concern raised by Kristi can demand a great debate on why it is unethical to eat meat coming from those animals that are fed purchased grain for the sole purpose on "fattening them up" for human consumption. In the story example, Kristi's rationale for not eating meat stemmed from her major concern for conserving energy within the complex food web; that is, cut out the "middle man" (ie primary consumer--cow, chicken, pig, turkey, etc) and save food from primary production to make humans the primary consumers instead of secondary consumers. I believe this ethical concern is a great one that I had been previously unaware of. After thinking about it for some time--it all seems so simple: how can we, as humans, be so greedy and concerned with "living/eating in luxury" that we'd rather feed animals than starving people and not try to solve the hunger problem of the world?

Student 2:

I agree with Liz, prior to this story I was unaware of people refusing to eat meat due to energy flow concerns. I think it is an interesting ethical issue that most of our population is probably unaware of. However, I do not view humans as being "greedy" for living and eating the way that we do. I believe throughout history we have been predominately meat eaters and only in "recent" years has our society turned to the methods that are used in the meat and poultry industries. In a sense I don't think it is typically thought of as feeding animals versus solving the hunger problem. Most people don't think in such a global sense, and perhaps that is where we need to change as a society.

Also consider the economy; essentially we are talking about eliminating the meat and poultry industries. What kind of a greater impact would that have on the world economy?

Reference list

Bloom, B.S. 1956. Taxonomy of educational objectives., Handbook I: The Cognitive Domain. New York: David McKay Co, Inc.