# Where is University of Queensland AFFA Activity at in August 2012?
# Project Summary and a Reflection on the AFFA Initiative

Margaret Wegener, Tim McIntyre University of Queensland

Context statement from the Fellow: In this experiment students studied the effect of materials on the temperature within a "house" placed on the roof of a UQ building.

## Project Summary August, 2012

The "House" experiment was implemented in PHYS1171 in the later part of Semester I.
Temperature measurements were streamed live so students could see the progress of their house via web links.

### Who you have trialed your activity on and any assessment you have made of the outcomes

All students enrolled in PHYS1171: The Physical Basis of Biological Systems in Semester I (170 students).

Academics visited labs at intervals to observe; also supervised and interacted with students when setting up experiments on rooftop. Informal reports from tutors also helped with assessment of outcomes. Used surveys (provided by AFFA) designed for tutors and support staff – amended - to get structured feedback from them. Course survey at end of semester gave chance for students to comment.

### Assessment of outcomes at range of levels:

#### *Practicalities*

**Experimental setup** – one or two refinements thought necessary (eg: silicon gloves for handling); acquiring more thermal conductivity measuring kits.
**Timing of activity** – OK - Some students in Session I and II finished their work in lab at about 4 pm; almost all students finished by 5 without problem, when lab officially closed.
**Group management** – OK –with effort by teaching staff (students and equipment within lab; students and apparatus moving between lab and rooftop).
**Remote access to data** – works reliably. Issue when person unknown closed down software that was running data collection.
**Solution** – sufficient capability and flexibility to re-run experiment; greater security (less access) to computers being used for experiment.
**Handing in of reports** - Few issues with mechanics of this (students unused to this, as previously handed in reports at lab sessions)

#### *Student attitudes to activity*

Students really quite engaged; confident in reasons for making design choices based on physics of heat transfer; interested in monitoring progress of their experiments remotely.

Semi-realism was very successful in engaging students. They were entertained by the idea of their structure, for example, some said they were going to build a "metal shed"; someone's report was labeled "The Hotbox".
One group was sufficiently motivated to bring in their own materials to use on their structure.

#### *Student learning*

**For Session I** – Most students got reasonable experimental values of thermal conductivities of materials. The most problematic thing for students was subtraction of the ambient rate of ice melting. There was quite a lot of variation between the structures that students built (some prompted by staff because variation is useful for group as a whole). Students were restrained by staff to using one material so it would be simpler to analyse – most students did not consider this as an issue. For the 3 experiments with temperature probes (which was partly a familiarisation exercise), there was not a lot of variation in what students came up with, but there was some – e.g.: measuring temperature near incandescent light. In future maybe push the students more by asking them to do 3 experiments but only making suggestions for 2 of them, or asking them to do experiments that cover the 3 different heat transfer mechanisms.

**For the Progress Reports** – tutors' comments were that the standard was fine in general. Marks ranged from 6.5-10 out of 10.

**For Session II** – A fairly wide variety of designs were used by students. The strategy of telling students that they had to design to achieve their own particular aims worked here. These aims were as diverse as building a greenhouse; minimising temperature variations; making as hot /cold as possible. Most aimed to make a house comfortable for humans. Regarding the strategies students used in building their structures, some were as expected; some more complex / original. Examples:

- House built of double layer walls with air gap, roof with insulation layer;
- Gable/skillion roof to create large air mass on top of structure;
- Clear Perspex wall oriented to afternoon sun.
- A few design choices were a bit questionable.
- Use by students of material of low thermal conductivity, and significant thickness, was informed by what they knew of theory, and their measurements of conductivity. They were able to apply the physics, eg: using triple layer of one material. Decisions made regarding orientation on the block, and choice of wall surfaces, eg: white and black walls to manage reflection and absorption of sunlight, showed some understanding of the relevant theory. Some final designs were informed by the experiment with a simple structure done in Session I, e.g.: findings that clear Perspex traps heat. With some students, thinking about the optimum orientation of their structure prompted discussion of seasonal variations in the path of the sun through the sky, so some more physics was learned.
- Students spontaneously identified from other students' structures what their design aims had been (ie: they successfully interpreted the physics).

**For the Final Reports** – marks ranged from 3 (incomplete submission) upwards, with multiple full marks of 10.

### Who you have involved during the development of the activity

- The two academics involved in teaching the course largely developed the activity. As reference, we used materials developed by others for similar activities.
- Solar PV array researchers in our university ensured that weather and solar irradiance data were available for our students.
- The project directly involved the school's Teaching Laboratory Manager and Physics Workshop in creating items for the experimental setup (particularly designing modular structures with various design choices possible). Teaching Lab Manager was also involved in sourcing instrumentation, and created required Occupational Health and Safety documentation. IT support staff were involved in setting up remote access to data.
- On implementation, the tutors associated with the laboratory component of the PHYS1171 course were involved with development of the activity. The first two tutors to take the lab did so with preparation based on familiarisation with the lab documentation (lab manual for students + tutor's notes) and the experimental apparatus. After this the whole group of tutors involved in the PHYS1171 labs also spent considerable time with the experiment (apparatus and theory) before the next sessions ran. This discussion, including the experiences of the first two tutors, was very valuable in thoroughly preparing the tutors, and some refinements were made to how students were directed in the lab, and in the marking scheme.

### Any dissemination plans you have

- I've taken photos of students' experiments, including varied setups outside on the roof of the Physics building, for use in dissemination.
- As we said in our original application, the results of this project will be disseminated to the Physics Education Group that meets on a regular basis within UQ Physics – will happen at next meeting.
- We could consider expanding this experiment for use in our core physics course that includes a module on thermodynamics (PHYS1001).
- The implemented experiment has been discussed with Hans Bachor from ANU (who was responsible for an experiment that inspired us) while he was visiting UQ.
- Our university runs a Teaching and Learning Week each year and we would seek to present results of our study at this symposium.

- We could invite academics within UQ up onto the roof to see the experiment in action. These could include Solar PV array researchers, and staff from Architecture.
- Wider publication will be considered where possible. With a little further development, we think we will have something worthwhile to present at ACSME next year, and at the AIP Congress Education sessions after that.
- Could imagine an article for the university newsletter, or wider distribution, based on similarity to "The Block" TV show – need to discuss with Marketing.

### What you are going to do next

In Semester II we will again run this experiment for students enrolled in PHYS1171 (Biomed students in this semester will do a different extended experiment, tailored to their interests).

At the end of last semester, after tutors had marked students' Final Reports, they were asked to bring to our attention typical and exemplary or interesting work. This warrants examination before revising materials for this semester.

We'll employ a tutor to do rooftop duties (rather than an academic doing this every session). Update tutor material with instructions for rooftop duties and how to operate data collecting software.

Extend prac to context of animal (with the aim of implementation next year). This development can possibly be done with assistance of undergraduate student(s) as a Capstone project or Summer Research Experience.

### The extent to which you are being supported internally to carry on your development work

Currently, money is easily available to buy lab equipment. Workshop time to build equipment is at a premium. Development of teaching laboratory equipment and activities is part of the job description of the Teaching Lab Manager. One of the project members has been Head of Physics since the start of the year, so internal support is pretty clear-cut!

## The AFFA initiative

We've had lots of fun working on this project. We've enjoyed developing the activity, and being involved with students doing experiments.

While we had been planning to do this experimental development in the near future, the AFFA initiative gave an extra impetus.

Knowing that we had access to an external expert was very encouraging. We used your template survey (for evaluating how well an experiment achieved particular aims) as a tool for designing the lab activity and lab manual. The idea of feedback on a draft of our written materials, before running the lab, seemed very useful, but our preparation running behind our hoped-for schedule precluded this.

The immediate possibility of external observers of the experimental activity was valued. Having you as observers on the very first occasion that the prac ran was rather daunting, however. The summary of what was discussed at the focus groups you ran was useful. For example, the information that the students would like to be able to confirm their direction and use their pre-lab work to refer to during the session changed what we do in the session – we now do some more whole-group discussion at the start. We've taken on board Les's comments about the usefulness of whole-class discussions, and now emphasise this as an important activity at the start of Session II when the students have a record of how their various initial structures responded to ambient conditions.

The network aspect of the AFFA initiative did not feel particularly active or useful.

The request for this report prompted serious thought and discussion about where to from here – something that could easily get pushed aside with the pressures of other tasks at the change between semesters. This thinking has been valuable.