Cocktail of Food Science and Argumentation: Shaken or Stirred for Learning?
Shaken nor stirred!

- James Bond prefers his vodka martinis shaken rather than stirred.
- Connoisseurs agree that stirred martini is superior to shaken.
- Alternative claims:
  - Shaking gets aldehydes oxidised the vermouth in the Martini in the way that red wine oxidises while it ‘breathes’?
  - Shaking a Martini breaks down hydrogen peroxide in the drink thus altering its flavour?
  - Shaking ‘bruises’ the vodka?
- Ian Fleming writing after World War II, grain was expensive, a lot of vodka was made of potatoes. Potato vodka shaken with ice dissipates oil, making for a smoother drink.
Mythical versus Evidence-base Claims about Food

• A potato will absorb excess salt in a soup or stew
• Butter will spoil if not refrigerated constantly
• Leaving an avocado pit in a pot of guacamole will prevent it from turning brown
• Some foods contain negative calories
Outline of Presentation

- Argumentation in science education
  - Rationale for promoting argumentation in science education
  - Content analysis of top journals to indicate trends

- Developing teaching strategies and professional development programmes to foster argumentation

- Agenda for food science and argumentation

- Conclusions
Goals of Science Education

Scientific literacy for all citizens
  e.g. What is the evidence for oxidation in guacamole?

Scientific knowledge and reasoning skills for scientists-to-be
  e.g. How do we know and justify our knowledge about the physical and natural world?
Issues

- **Cookbook problem (van Keulen, 1998)**
  - Mindless following of procedures vs authentic inquiry

- **Verification of knowledge versus knowledge construction**
  - Why do we know?
  - How do we know?

- **Habits of mind/ways of thinking in scientific reasoning**

- **Delivery of scientific knowledge as unscientific in nature**
Types of Activity

- Listening
- Reading
- Set Exercise
- Copying
- Open paper and Pencil Task
- Observing Demonstration
- Closed Practical Task
- Open Practical Task
- Preparing or Clearing Away
- Grouped Discussion
- Other

(Driver et al., 1987)
Argumentation

Coordination of theory and evidence to justify or refute an explanatory conclusion

Toulmin’s Model of Argument (Toulmin, 1958)

TOULMIN’S ARGUMENT PATTERN

DATA

CLAIM

WARRANT

REBUTTAL

BACKING
Research
- Argument is an important aspect of scientific discourse and practice
  - (Kelly & Takao, 2002; Kuhn, 1991; Pontecorvo, 1987; Walton, 1996; Zeidler, 2003)

- Argument skills critical dimensions of learning and reasoning

- Argument skills are applicable in everyday contexts that are demanded of informed citizens particularly in relation to socio-scientific issues (e.g. political, medical, economic decisions)
  - (e.g. Sadler, 2011; Simonneaux, 2008; Zeidler & Sadler, 2008)

Policy
- South Africa - Critical Thinking Skills (Science Curriculum 2005)
Science Example 2.2

Suppose that on one stretch of narrow road Peter finds that after the lane lines are painted the traffic changes as below.

<table>
<thead>
<tr>
<th>Speed</th>
<th>Traffic moves more quickly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>Traffic keeps nearer edges of road</td>
</tr>
<tr>
<td>Distance apart</td>
<td>No change</td>
</tr>
</tbody>
</table>

On the basis of these results it was decided that lane lines should be painted on all narrow roads. Do you think this was the best decision? Give your reasons for agreeing or disagreeing.

Agree: ________
Disagree: ________
Reason: ________

Scoring and comments on Science Example 2.2

Full Credit

Code 1: Answers that agree or disagree with the decision for reasons that are consistent with the given information. For example:
- agree because there is less chance of collisions if the traffic is keeping near the edges of the road, even if it is moving faster;
- agree because if traffic is moving faster, there is less incentive to overtake;
- disagree because if the traffic is moving faster and keeping the same distance apart, this may mean that the drivers don’t have enough room to stop in an emergency.

No Credit

Code 0: Answers that agree or disagree without specifying the reasons, or provide reasons unrelated to the problem.

Item type: Open-concepted response
Process: Interpreting scientific evidence and conclusions (Process 3)
Concept: Forces and movement
Situation: Science in technology

(OECD, 2003; p. 144)

Learning Argumentation

Role in learning
- Acquisition of scientific literacy and knowledge
- Development of habits of mind. e.g. NRC, DfEE
- Appropriation of community practices

Implications for teaching
- Tool in construction of scientific knowledge
- Relation of evidence and theory
- "Science talk" (Lemke, 1990)

Argumentation
- Explicitly taught
- Strategies and materials
- Training
Model of Science Generated by School Science

REAL WORLD

Observation/Experiment

THEORY
Model of Science
(e.g. Giere, 1991)

Step 1
REAL WORLD

Step 2
MODEL

Step 3
DATA

Step 4
PREDICTION

Observation/Experiment

Model fits/Doesn't Fit

Reasoning/Calculation

Agree/Disagree

Negative Evidence

Positive Evidence

Accept/Reject
Lee, Wu and Tsai (2009) have identified ‘argumentation’ as an area of research in science education that has “gained significant attention” in recent years (p.2016).

Trends in Research on Argumentation: Content Analysis of Science Education Journals

(Erduran, Ozdem, & Park, 2012)
Content Analysis of Key Journals

Four levels of analysis

1. **1st level**
   - Epistemic aspects of argumentation

2. **2nd level**
   - Linguistic and cognitive aspects of argumentation

3. **3rd level**
   - Social aspects of argumentation

4. **4th level**
   - Wider epistemic notions related to argumentation

**Keyword identification & generating systematic categories**

1) Argumentation
2) Argument / argue
3) Claim
4) Evidence based
5) Justification
6) Reasoning

1) Talk
2) Discuss
3) Discourse
4) Conversation
5) Dialogue
6) Negotiation

1) Decision making
2) Shared/sharing meaning making

1) Inquiry
2) Explain/explanation
### No. of articles from 1998 to 2009 (%)

<table>
<thead>
<tr>
<th></th>
<th>IJSE</th>
<th>JRST</th>
<th>SE</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of total published articles from 1998 to 2009</td>
<td>961 (100)</td>
<td>598 (100)</td>
<td>497 (100)</td>
<td>2,056 (100)</td>
</tr>
<tr>
<td>No. of non-argumentation-related articles (not including any of 16 keywords)</td>
<td>431 (44.9)</td>
<td>225 (37.6)</td>
<td>176 (35.4)</td>
<td>832 (40.5)</td>
</tr>
<tr>
<td>No. of argumentation-related articles using one of 16 keywords</td>
<td>530 (55.2)</td>
<td>373 (62.4)</td>
<td>321 (64.6)</td>
<td>1,224 (59.5)</td>
</tr>
</tbody>
</table>

- **40% articles from 1998 to 2009 did not include any of 16 keywords at all.**

<table>
<thead>
<tr>
<th></th>
<th>IJSE</th>
<th>JRST</th>
<th>SE</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of articles using one of 6 A keywords</td>
<td>194 (20.19)</td>
<td>108 (18.06)</td>
<td>118 (23.74)</td>
<td>420 (20.43)</td>
</tr>
<tr>
<td>No. of articles using one of 6 B keywords</td>
<td>340 (35.38)</td>
<td>223 (37.29)</td>
<td>196 (39.44)</td>
<td>759 (36.92)</td>
</tr>
<tr>
<td>No. of articles using one of 2 C keywords</td>
<td>24 (2.50)</td>
<td>28 (4.68)</td>
<td>18 (3.62)</td>
<td>70 (3.40)</td>
</tr>
<tr>
<td>No. of articles using one of 2 D keywords</td>
<td>144 (14.98)</td>
<td>158 (26.42)</td>
<td>121 (24.35)</td>
<td>423 (20.57)</td>
</tr>
</tbody>
</table>

- omitted articles do not have abstract (editorial, guest editorial, book review, etc) and analysed total of 2056 articles.

Total number of publications is 2466 and total number of articles analysed is 2056.
Distribution of Key Words Across Journals

- No. of articles using one of 6 A keywords
- No. of articles using one of 6 B keywords
- No. of articles using one of 2 C keywords
- No. of articles using one of 2 D keywords

- IJSE
- JRST
- SE
Distribution by key categories and journal

A. Epistemic aspects of argumentation
B. Linguistic and cognitive aspects of argumentation
C. Social aspects of argumentation
D. Wider aspects related to argumentation

Trends by Journal across 3-year periods
Funded Projects

- Enhancing the Quality of Argumentation in School Science (ESRC) - 1999-2002
- Ideas, Evidence and Argument in Science Education (Nuffield) - 2002-2003
- Continuing Professional Development in Argumentation (Gatsby) - 2003-2004
- Ideas and Evidence in Initial Teacher Training (Key Stage 3 Strategy) – 2004
- Step-IN (Training and Development Agency for Schools) – 2005-2006
- Fostering Evidence-Based Science Teaching (2007-2008)
- Mind the Gap in Inquiry-Based Science Teaching (European Union) – 2008-2010
- Science Teaching Advanced Methods (European Union) – 2009-2012
New professional development resources for inquiry-based science teaching approaches
29 November 2011

The teaching and learning of scientific inquiry has been the focus of a professional development project based in the Graduate School of Education and funded by the European Union FP7 Programme.

The STEAM (Science Teaching Advanced Methods) project brought together 25 institutions from across Europe investigating and disseminating effective practices in inquiry-based approaches in science teaching.

The Bristol team, led by Professor Sibel Erduran included Wan Ching Yee and Dr Neil Ingram along with a group of science teachers from local schools.

As part of the professional development efforts, the Bristol team and two teachers, Damian Murphy from Stroud High School and Catherine Cain from Deer Park School in Cirencester, have recently shared their experiences with colleagues from Spain, Lithuania and the Czech Republic. The event took place in October and was hosted by the University of South Bohemia.

The Bristol project has produced several resources. The first resource is entitled Assessment and practical inquiry in scientific argumentation: A professional development programme for secondary school science teachers. It is a resource for teacher educators supporting the training of science teachers in acquiring skills and knowledge of teaching argumentation in science.

The second resource is called Science Teaching Advanced Methods: Frameworks for supporting argumentation in Science teaching and learning 2011. It was co-produced with colleagues in France and Spain, and includes a set of policy statements for teacher education, outlining an indicative set of vignettes for the teaching of argumentation based on inquiry approaches in science.

Finally the project has gathered example lesson materials as well as the project teachers’ reflections captured on video which are available on the Assessment and Practical Inquiry in Scientific Argumentation (APISA) website.

Read more about Professor Sibel Erduran's work
Read more about Professional development at the Graduate School
Professional Development Resources
Argumentation through Chemistry Stories
Activity 1: Halloween Crush!
Teacher outline

This activity presents a set of alternative explanations about strange incidents that occurred when a group of students were having a party during Halloween in a chalet set in the mountains. Students are asked to evaluate through discussions in small groups the plausibility of the different explanations for why the lid of oilcan to shoot off when heated and why an oilcan collapses on itself when it’s subsequently left to cool off. Furthermore, the activity immerses students to generate their own explanations to account for the observed phenomenon.

The aims
The aim of this exercise is to evaluate different theories for what causes the can to collapse and the lid to shoot off. Students will be required to justify with reasons their choice of claims and also justify with reasons why they do not agree with other claims.

Learning goals
The learning goals of this activity are for students:
- to learn to evaluate arguments and provide justifications for what they believe in;
- to provide justifications for why they think alternative arguments are not plausible;
- to evaluate alternative explanations and reasons;
- to think about the language they use, whether their reasoning is clear, and whether it justifies their conclusion.

Teaching points
For this activity students will need to know about the air pressure and the behaviour of gases. Also they need to know how to express their ideas in words.

Teaching sequence
- Distribute the activity sheet and explain the task.
- Probe the students’ understandings of air pressure and the behaviour of gases through a brainstorming session. This should take about 10 minutes.
- Now explain that the students will need to assess the explanations for the strange incidents that occurred in the chalet from the table on the sheet and give reasons why they think the observations took place. They will also need to create their own explanations about the situation. Ask the students to get into groups of 4 or 5 and discuss each explanation together before putting their responses in the boxes on the sheet. Allow about 20 minutes for the group task.
- Finally conduct a plenary of the results from the groups. Conduct a class discussion at the end and ask who would like to argue against other people’s explanations.

Activity 1: Halloween Crush!
Student exercise

Scenario
It was an unusually cold Halloween day. It was freezing and snow covered the mountains. A few teenagers had rented a chalet in the mountains to have a Halloween party. Because of the heavy snowstorm, they were stuck in the chalet. The teenagers did not care much about this unusual snowstorm because they had brought a lot of food and drinks with them. They started to prepare a big Halloween supper for themselves but after a while they realized that they had not brought any oil or butter with them. Because the chalet had not been used for a long time, there was little in the kitchen. After searching the chalet for a long time, they found one empty olive oilcan in the kitchen. They were upset and stopped preparing supper, eating just cold snacks and sandwiches in front of the fireplace. While they were telling each other horror stories, there was only Jane in the kitchen. Suddenly they heard Jane scream in the kitchen. The teenagers ran to the kitchen where they found Jane to be really scared. But a few seconds later when she saw her friends’ fright, she burst into laughter and she cheerfully started to explain what happened. She said she realized there was some frozen olive oil at the bottom of the can, and in order to get rid of this frozen oil, she started to heat the can on the stove. However a few minutes later, because the lid of the can abruptly burst with a loud noise she got frightened and screamed. Another teenager, Eddie, held the oilcan with a piece of cloth and removed it from the stove. He attentively put the lid on the can and left it in the kitchen. After five minutes, while all the teenagers were in front of the fireplace continuing to tell horror stories, they heard some weird noises from the kitchen. But now, there was nobody in the kitchen. They got scared! At last when they plucked up the courage to go to the kitchen, they saw that there was nobody there, but the oilcan had crushed noisily by itself. Now they were really frightened and hugged each other in desperation. Sebastian tried to call them by saying that he knew what had happened! He remembered his chemistry lessons and he explained what had happened in the kitchen by using his chemistry knowledge.
Activity 1: Halloween Crush!  
Student exercise

In the table that follows, some explanations are given. Decide which of the explanations Sebastian could have used to explain the lid was thrown off, and rank each explanation with points: 0 for not relevant; 1 slightly relevant; 2 definitely related to the explanation. If you are not sure or do not have an idea, please put down N/A for “no idea”.

<table>
<thead>
<tr>
<th>The reason of bursting of the lid was...</th>
<th>Credit</th>
<th>Our explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>increasing inside pressure of the can</td>
<td></td>
<td></td>
</tr>
<tr>
<td>increasing volume of the gas molecules in the can</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increasing speed of gas molecules in the can</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increasing impact of gas molecules on the can</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hot air rises</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the inequality of the pressure inside the can and the air pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the expansion of the can by heating</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Our explanation about the reason for why the lid burst

Below are some explanations about why the oil can crashes by itself. Decide which of the explanations Sebastian could use and rank your choice from 1 (most relevant) to 0 (least relevant).

<table>
<thead>
<tr>
<th>Ollcan crushed because of...</th>
<th>Rank</th>
<th>Our Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>the power of air pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>no gas molecules inside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the number of gas molecules inside decreases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the volume of gas molecules inside decreases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the speed of gas molecules inside decreases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the volume of the can decreases</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Our explanation about the reason for why the oil can crashes by itself

Below is a figure that shows the condition of the can when teenagers first found it in the kitchen.

Consider Figure 1 and draw the final crushed ollcan.

Now, take a look at Figure 1 again. Draw what would have happened if Eddie had not closed the lid of the ollcan after he removed it from the stove.
Sound Travels

- Through Solids
- Through Liquids
- Through Gases

Michael is sitting in a boat in the ocean. The boat has a metal hull. He is hammering the bottom of the boat.

Will Nicola or Naseem hear the sound of the hammering first? Or will they hear it at the same time?

Use the evidence on Handout 4.8 to make your case.
Don’t put the coat on the snowman. It will melt him.

I don’t think the coat will make any difference.

It will keep him cold and stop him melting.

©Brenda Keogh & Stuart Naylor
Potatoes to the rescue?

Scenario:
When Martin was making a beef stew, the phone rang and he went to answer it. Meanwhile, Amy who didn’t know that Martin had already put some salt in the stew put some more. When Martin came back, he tasted the stew and found out that it tasted horrible and so salty! He had an idea that he could put some potatoes to absorb the excess salt. Amy however disagreed that adding potatoes to the stew would make any difference. What do you think?
Pedagogical approaches

- One way of approaching this problem is to explain to the students why adding potatoes to a stew does not make any difference to the salt concentration. i.e. teacher explains the reasoning.

- Another way is to get the students to reach the conclusions themselves by using information to discuss and evaluate ideas/evidence.
Claim 1: Adding potatoes to a salty stew helps absorb the extra salt (Martin’s claim)

Claim 2: Adding potatoes to a salty stew makes no difference in absorbing the extra salt (Amy’s claim)

Claim 3: Adding potatoes to a salty stew actually makes it more salty (Potential other claim)
<table>
<thead>
<tr>
<th>Evidence Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>A potato absorbs any liquid like a sponge absorbs water.</td>
</tr>
<tr>
<td>The concentration of salt in the potato is lower than in the liquid of the stew.</td>
</tr>
<tr>
<td>Potatoes contain salt.</td>
</tr>
</tbody>
</table>
TOULMIN’S ARGUMENT PATTERN

DATA

QUALIFIER

CLAIM

WARRANT

REBUTTAL

BACKING

(Toulmin, 1958)
In so far as salt concentration is concerned...

Adding potatoes to a salty stew will absorb some liquid but will not make it any less salty.

The liquid left behind in the stew is no less salty than before.

Salt concentration in the stew is constant across different parts of the stew.

Concepts of concentration, osmosis etc. (i.e. theoretical statements to back up processes)

Unless there are personal preferences that make potatoes perceptually appealing and appear to assist in the reduction of salty taste.
Argumentation in Science Teacher Education

• Relatively understudied aspect of argumentation studies in science education

• Mainly contextualised relative to other agendas such as learning to teach higher-order thinking skills and critical thinking skills (Zohar, 2008)

• Examples of professional development projects in argumentation in communities of science teachers (Ozdem, Cakiroglu, Ertepinar & Erduran, in press; Simon & Maloney, 2006; Zembal-Saul et al, 2002; 2009)
Supovitz and Turner (2000, p. 964) identify as critical to high-quality professional development the following conditions:

- immerse participants in inquiry, questioning and experimentation;
- be intensive and sustained;
- engage teachers in concrete teaching tasks and be based on teachers’ experiences with students;
- focus on subject-matter knowledge and deepen teachers’ content skills;
- be grounded in a common set of professional development standards and show teachers how to connect their work to specific standards; and
- be connected to other aspects of school change.
Principles of Continuous Professional Development

- **Distributed expertise and peer-mentoring** provide the structure and support for teachers to learn with and from each other – can be a team of teachers from different stages in their careers.

- **Teachers as researchers** situate teachers at the centre of their own learning, investigating problems and devising solutions to their teaching and learning needs – teachers identified their own issues and the means to address them.

- **Reflective enquiries into teaching** promote learning based on concrete examples of teaching and meta-cognitive awareness of own pedagogical content knowledge – teacher reflectivity enhanced by the use of video and peer feedback.

- **Collaborative planning, teaching and reflection** facilitates teachers’ learning through communication and sharing of the knowledge and skills required of teaching – a team of teachers was set up and given time resources to share knowledge and work collaboratively.

- **Evidence-based teaching** engages teachers in the modes of thinking and acting that promote understanding of syntactic knowledge of science, and provide rationale for decisions about teaching and learning – the university-school partnership provided instruments for gathering evidence and a forum for developing such evidence-based thinking.
Teacher Knowledge

- Subject matter knowledge
  - Substantive knowledge (explanatory structures and paradigms of the field)
  - Syntactic knowledge (procedures and methods through which new knowledge is created in the field)
  - Content knowledge (facts and concepts)
- Pedagogical content knowledge
  - Blend of pedagogical knowledge and subject matter knowledge specific to teaching topic

(Lee Shulman, 1986)
Meta-Knowledge

- **Meta-strategic knowledge (MSK)**
  - Metal-level knowledge of thinking skills
  - General knowledge about cognitive structures being manipulated

- **Epistemological meta-knowing (EMK)**
  - Way individuals conceptualise knowledge and knowing

(Zohar et al., 2009)
Modelling Argumentation Practices

- Identifying a problem to investigate
  - Negotiating and justifying choice of topic, pupils etc.
- Gathering and evaluating data
  - School-based work including peer video-taping and pair conversations on data
- Selecting and justifying evidence
  - Group selection of video and resource data
- Communicating knowledge
  - Workshop presentations to peers; conference presentation by team
Data Gathering and Interpretation: Counter-claim & appeal to data

- T1: You know it’s... It didn’t flow as well as I hoped it would. The barriers to talking seemed to still be there.
- T2: Uhm, I don’t, I don’t know whether I agree coz having gone around and spoken to them, uhm, on an individual group by group basis...
- T1: Yeah.
- T2: ...each group was very happy to tell me on camera...
- T1: Yes.
- T2:... what they were doing and who was doing what and their strengths and all that kind of thing within the group, so they obviously had it worked out.
Identifying a Problem to Investigate

T1: We’ve had a theme, a goal. We knew what we were striving for and I think that’s very important for your professional development. If you know what the end product, the objective is, much like the kids really, then you can drive yourself to the end. I often feel with professional development days, sessions, it’s very waffly and you have no idea. You feel, that wasn’t personalised for me. I think what this project has done is it made it personal for each one of us.

T2: That comes from the fact that we chose what we were going to do. In terms of a brief, it was a very open brief. To be honest, we were a bit like...right! What do we do now? Then we sort of discussed what classes we shared together. We asked what do we do together? So that was the initial collaboration to begin with.

T1: What concerns do we have.

T2: What problems do we have? We discussed our classes and suddenly it started fitting in together because we came up with it not, because we were prescribed with something to do.
Selecting and Justifying Evidence: 
**Pedagogical goals and outcomes**

- T4: At least it shows how they use, that, that we did get them to use ICT eh?
- T2: Yeah, I think, it’s fine to show that they are using IT...
- T3: Right, let’s get the clip with Sam
- T4: ...coz we did say about that didn’t we?
- T3: ...sort of looking at...
“It has kind of opened up our eyes to the fact that professional development obviously isn’t just going out on a course. Like professional development is something that you can do for yourself if you’re given the time. So for example, you know for us we feel our professional development has stemmed from us working together and pulling ideas from each other and exploiting if you like everybody’s strong points.”
Scaling up
www.apisa.co.uk

- 25 institutions across Europe, funded by EU
- Teachers leading professional development workshops
Questions Raised

- How do we map knowledge the physical, chemical and biological components of food from the theoretical domain of the discipline of food science to the everyday experience of food?
  - Big gap between the macro and micro level claims!
  - Transformation of everyday experience of food to the perspective of ‘science’ of food?
  - What are the trajectories of this transformation in learning?

- How are claims about food components and chemistry be justified given foods are complex systems?
Merging Food Science with Argumentation

- Not another case of authoritative delivery of facts and the cookbook problem!

- History of food science cannot be recreated at the level of the classroom but students can be encouraged to use data to reach conclusions themselves.

- Design of activities to structure problems/issues in a way to support argumentation to take place
  - e.g. Predict-Observe-Explain (e.g. peach sorbet or scrambled eggs activities from yesterday)
    - opportunity to argue about consistency between predictions vs observations
  - Being mindful of verification vs construction of claims

- Use of other pedagogical strategies such as questioning and presentations to support argumentation
Journal of Visualized Experiments (JoVE)

a peer reviewed publication indexed in PubMed.

Devoted to the publication of biological, medical, chemical and physical research in a video format.

(http://www.jove.com/)
“Visualization greatly facilitates the understanding and efficient reproduction of both basic and complex experimental techniques, thereby addressing two of the biggest challenges faced by today's life science research community: i) low transparency and poor reproducibility of biological experiments and ii) time and labor-intensive nature of learning new experimental techniques.”
Discussion

- Debunking myths about food processes on the basis of evidence and justifications
- Support for teachers and learners to engage in the construction, evaluation and application of evidence
- Design of learning environments and professional development opportunities to develop resources and programmes to promote and support evidence-based reasoning
Food Science & Argumentation?

- Shaken, not stirred!