ATLAST Flow of Matter and Energy Teacher Assessment
User Manual

1. Overview

The ATLAST Flow of Matter and Energy Teacher Assessment is a 29-item multiple-choice assessment for middle grades science teachers. The assessment measures understanding of the following set of concepts:

> Food provides molecules that serve as fuel and building materials for all organisms. Plants use the energy in light to make sugars out of carbon dioxide and water. This food [sugars] can be used immediately for fuel or materials, or it may be stored for later use. Organisms that eat plants break down the plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms. (American Association for the Advancement of Science/Project 2061, 1993).

This user manual describes the background, development, measurement properties, and appropriate uses of the assessment. User manuals for other ATLAST assessments may be found at www.horizon-research.com/atlast.

2. Background

Horizon Research, Inc. (HRI) developed the ATLAST Flow of Matter and Energy Teacher Assessment as part of a larger study. The project—Assessing Teacher Learning About Science Teaching (ATLAST)—was funded by the National Science Foundation under Grant no. DUE-0335328[1]. The goal of ATLAST was to develop instruments that researchers could use to study the theory of action that underlies much professional development for science teachers. Briefly, the model asserts that changes in teacher knowledge lead to changes in classroom practice (mediated by instructional materials), and ultimately, changes in student learning. (See Figure 1.) Despite the prominent role this model plays in professional development design, it has not been studied systematically, in part because of a lack of instruments. Among other products, ATLAST developed pairs of assessments—one for teachers and one for students—focused on the same science content. These pairs of assessments enable the study of relationships between teacher knowledge and student learning in specific science contexts. ATLAST assessments exist for three content areas: flow of matter and energy in living systems (photosynthesis and cellular respiration), force and motion (Newton's first and second laws), and plate tectonics.

[1] Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

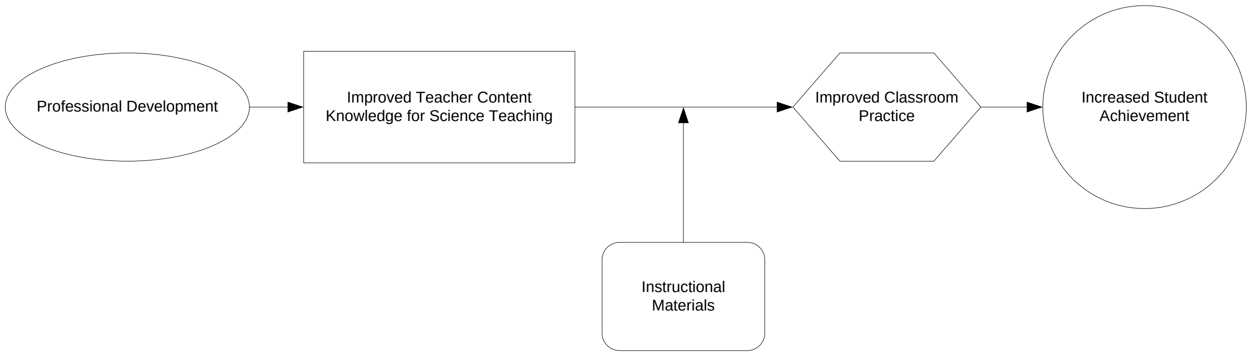

Figure 1.
Professional Development Theory of Action

To enable large-scale research, HRI set out to create assessments that would be minimally burdensome, both for the test taker and the researcher. Accordingly, HRI opted for a multiple-choice format, recognizing the limitations of such items. For instance, well-constructed open-ended items may probe more depth of understanding than multiple-choice items, but they are more burdensome for both the researcher (in terms of scoring costs) and the test-taker (in terms of time required to complete the assessment). In addition, scoring open-ended items requires the training of raters to establish inter-rater reliability.

3. Development of the Flow of Matter and Energy Teacher Assessment

As described above, this development effort was part of a much larger and well-funded project, which afforded the luxury of a thorough development process. This process is depicted in Figure 2.

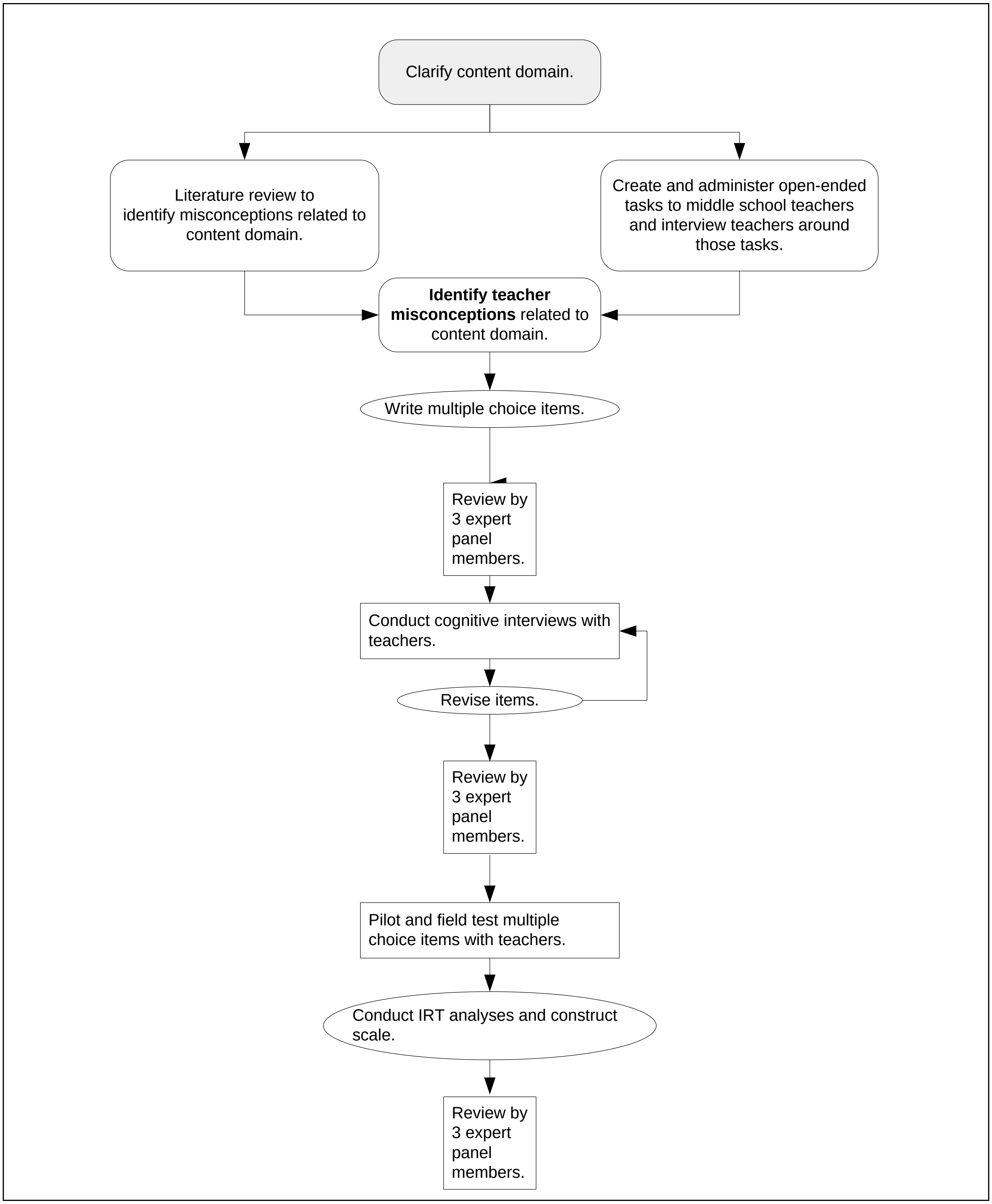

Figure 2
ATLAST Assessment Development Process

3.1. Clarifying the Content Domain

Development began with identifying the target content for the assessment, the ideas that "*Food provides molecules that serve as fuel and building materials for all organisms. Plants use the energy in light to make sugars out of carbon dioxide and water. This food [sugars] can be used immediately for fuel or materials, or it may be stored for later use. Organisms that eat plants break down the plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms*" (American Association for the Advancement of Science/Project 2061, 1993). HRI specified the domain by "unpacking" these targeted ideas into 11 "sub-ideas" that were reviewed by four biologists/biology educators, resulting in minor edits. The final description of the content domain is shown in Table 1.

Table 1
Flow of Matter and Energy Content Domain

Targeted Ideas:	Food provides molecules that serve as fuel and building materials for all organisms. Plants use the energy in light to make sugars out of carbon dioxide and water. This food [sugars] can be used immediately for fuel or materials, or it may be stored for later use. Organisms that eat plants break down the plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms.

Sub-ideas:

A. Food serves as both fuel (energy source) and building materials for an organism. Sugars are an example of food for both plants and animals, but water, carbon dioxide, and oxygen are not.

B. Using light energy, plants make their own food - in the form of sugars - from carbon dioxide (in the air) and water. Nothing else is required for this process. Oxygen is released as a result.

C. Plants transform light energy into chemical energy in sugars made by the plants

D. Humans and other animals acquire food by consuming plants or other animals that have consumed plants. Animals break down this food into simpler substances (including sugars).[†]

E. Organisms (including both plants and animals) grow by breaking down food (including sugars made by plants and sugars ingested by animals) into simpler substances which they reassemble into other substances that become part of new or replacement body structures.

F. Organisms (including both plants and animals) break down energy-rich food (such as sugars), using oxygen, into simpler substances with less energy (such as carbon dioxide and water), releasing energy in the process. This process does not require light. Some of this energy from food is used for growth and other body functions, and some is released as heat.

G. If not used immediately as fuel or building material, food can be stored for later use by plants and animals. In animals, but not in plants, food can also be eliminated from the body as waste .

H. **Respiration** is the continual process by which an organism uses oxygen and sugars to release energy: $6O_2 + C_6H_{12}O_6 \rightarrow 6H_2O + 6CO_2$ + energy

I. **Photosynthesis** is the process by which a plant uses the energy from light to make sugars from carbon dioxide and water: Light energy + $6H_2O + 6CO_2 \rightarrow 6O_2 + C_6H_{12}O_6$
Note: The oxygen that is released comes from the water, not the CO_2. Energy comes from light, not heat of the Sun.

J. Some energy is lost to the system as heat between each trophic level, so only a portion of the energy is passed from one trophic level to the next. This continuous loss of energy to the system as heat means that an outside source of energy (usually the Sun) is required to maintain the flow of energy in ecosystems.

K. Decomposers transform dead organisms into simpler substances that can be used by plants and other organisms. This release of nutrients back into the environment is necessary to complete the cycle of matter.

[†] This sub-idea is integral to the benchmark but is considered prerequisite knowledge. No items will be written around this sub-idea.

In addition to specifying the science content domain, HRI specified the kinds of teacher knowledge the assessment would measure. Knowledge of science content was a given, but other kinds of knowledge were considered. For instance, one could argue that teachers should know what misconceptions or prior conceptions students are likely to bring to a study of the content. Teachers should also know effective strategies for engaging students with the science content and for helping students make sense of the content. Finally, teachers should know effective strategies for informally assessing student understanding during instruction. Each of these types of knowledge, which Shulman (1987) dubbed "pedagogical content knowledge," is content-specific.

After a review of existing literature on pedagogical content knowledge (e.g., Carlsen, 1999; Magnusson, Krajcik, & Borko, 1999; Shulman, 1987; Veal and MaKinster, 1999; Wilson & Berne, 1999), HRI compiled seven content-specific domains of teaching knowledge (see Table 2). Because the research base in the flow of matter and energy content area is not as extensive as it is in other areas (e.g., physics), researchers used open-ended items and conducted cognitive interviews to learn more about teachers' ideas in this content area. The combination of this research and the existing literature provided sufficient information to support item development in the first, fourth, and seventh domains; i.e., item writers were able to generate plausible distractors as well as a single correct answer.

Table 2
Content-Specific Domains of Teacher Knowledge

1. **Knowledge of disciplinary content**
   This knowledge refers strictly to the science content, with no other elements of what a teacher would need to know in order to relate the content to students.

2. **Knowledge that alternative frameworks for thinking about the content exist**
   When teachers have deep knowledge of disciplinary content and recognize that different ways of organizing ideas exist, they can focus on helping students understand the important ideas, without necessarily requiring students to organize ideas in the exact same way. Such knowledge also enables teachers to recognize student understanding that is correct, but presented differently from how the teacher might organize it.

3. **Knowledge of the relationships between big ideas and the supporting ideas in a content area**
   Teachers need to help students not be so focused on the small details of the content that they never grasp the larger (and more powerful) concept.

4. **Knowledge/understanding of student thinking about the content**
   To help students understand content, teachers need to know what ideas students are *likely* to bring with them and where they are likely to struggle. Some content areas—e.g., force and motion—have a rich research base on student preconceptions and misconceptions, which includes research on how resistant these ideas may be to change. Most content areas do not have such a research base.

5. **Knowledge of activities/representations/hypothetical scenarios, etc. that can be used to *diagnose the thinking* of a particular group of students**
   Teachers need to know how to discern what ideas students have about a content area, both prior to and during a unit of instruction.

6. **Knowledge of how to sequence ideas for students to learn the content of interest**
   This type of knowledge highlights one of the differences in how a teacher and scientist think about content. A teacher needs to be able to think about content in terms of how students can most efficiently come to understand it. They need to know which ideas are pre-requisites for later ideas and how to progress from less complex to more complex ideas.

7. **Knowledge of content-specific strategies (activities/representations/hypothetical scenarios, etc.) that *move students' thinking forward***
   In addition to knowledge of student thinking, teachers need knowledge of ways to move that thinking forward. Included in this knowledge is an awareness that not all strategies will work equally well with all groups of students. The implications of some student differences are obvious—e.g., seeing or hearing impairments. Others are more subtle; e.g., representations that communicate well for students in inner city settings may not work well for students in rural schools, and vice-versa.

Attempts to write items targeting teachers' knowledge of common patterns of student thinking were not successful. Items generally took the form of, "Which of the following misconceptions are students likely to exhibit in a study of the flow of matter and energy?" Although a literature search, cognitive interviews, and open-ended assessments had identified prevalent misconceptions in this content area, the research base is not strong enough to argue the relative prominence of the various misconceptions. Further, it seemed unreasonable to expect teachers to be thoroughly familiar with the literature on student thinking in every content area they teach.

Multiple-choice items testing teachers' knowledge of instructional strategies were abandoned on different grounds. After many attempts to write such items, HRI recognized that the literature is not strong enough to judge the relative effectiveness of two or more activities that reasonably address the same idea. Interviews with teachers revealed that such items were not measuring teachers' knowledge, but rather they were measuring teachers' beliefs or attitudes about teaching.

In summary, the ATLAST Flow of Matter and Energy Teacher Assessment measures only knowledge of science content.

3.2. Types of Teacher Assessment Items

The sections that follow discuss the three types of teacher multiple-choice items included in the assessment:

1. knowledge of science content (Level 1 items);
2. using content knowledge to analyze/diagnose student thinking (Level 2 items); and
3. using content knowledge to make instructional decisions (Level 3 items).

Knowledge of science content

All of the ATLAST items for teachers assess knowledge of science content, but the most basic type of question attempts to isolate disciplinary content knowledge from a teacher's ability to apply that knowledge in making instructional decisions. An example of these "Level 1" items is shown in Figure 3 (correct answer is A).

In a unit on the flow of matter and energy in living systems, students were asked to describe what happens to the light energy from the Sun that plants absorb. Which one of the following student answers is correct?

A. Some of the energy is changed into chemical energy.
B. Some of the energy is changed into sugars.
C. All of the energy is changed into heat when sugars are made.
D. All of the energy is used up while making sugars.

Figure 3
Level 1 Item

This item illustrates some features common to all ATLAST teacher assessment items. As mentioned previously, all of the items are multiple-choice. In addition, all items include only four choices, and answer choices are never worded as "all of the above" or "none of the above." Multiple correct answers, such as "A and B but not C," are also not used. Perhaps most importantly, all of the items are set in an instructional context. The intent in using these contexts was two-fold: first, to make teachers feel like they were taking a test that was written for them, as opposed to, for example, a test constructed for undergraduates. The second goal was for teachers to recognize in the items the kind of work they do every day, making it more likely that they would intellectually engage with the items.

Using science content knowledge to analyze/diagnose student thinking
"Level 2" items require teachers to *apply* their content knowledge in analyzing or diagnosing a sample of student thinking. Figure 4 shows an illustrative item (correct answer is B).

A teacher asks his students what happens to food that a plant doesn't use right away for growth or energy. One student answers,

"There is no unused food, because plants use all their food immediately."

What does this response indicate about this student's understanding of how plants use food?

A. The student does *not* understand that plants use food for fuel or building material.
B. The student does *not* understand that plants store food.
C. The student does *not* understand that plants break down their food.
D. The student has an accurate understanding of how plants use food.

Figure 4
Level 2 Item

A teacher must certainly understand the science content in order to answer Level 2 items correctly. However, additional analysis of the question is required because, unlike the Level 1 item in Figure 3, more than one of the choices includes a scientifically correct statement. In Figure 4, the statements in choices A, B, and C are all correct in terms of the biology, but only choice B *also* applies to what the students said. This feature is present in all Level 2 items and makes the cognitive load of these items higher than that of Level 1, as teachers must evaluate the students' thinking in relation to the scenario in order to choose the correct answer.

Using content knowledge to make instructional decisions
"Level 3" items ask teachers to apply their content knowledge in choosing among instructional moves. A sample Level 3 item is shown in Figure 5 (correct answer is D).

In a lesson on plant growth, a teacher asks students to explain what happens to the light energy that is used by plants to make sugars. Most of the students respond that **the light energy is turned into sugars by the plant.** What should the teacher do next in class to move the students forward in their thinking about plants' use of light energy?

A. Set up an experiment in which some leaves on a plant are covered in aluminum foil and others are left uncovered, and then test starch levels after several days.
B. Draw a diagram of the inputs and outputs of photosynthesis.
C. Ask the students to describe the growth of plants in the light versus the growth of plants in the dark.
D. Explain how light energy is converted to another form of energy and stored in the plant.

Figure 5
Level 3 Item

Level 3 items have the highest cognitive load, because teachers must not only evaluate the scenario, but also consider the student's thinking in relation to the scenario and then evaluate each instructional choice. As with Level 2 items, more than one answer choice has a scientifically correct statement, but only one has a scientifically correct statement *and* is relevant to the instructional context. Although the cognitive load of Level 3 items is demanding, it is only a small fraction of the demand placed on a teacher managing the learning of a classroom of students.

3.3 Item Development

Development of the multiple-choice items began with asking 67 teachers to respond to open-ended items about the teaching of concepts related to the flow of matter and energy in living systems. A sample item is shown in Figure 6. These items accomplished two things. First, responses to these items provided a window into teachers' thinking about the content, in many cases revealing the kinds of misconceptions teachers have about the flow of matter and energy. In many instances their misconceptions were the same as those identified in the literature about middle grades students, but the items also uncovered a few additional ideas. Second, teachers' incorrect responses could be used to generate distractors for the multiple-choice items.

At the end of a unit on food and energy in plants and animals, a student asks:

"After an animal dies, what happens to all of the matter and energy it had stored in its body?"

How would you respond to the student?

Figure 6
Open-Ended Item Used in Development

Once teachers' responses to open-ended items were collected, a months-long iterative process followed in which multiple-choice items were written and refined based on conducting cognitive interviews with middle grades science teachers. The interview protocol is shown in Figure 7.

<u>Prologue:</u>

We are developing a test for middle school teachers who teach about food and energy in plants and animals, and we need your help to get the questions on the test just right. I don't expect you to answer all of the answers correctly. If you get a few wrong, it will help me know whether we have written the items well. Remember, the point is to help us write a good test, not to test what you do or don't know. Do you have any questions before we get started? Remember that all of your answers are confidential.

<u>Procedure:</u>

- Ask teacher to read aloud and "think aloud" as they read the questions and answer choices, if they are comfortable doing so.

- For each multiple-choice item, ask:
  1. Why did you choose that answer? (probe for words or diagrams they keyed in on, as well as their thinking behind the response)
  2. Were there other answer choices that you almost chose? (why?)
  3. Were there any answer choices that you did not even consider? (why?)
  4. Was there an answer choice you were expecting to see, but did not? What was it?
  5. Were there any words or diagrams you did not really understand, or situations that made the question confusing?
  6. Do you have any other comments on the item?

Figure 7
Cognitive Interview Protocol

The cognitive interviews revealed distinct patterns of errors in teacher responses to the Level 2 items (using content knowledge to analyze/diagnose student thinking). One trend is that teachers tend to choose an answer that included student thinking they were familiar with, whether or not it represented the thinking of the student in the item. Others choose a statement that was correct in terms of the biology, but not in relation to the student's thinking.

Interviews also suggest some common errors teachers make with Level 3 items (using content knowledge to make instructional decisions). First, they often saw more than one of the instructional choices, including the correct one, as equally good. Teachers have an especially difficult time choosing an answer when the item requires teachers to evaluate which question should be asked next. When the choices are about actual activities, teachers sometimes get bogged down in the details of the choices. For instance, they may rule out a choice that includes a computer simulation or detailed lab because they do not have access to the required equipment, regardless of whether the activity would help move the student's thinking forward. Finally, teacher beliefs about effective instruction may get in the way, even when they seem to understand the content targeted by the item. For example, teachers often choose a hands-on activity, as in choice A in Figure 5, even if it does not address the student's thinking.

3.4 Field Tests

A pool of 75 flow of matter and energy teacher items was distributed over three forms for the initial field test, with several linking items common to each form. Over 500 science teachers across the nation responded to each item. Each group included roughly one-fifth high school biology teachers to ensure an adequate distribution of levels of teacher knowledge in the sample. The remaining respondents were middle grades science teachers.

Using results from the first field test, 35 items were selected for the second field test with approximately 700 teachers nationally, with 17 percent of the sample being high school science teachers. Table 3 describes the sample in terms of various demographic variables. Both field tests were administered entirely online.

Table 3
Characteristics of the Second Field Test Sample (N = 692)

	Percent
Experience Teaching Growth and Energy in Plants and Animals	
Middle school life science	61
Middle school integrated science	60
High school biology	16
High school AP biology	1
Other	8
Taken a college-level introductory biology course	93
Gender	
Female	69
Male	31
Race/Ethnicity	
American Indian or Alaskan Native	1
Asian	2
Black or African American	3
Hispanic or Latino	2
Native Hawaiian or Other Pacific Islander	0
White	94

4. Measurement Properties of the Assessment

Following is a description of the content coverage of the assessment, information about the validity and reliability of the assessment, and the results of the item-response theory (IRT) analysis.

4.1 Content Coverage

Using results from the field test, 29 items were selected for the final form. The distribution of items by sub-idea is shown in Table 4. The number of items totals more than 29 because one item may address more than one sub-idea.

Table 4
Number of Items Addressing Each Sub-Idea

Sub-Ideas:	**Number of Items**
A. Food serves as both fuel (energy source) and building materials for an organism. Sugars are an example of food for both plants and animals, but water, carbon dioxide, and oxygen are not..	5
B. Using light energy, plants make their own food - in the form of sugars - from carbon dioxide (in the air) and water. Nothing else is required for this process. Oxygen is released as a result.	5
C. Plants transform light energy into chemical energy in sugars made by the plants	3
D. Humans and other animals acquire food by consuming plants or other animals that have consumed plants. Animals break down this food into simpler substances (including sugars). †	0
E. Organisms (including both plants and animals) grow by breaking down food (including sugars made by plants and sugars ingested by animals) into simpler substances which they reassemble into other substances that become part of new or replacement body structures..	6
F. Organisms (including both plants and animals) break down energy-rich food (such as sugars), using oxygen, into simpler substances with less energy (such as carbon dioxide and water), releasing energy in the process. This process does not require light. Some of this energy from food is used for growth and other body functions, and some is released as heat..	6
G. If not used immediately as fuel or building material, food can be stored for later use by plants and animals. In animals, but not in plants, food can also be eliminated from the body as waste .	3
H. **Respiration** is the continual process by which an organism uses oxygen and sugars to release energy**:** $6O_2 + C_6H_{12}O_6 \rightarrow 6H_2O + 6CO_2$ + energy	2
I. **Photosynthesis** is the process by which a plant uses the energy from light to make sugars from carbon dioxide and water: Light energy + $6H_2O + 6CO_2 \rightarrow 6O_2 + C_6H_{12}O_6$	4
J. Some energy is lost to the system as heat between each trophic level, so only a portion of the energy is passed from one trophic level to the next. This continuous loss of energy to the system as heat means that an outside source of energy (usually the Sun) is required to maintain the flow of energy in ecosystems.	3
K. Decomposers transform dead organisms into simpler substances that can be used by plants and other organisms. This release of nutrients back into the environment is necessary to complete the cycle of matter.	2

† This sub-idea is integral to the benchmark but is considered prerequisite knowledge. No items were written around this sub-idea.

Table 5 shows the answer key and content association for each item on the assessment. The letter "P" denotes a primary association with the sub-idea being targeted by the item. An "s" denotes a secondary association with a sub-idea that is also necessary in order to answer the item correctly but is not the primary idea being assessed.

Table 5
Answer Key and Sub-Idea Associations

Item #	**Key**	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***	***K***
1	A							P				
2	A		P							P		
3	A											P
4	B			P								
5	D					P						
6	D								P			
7	C					P						
8	D		P									
9	B			P								
10	A					P						
11	A	P	P									
12	D		P							P		
13	A						P					
14	D							P				
15	C	P										
16	C						P		P			
17	C						s				P	
18	B						P					
19	A	P										
20	B							P				
21	D	P										
22	C										P	
23	B					P						
24	C						P					
25	B						P					
26	B			P						s		
27	A	s				P						
28	B										P	P
29	D		P			P				P		
Primary:		4	5	3	0	6	5	3	2	3	3	2
Secondary:		1	0	0	0	0	1	0	0	1	0	0
Total:		5	5	3	0	6	6	3	2	4	3	2

4.2 Validity

Four lines of evidence support the argument that the assessment is a valid measure of teachers' knowledge of ideas related to the flow of matter and energy in living systems. First, cognitive interviews with teachers established that teachers interpret the items as intended and that teachers must use their knowledge of content to answer the items correctly. Second, a panel of three content experts (individuals with Ph.D.s in biological sciences) reviewed the assessment items at three stages to ensure content accuracy (see Figure 2). These content experts also reviewed the final assessment and judged it to be an adequate measure of the content domain. Third, dimensionality analyses (including both factor analysis and cluster analysis) indicate that all items on the assessment measure a single dominant trait. HRI termed this trait "content knowledge for teaching about flow of matter and energy."

A fourth line of evidence for the validity of the assessment is derived from a study that compared teachers' performance on the assessment with their knowledge level as indicated in an interview. HRI administered the assessment to approximately 100 middle grades teachers. The five highest- and lowest-scoring teachers were selected for interviews. Interviews were conducted approximately two months after the assessment by a content expert (a Ph.D. biology professor). The interviewer was not aware of the teachers' assessment scores. Interview questions addressed the same content used to formulate the assessment and were developed through the collaboration of HRI researchers with the content expert. The interview provided a second measure of content knowledge, independent of the assessment with regard to format and time of administration.

Based on the interview responses, the content expert categorized each interviewee as displaying "extensive knowledge of the content" or "limited knowledge of the content." Analysis of the interviewer ratings and assessment scores showed that four of the five highest-scoring teachers were categorized as having "extensive knowledge of the content" while the five lowest-scoring teachers were categorized as having "limited knowledge of the content." The agreement between assessment score and interviewer rating provides further evidence that the assessment is a valid measure of teachers' knowledge of flow of matter and energy ideas.

4.3 Reliability

The assessment has an internal reliability of 0.85. HRI conducted a study of test-retest reliability with approximately 100 middle grades science teachers who took the test twice, two weeks apart with no intervening instruction. The test-reliability was 0.93.

4.4 Speededness

Neither the pilot, field test, nor test-retest study were timed administrations. As such, there is no information about speededness.

5. Using the Assessment

The ATLAST Flow of Matter and Energy Teacher Assessment is available at no cost to individuals who agree to certain terms of use. To request a review copy of the assessment, or to access the terms of use, visit http://www.horizon-research.com/atlast.

5.1 Appropriate Use

The ATLAST Flow of Matter and Energy Teacher Assessment will yield a score for each individual. However, the assessment is not valid for making *judgments* about individuals based on those scores. For instance, assigning grades based on scores is not a valid use of the assessment. The assessment was not validated for such purposes.

HRI developed the assessment for use in research contexts involving groups of teachers. Appropriate uses with sufficiently large groups of teachers (20 or more) include:

- Measuring the change in group mean from pre-workshop to post-workshop;
- Comparing the gains of treatment and control groups; and
- Investigating the relationship between teacher knowledge and student learning.

5.2 Amount of Time Required to Complete the Assessment

As described above, both the pilot and field test were administered on-line and were not timed. Although there is no evidence of speededness, it is recommended that at least 30 minutes be allowed for completing the assessment.

5.3 Computing Scores

Scores may be computed either as number correct or percent correct. Results of an item-response theory (IRT) analysis are shown in Table 6. This table can be used to convert a raw score in terms of number correct to the corresponding scaled score. Raw and scaled scores representing mean values are presented in bold text.

Table 6
Assessment Score Conversions

Flow of Matter and Energy Teacher Assessment				
RawScore	Scaled Score		Raw Scores	
0	5		Mean	SD
1	10		16.4	5.38
2	12			
3	14			
4	16			
5	19			
6	21			
7	24			
8	28			
9	31			
10	35			
11	39			
12	43			
13	45			
14	47			
15	51			
16	**55**			
17	58			
18	62			
19	66			
20	69			
21	72			
22	75			
23	80			
24	83			
25	87			
26	91			
27	94			
28	97			
29	100			

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Terms of Use Agreement
Flow of Matter and Energy Teacher Assessment

By using the ATLAST Flow of Matter and Energy Teacher developed by Horizon Research, Inc. (HRI), you agree to abide by the stipulations below concerning use, test security, test administration, and citations.

Use of the Assessment

The Flow of Matter and Energy Teacher assessment may be used to gauge growth in knowledge about a specific content area as a result of an intervention such as professional development, curriculum use, or mentoring. It may also be used to learn about the contribution of teacher knowledge to student knowledge and classroom instruction.

We ask that you abide generally by the standards put forward in the *Standards for Educational and Psychological Testing* (AERA/APA 1999).

You may not use the assessment to evaluate individuals. Assessment results may not be associated with any high-stakes consequence such as tenure, pay, hiring, or grades. The assessments were not developed for making decisions/judgments about individuals.

You should also refrain from using these measures to publicly demonstrate teachers' ability or lack of ability in science, which may adversely affect willingness to participate in future studies.

IRB and/or District/School Study Approval

It is your responsibility to obtain proper IRB and/or the appropriate district/school approval for your study and to follow the necessary requirements for obtaining principal, teacher, parent, and/or student permission/approval to administer to the assessment(s).

Responsibilities to Teachers and Students

Your responsibilities to study participants will largely depend on the details of the IRB and/or district/school approval of your study. In most cases, completion of the assessment will be strictly voluntary. As such, participants should be informed of the voluntary nature of the study. Teachers should be assured that if their data are not anonymous, individual identities will be kept strictly confidential; i.e., an individual's score or responses will never be reported in association with his or her name or any other identifying information. To encourage a high response rate among teachers, it may be helpful to:

- Clearly explain what the data will be used for and why the data are important for your study;
- Explain that there are no high-stakes consequences associated with completing the assessment;

- Offer teachers compensation for time spent outside of the regular school day completing the assessment.

Test Security

The ATLAST Flow of Matter and Energy Teacher Assessment may NOT be shared without prior authorization from HRI. Anyone who administers the assessment must agree to:

- Refrain from using any non-released item in any presentation, paper, article, or other public forum. Items are expensive to develop and pilot, and we are attempting to keep our item pool secure.
- Refrain from distributing copies of any non-released item to individuals other than participants in your research project.
- Refrain from using the assessment, in original or in copied form, to provide test-taking practice or to enhance test-taking skills.
- Refrain from using test items, actual or similar, for discussion or review.

(HRI acknowledges that, in some cases, school administrators and IRBs may require that the test materials be reviewed prior to granting permission for study participants to take the test. Such a review is not considered a violation of this Test Security Policy as long as the other provisions of this policy are not violated.)

Citing ATLAST Assessments

In any writing in which data from HRI's ATLAST assessments are included, the following citation must be used:

The assessment was developed by the Assessing Teacher Learning About Science Teaching (ATLAST) project at Horizon Research, Inc. ATLAST is funded by the National Science Foundation under grant number DUE-0335328.

By signing below, I acknowledge that I have read the user manual, and I agree to abide by terms of use described above.

____

Printed Name   Signature   Date

Address: ____

Street   City   State   Zip code

Phone number (including area code): ____________________________________

Your email address: ____