

TEACHING ENQUIRY
with MYSTERIES INCORPORATED



The TEMIfication of science teaching

**Peter E. Childs, Sarah Hayes, Orla McCormack &
Laurie Ryan**
University of Limerick, Limerick, Ireland



National Centre for STEM Education



UNIVERSITY of LIMERICK
OLLSCOIL LUIMNIGH



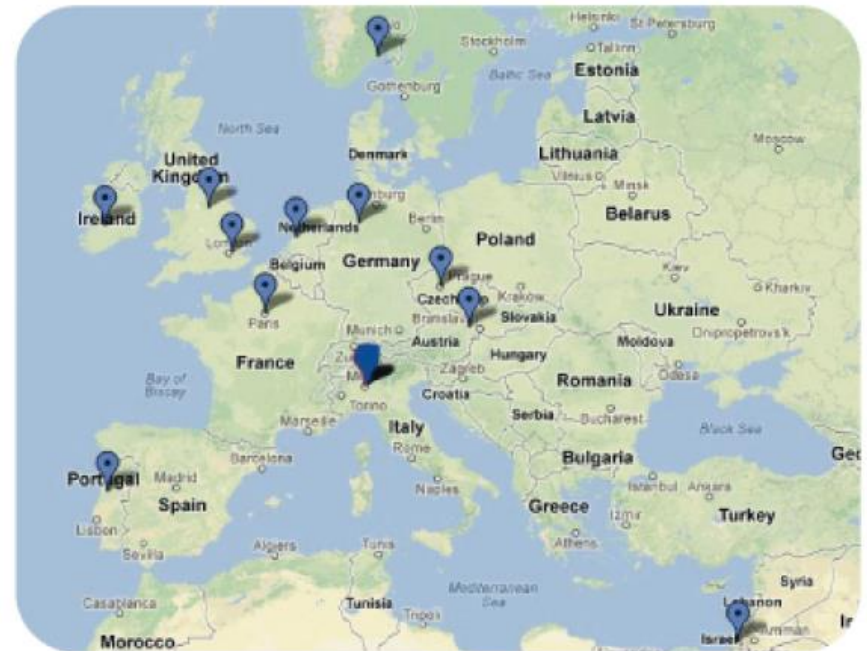
Co-funded by
the Seventh Framework Programme
of the European Union

SMEC Conference, Dublin 16-17 June 2016
FP7-Science-in-Society-2012-1, Grant Agreement N. 321403



What is TEMI?

- Teaching Enquiry with Mysteries Incorporated
- Funded by the FP7 programme 2013-2016
- 12 European partners
- Professional Development Workshops





TEMI Goals

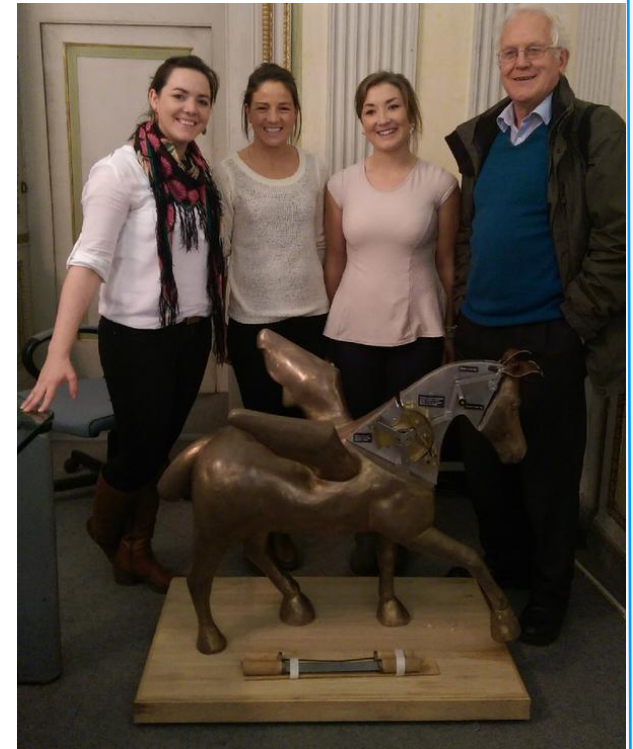
- Improving Science and Maths teaching across Europe through teachers' CPD.
- Focus on pupil enquiry as a driving force for learning.
- Teaching is organised around mysteries and questions in a highly pupil-centred enquiry process.

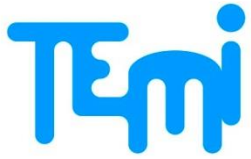
www.teachingmysteries.eu



The UL TEMI Team

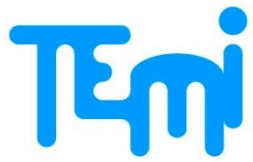
- Joanne Broggy
- Peter Childs (Team leader)
- Sarah Hayes
- Beulah McManus
- Orla McCormack
- Anne O'Dwyer
- Laurie Ryan





4 TEMI innovations

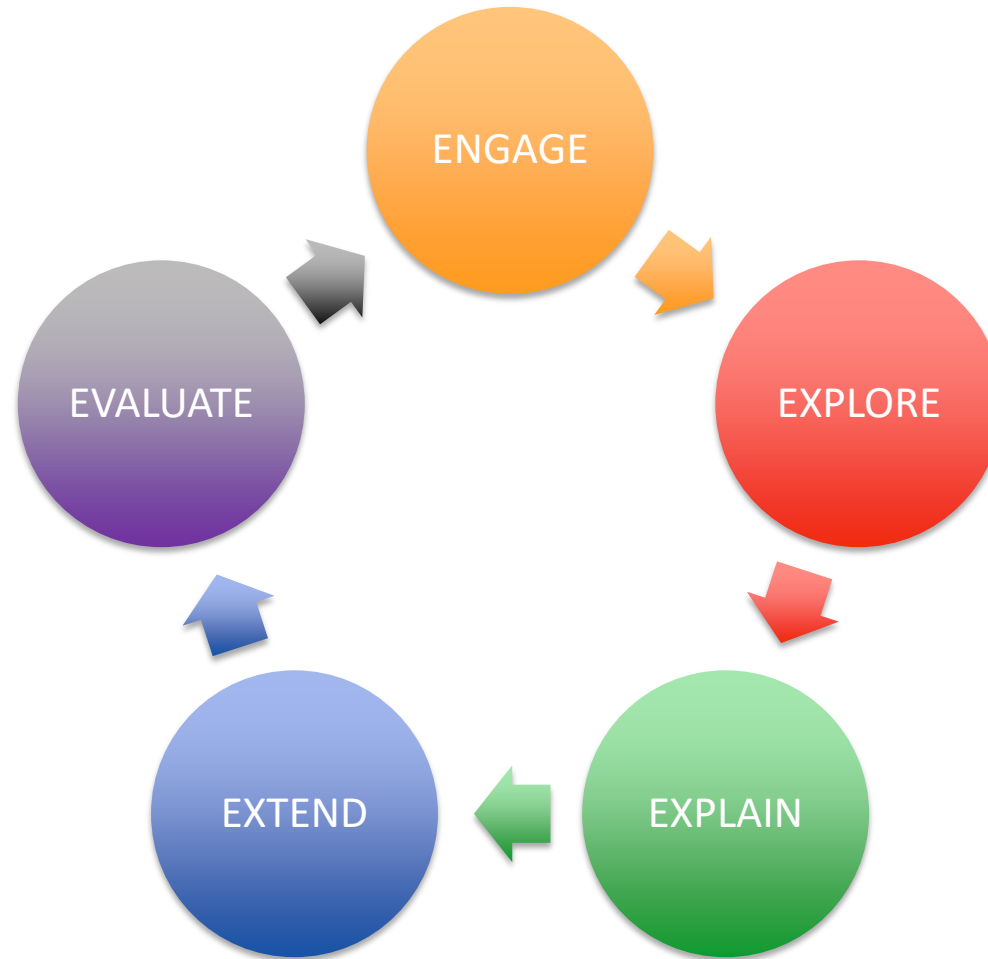
1. The use of mysteries to engage students.
2. The use of the 5E model to structure inquiry in the classroom.
3. The use of showmanship to enhance and sustain engagement.
4. The use of the Gradual Release of Responsibility (GRR) model to

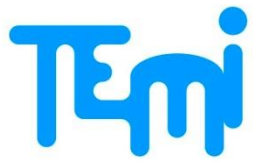


TEMification of science teaching

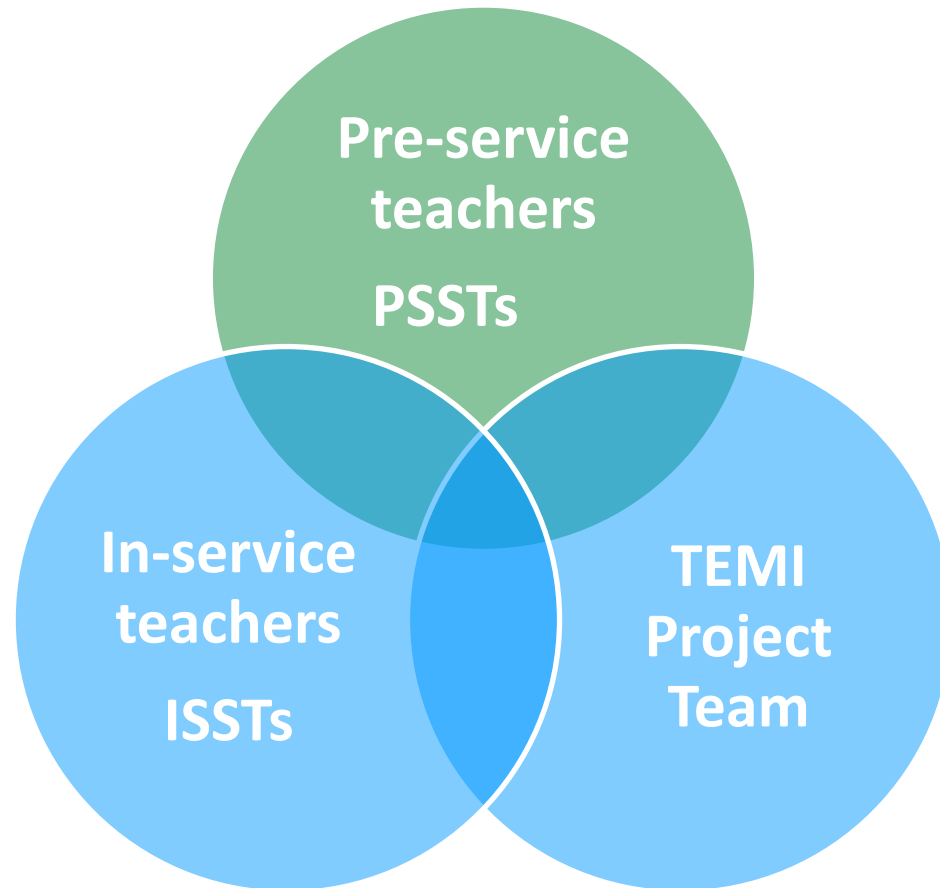
- TEMification: introducing inquiry into science teaching & learning through the use of mysteries or discrepant events.

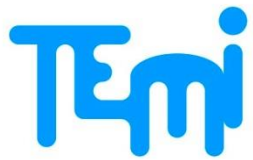
5 E Model of Enquiry





A Professional Learning Community





Community of Practice



The screenshot displays the TEMI (Ireland) Facebook page. The header includes the TEMI logo, a notification bell, and a settings gear. Below the header, there's a section for sharing updates with options for Text, Photos, Link, Video, and Event. The main content area shows a discussion thread. The first post is by David Kett, dated April 5, 2014, sharing a Google Drive link to a TES magazine article. The second post is by Clare Carroll, dated April 3, 2014, sharing another Google Drive link. The third post is by Anne O Dwyer, dated April 3, 2014, replying to Clare Carroll. The right sidebar features a 'Spread the word' section with buttons to 'Invite people' and 'Share this community'. Below this, there are more posts from Beulah McManus and Brigid Corrigan, both dated April 4, 2014. The left sidebar shows the community's profile, including the number of members (13), a search bar, and a list of posts and events.

TEMI (Ireland)

Notifications on

Share what's new...

Text Photos Link Video Event

David Kett
Discussion - Apr 5, 2014

<https://drive.google.com/file/d/0BzWAXe87kWfhTG1Oek53ckdoaJg/edit?usp=sharing>

+1 Add a comment...

Clare Carroll
Discussion - Apr 3, 2014

<https://drive.google.com/file/d/0BzWAXe87kWfhTG1Oek53ckdoaJg/edit?usp=sharing>

+1

Anne O Dwyer OWNER
Apr 3, 2014

Hi Clare,
Thanks for posting these. This one looks very interesting. Is this the demo that you intend on showing on Saturday?

Read more

Add a comment...

Spread the word

Invite people Share this community

Beulah McManus
Discussion - 8:30 AM

#UK

Here is an article written in TES magazine (a weekly UK publication aimed primarily at school teachers in the UK) that Peter found and which is v. relevant to TEMI

<http://www.tes.co.uk/article.aspx?storyCode=6422702>

+1 Add a comment...

Brigid Corrigan
Discussion - Apr 4, 2014

Done and done!

<https://drive.google.com/file/d/0Byf4YWSDi9n4cjFxMy1xQTk1aUE/edit?usp=sharing>

TEMI Lesson Idea-KMnO4 Iron Wool - Copy.docx

<https://drive.google.com/file/d/0Byf4YWSDi9n4cjFxMy1xQTk1aUE/edit?usp=sharing>

+1 Add a comment...

Clare Carroll
Discussion - Apr 3, 2014

Members (13) See all

All posts

Events

Search community

Co-funded by the Seventh Framework Programme of the European Union

TEMI Lesson Ideas

Title: The blue bottle

Short abstract: A stoppered bottle, one-third full of liquid is shaken. It turns blue and on standing the blue colour slowly disappears. The more it is shaken, the stronger the blue colour and the longer it takes to disappear.

Domain(s): Chemistry

Content: Changes in colour usually indicate a chemical reaction has occurred. Redox chemistry; solubility of gases in liquid; reactions between gas and liquid;

Grade level: Grades 10 upwards

Expected time: Single period

Group size: Whole class, in groups of 2/3.

Safety/supervised: Supervision is needed and safety glasses. Care should be taken that the flasks are properly stoppered. The contents can be disposed of safely by mixing with a large quantity of water and flushing away. Care should be taken not to get the strongly alkaline solution on the skin or in the eyes.

Costs: Low. Needs ~5g NaOH and ~5g glucose plus small amount of methylene blue solution per bottle.


Location:

Language(s): English

Enquiry mode(s): Best done in a laboratory as that wastes can be disposed of.

Enquiry scenario and pedagogies: Allow for 4 types of enquiry:
 a. Open ended enquiry
 b. Guided enquiry
 c. Structured enquiry

Engage: Describe the textbook and pedagogical approach towards the enquiry and if possible give an example for a video. Give an example of a question:
 • Why does the stoppered bottle turn blue when shaken?
 • Why is the blue colour stronger the more it is shaken and takes longer to disappear?
 • What is going on?
 • How could you test your idea?
 http://www.youtube.com/watch?v=a_4LUaaL6FU



Explore: Describe the practical work related to the mystery. What happens if tap water is added to the bottle? What happens if the bottle is filled to the top with water and then shaken when it is colourless?

Explain: Give a short summary explanation of the mystery.
 • An alkaline solution of glucose is a reducing agent and reduces methylene blue from a blue to its colourless form.
 • Shaking the solution causes oxygen to dissolve and this oxidises the methylene blue back to blue.
 • When the dissolved oxygen has been used up, the methylene blue is slowly reduced back to its colourless form by the remaining glucose.
 • The cycle can be repeated many times by further shaking.
 • When tap water is added it turns blue due to dissolved oxygen in the water.
 • If filled to the top with water, and left to go colourless it does not turn blue on shaking because there is no air (oxygen) left.

Extend: Describe the connection with other ideas from within the school curriculum and beyond.
 Connects to redox chemistry, chemical kinetics (rate of decolourisation), dissolved oxygen in water.

Evaluation: Describe the pedagogy how the learning objectives will be assessed and how teacher may verify they are using the TEMI activity well.
 Richness of the student discussion and possible answers they come up with. Recognition that the production of the blue colour and its disappearance indicates a chemical reaction. The amount of reaction is linked to the amount of shaking. Design of suitable experiments to test their hypotheses. Plausible explanation even if they do not know the chemicals involved.

Learning objectives: Identify the type of process involved. Suggest a reason why shaking produces a colour, whereas a resting solution produces a colour. Suggest a possible chemical explanation for the observations. Explain what happens when water is added. Design and try out an experiment to test your explanation. Refine the chemical explanation of the phenomena. Observation, engagement in scientific questions. Using prior knowledge of chemistry. Formulating explanations from evidence. Designing and carrying out experiments to test hypotheses. Communicating and

Background information: Give references to journals or book articles related to the activity, e.g. a description of the reaction.

Comments: Add any further comments.

Source: <http://www.science/temi-chemistry/temi-lesson-ideas/the-blue-bottle-chemistry>

License: <http://www.creativecommons.org/licenses/by/4.0/>

Author's name: Peter E. Childs

Author's affiliation: University of Limerick

Country: Ireland

Email address: Peter.childs@ul.ie

Additional information: This activity can be set up very quickly (in ~5 minutes) and will last long enough for single or double period. A 500 cm³ flask should be half filled with water and the NaOH added should be half filled with water dissolved and the glucose added. When a drop of methylene blue solution is added, add a blue colour (do not add too much). Stopper the bottle and allow the blue colour to disappear. The blue bottle is now primed for use. The chemical literature and author



Shared Resources



TEMI Lesson Resources		
My Drive ▸ TEMI (Teacher Community) ▸ TEMI Lesson Resources		
<input type="checkbox"/>	TITLE	OWNER
<input type="checkbox"/> ☆	🚩 Chemistry -Additional resources Shared	me
<input type="checkbox"/> ☆	🚩 Physics Additional resources Shared	me
<input type="checkbox"/> ☆	🚩 Biology Additional resources Shared	me
<input type="checkbox"/> ☆	🚩 Physics Lesson Ideas Shared	me
<input type="checkbox"/> ☆	🚩 Chemistry- Lesson Ideas Shared	me
<input type="checkbox"/> ☆	🚩 Biology-Lesson Ideas Shared	me
<input type="checkbox"/> ☆	🚩 TY Resources Shared	me

What is a ‘mystery’?

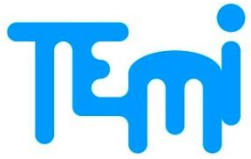
A mystery is a phenomenon or event that provokes the perception of suspense and wonder in the learner to initiate an emotionally-laden “want to know”-feeling, which leads to an increase in curiosity and which initiates the posing of questions to be answered by inquiry and problem-solving activities.



The amazing blue bottle

- Why does the bottle turn blue when shaken, and then goes colourless again?





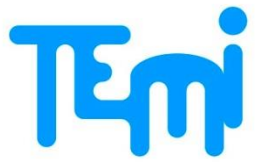
Turning the lesson around

A mystery doesn't need to be new or novel – except to the students.

Starting a lesson/topic with a well-known demonstration can be used to engage the students and provide a 'hook' for learning and inquiry.

Use the demo as a mystery to initiate the inquiry, not to illustrate what you've already taught.

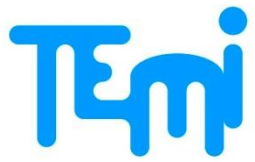
Provoke questions rather than giving answers at the start!



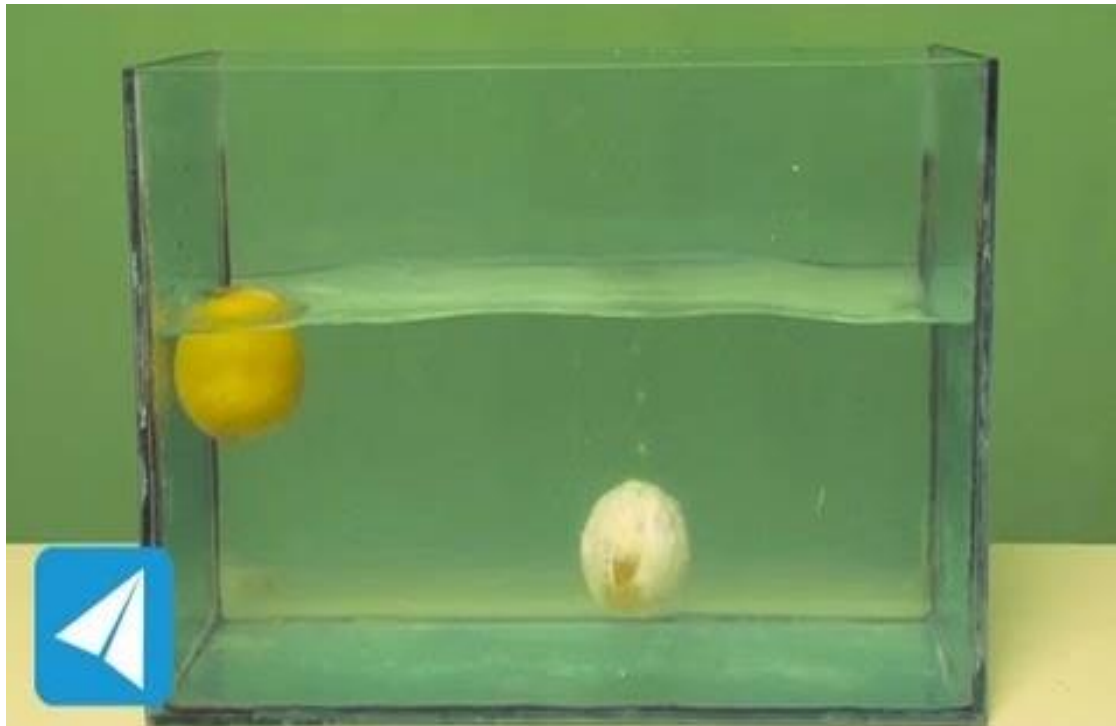
Density: the 2 coke cans

Why does one float and the other sink?



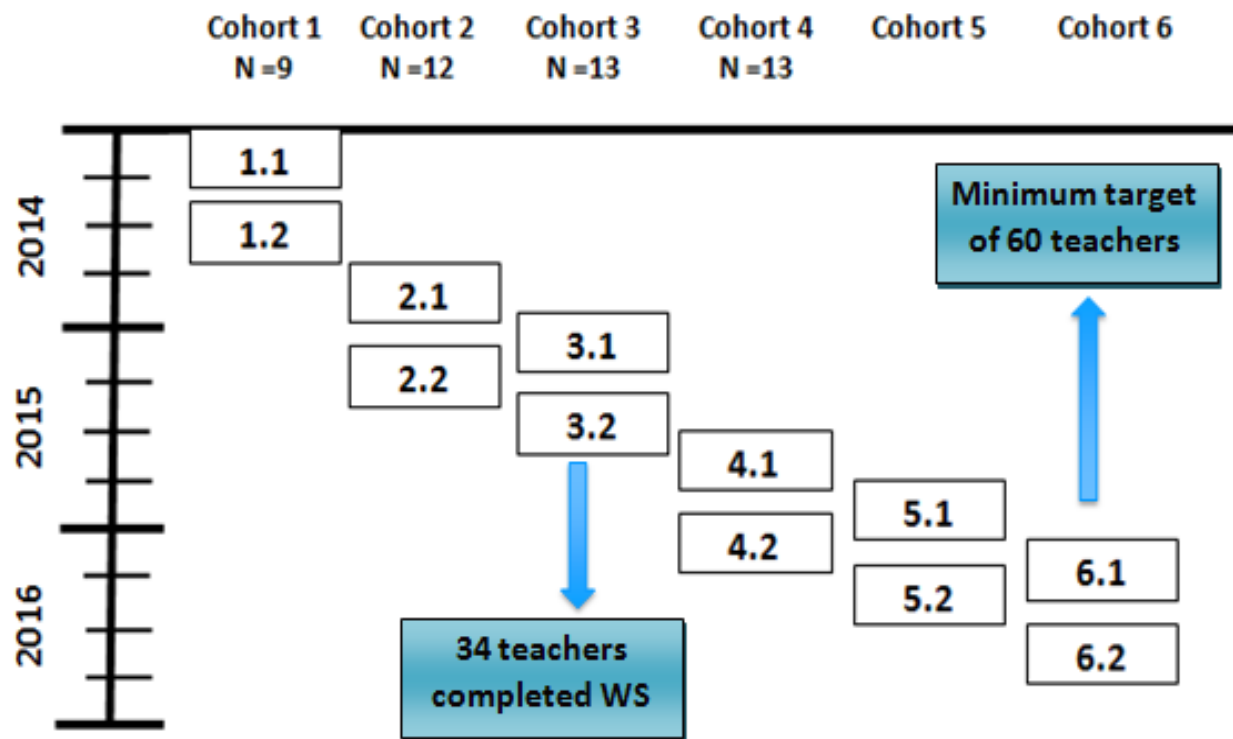


Floating and sinking – why?





Teacher Training CPD programme





TEMI CPD workshops

Workshop 1: introduction to TEMI and 5E model; developing TEMI lessons

In school: try out 5 TEMI lessons from the bank and develop 2 lessons





Numbers of teachers

In the TEMI workshops (2 x 6 hrs):

53 ISSTs and 11 PSSTs

64

In the 'taster' workshops:

ISSTs: 188

PSSTs: 40

Primary teachers: 5

233

Total project: 924 teachers

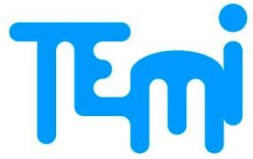


Response of teachers

Very positive response from teachers to the idea of using mysteries to engage students in inquiry and turning the lessons around.

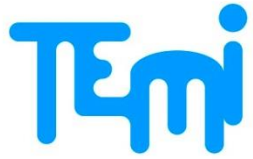
But:

- Lack of familiarity with inquiry
- Lack of time and resources to implement inquiry
- Pressure to cover the syllabus and prepare for external examinations



One teacher's view

“TEMI helped me to understand the significance of 'engaging students first' to enable a richer learning experience. This was evident from the level of participation and vibrant conversations that took place when I used an engaging activity to introduce a topic,” (BC)



Involvement of PSSTs

11 PSSTs were involved in the project in developing, trialling and evaluating TEMI lessons on their school placement as part of their Final Year projects (FYP).

They produced 40 TEMI lessons and 3 x 8 week TY modules.

They worked with ISSTs in workshops and in the online forum

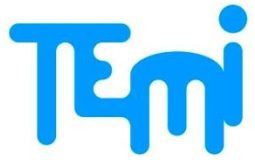


Some feedback from the students

Student #1 (MG)

From my co-operating teachers during school placement I learned that they don't see the value in inquiry based approaches to science. In their views it takes too much time and doesn't produce significantly greater results than the approaches that they already use. They also felt that students would take the subject less seriously than other subjects if IBL approaches were used as it would reduce the value that was placed on the subject.

I think what I've learned through my FYP and the TEMI project applies to my whole future career as a teacher. It has shown me the benefit of engaging students in lessons; it makes them easier to teach and after introduction, it requires less work on the teachers part, as the students work independently and the teacher facilitates this rather than guiding the students. Also by using mysteries that relate to the everyday lives of the students it shows them how relevant science is to their lives and makes the subject more relatable for them.

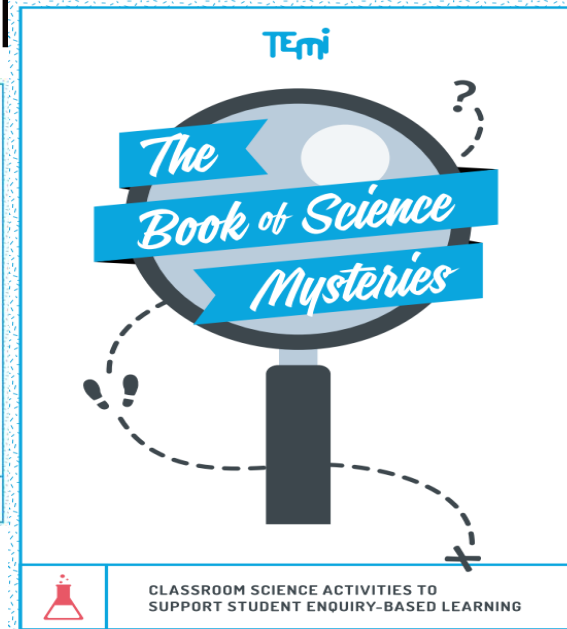
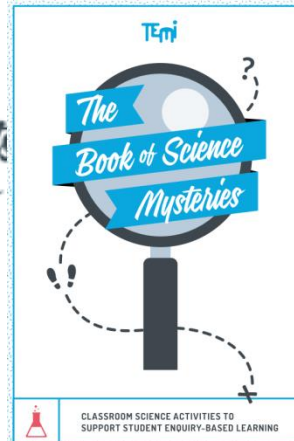


Output from the project

In l
oth
A b
be
Tea
Book of Mysteries

of TEMI

d
os.
will

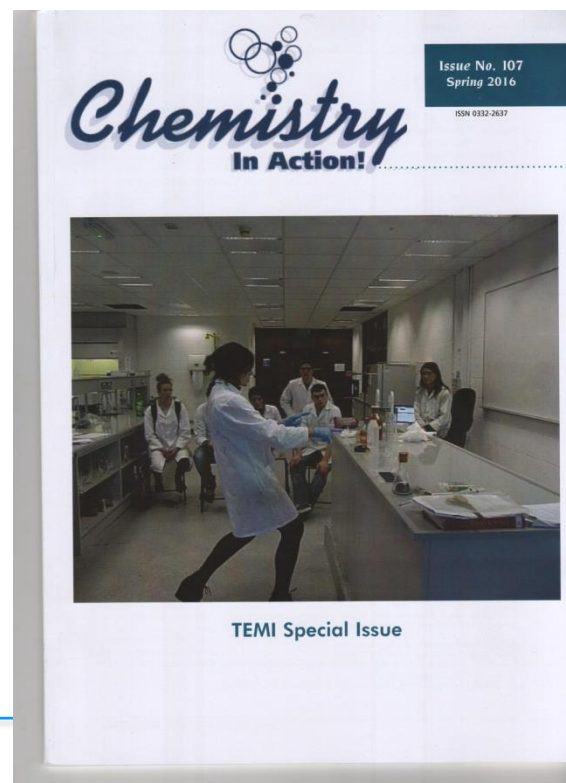


www.teachingmysteries.eu



Special issue of CinA!

Issue #107 *Chemistry in Action!* sent to 650 Irish teachers and 550 to TEMI partners.





Future plans in Ireland

- TEMI focus in the 10th Chemistry Demonstration Workshop (27 June -1 July) –contact sarah.hayes@ul.ie
- TEMI workshops for ISTA branches 2016-17
- TEMI ideas in *Chemistry in Action!*
- Workshops for PSSTs in UL



Acknowledgements

- **The ISSTs involved in the project – the TEMI teachers**
- **The PSSTs**
- **The TEMI partners**

The TEMI project is funded by the European Union in the FP7-programme under grant agreement no. 321403.

Any questions?

