B. History and Branding

ASELL started life in 2000 as APCELL where PC stood for Physical Chemistry, morphing into ACELL for all of Chemistry then maturing into ASELL for the Sciences. The project has been bedded in the tertiary sector, but it has taken tentative steps into High Schools and is now blossoming into STEM. There is now the opportunity is for re casting the name without comprising the brand. Specifically, we are proposing to evolve ASELL to stand for:

Advancing ***S***cience and ***E***ngineering through ***L***aboratory ***L***earning, with ASELL(Tertiary) and ASELL(Schools) being the two current projects.

Through each metamorphosis ASELL has learned, adapted and established itself. This current project rests on lessons learnt and seeks to setup enduring partnerships between teachers and academics around experiments; the essence of how **scientists** understand the world, how to **engineer** the science for society, and how to **educate** and engage students in this endeavour. The figure below is a schematic of a partnership between scientists, engineers and educationalists and the connection with the three themes embodied in the *Australian Curriculum: Science*: Science Understanding (S.U.), Science Inquiry Skills (S.I.) and Science as Human Endeavour (S.H.E.).

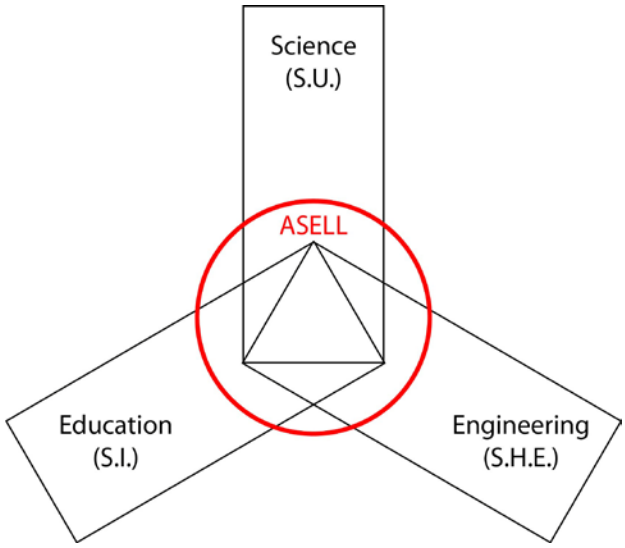

Figure 1: *Partnerships between disciplines and connection with elements of Australian Curriculum: Science*

C. The philosophy of ASELL

Figure 2 encapsulates the philosophy of ASELL and is elaborated below:

1. The inner circle is the heart of ASELL and of science; ***practicals, measurements, the use of first hand and second hand data, analysis, interpretations and applications.*** The obvious and the tacit, the tools and the processes interweave to generate knowledge and applications taking the learner and the teacher on a journey.
2. The inner circle encapsulates learning experiences, practicals that provide the mechanism for developing students' understandings of the relevant science concepts, the development of their inquiry skills and their appreciation of science as a human endeavour through argumentation and discussions. A skilful teacher using ***sound pedagogies, co-constructs ideas, develops and extends the learners*** and embeds the strands of the *Australian Curriculum: Science* and/or local state curricula.
3. The second circle captures how does the teachers know that the learners are progressing, are being enthused, excited and how to foster curiosity beyond and within the curriculum. The subtleties in integrating literacies, numeracy, and local contexts are developed through ***professional dialogues amongst teachers and with educationalists/scientists and engineers***. How does the teacher create experiences

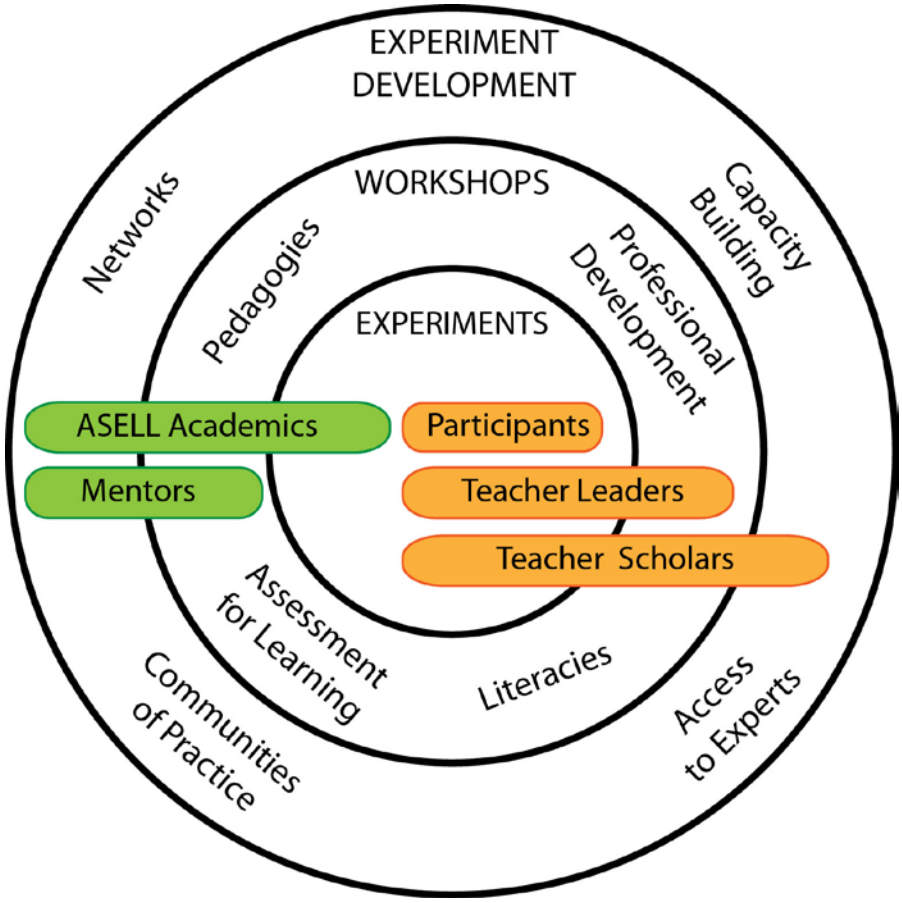

Figure 2: Teachers have a stronger personal interaction with academics the further out on the circles they are prepared to engage. In reverse, academics engagement with teachers is stronger the further in to the middle they explore. There are more teachers in the middle, and more academic on the periphery.

so that the learner knows and realises what they are learning and are able to demonstrate their understandings and competencies.

4. The second circle also embodies ***teachers taking ownership of their learning*** by sharing their practicals and collectively working on advancing their students' learning. In doing so they garner transferable skills and process –much more powerful than a set of resources. They are more nuanced and sophisticated in the classroom, influencing and developing colleagues in their schools.
5. The outer circle comprises a ***rich set of partnerships, networks and communities of practice*** amongst teachers, educationalists, scientists and engineers within states, regions and across diverse groups. At the intersection of these partnerships will be the investment in science education through discourse on practicals.
6. The outer circle crystallises the ***capacity building of teachers*** within schools by exposing them to a wide and engaged set of stakeholders. The leaders amongst the teachers will spend substantial time with educators/scientists/engineers to ensure sustained and systematic change.

Teacher participation in ASELL will be at different levels. The Teacher Leaders will interact within the two inner circles while the Teacher Scholars will interact across all three. Collectively ASELL is about empowering teachers through strategic and scaffolded interactions. If each teacher takes ownership of a small change and the changes align with the essence of science around the centrality of practicals then an evolutionary process will have started. The practicals are a mechanism for the journey with the internalised learnings as the product.

D. The ASELL Connections with ASTA

We have engaged with the Australian Science Teachers Association (ASTA), who have been funded to develop a repository of experiments, as well as develop support for technicians. ASTA has committed to partner with the ASELL bid. ASTA will provide the web portal for experiments, support for technicians, advise on the needs of the school sector and assistance in connecting with schools. ASTA will advice ASELL on areas of the Curriculum that need addressing. Finally, ASTA will promote our material as well as the opportunity to host a satellite meeting in conjunction with ASTA.

ASTA and ASELL will work closely and serve on each others advisory panels. ASELL with its educational and scientific expertise will provide a conceptual and practical framework for evaluating practicals for safety and engagement, as well as pedagogical and scientific soundness. There will be sharing of evaluation techniques all the way through to students doing practicals in classrooms. ASELL and ASTA will use the same evaluation scaffold (essentially our School version of the Education Template – see below).

ASELL adds value to the ASTA laboratory project by providing professional dialogues and networking amongst various groups – teachers with educationalists, scientists and engineers. In this way learning through scientific investigations is advanced as a collaborative endeavour building on expertise and capacity building in school science. Peer review, mentoring, and conversations will lead to understandings of standards, quality and how to serve science teaching and teachers.

E. Planned ASELL Structure

The ASELL project has both an operational and a conceptual arm. Given the geographic dispersion of the project across 5 states and territories, the operational arm will be geographically organised. A state based operation can also be sensitive to state educational and school matters and nuance strategies and process appropriate to the state. There will be state leaders, state organised meetings and the possibility of linking with state science teachers associations. The conceptual arm will focus on evaluation for cross referencing/ benchmarking across the entire enterprise, an evidence base for maintaining quality and research for maintaining currency and generating knowledge and understandings to advance the field of science education. An advisory panel will provide advice and direction.

To enable all these to happen there will be a range of activities as described below:

1. A national face-to-face meeting at the commencement of the project of all stakeholders to generate a shared understanding of the project, its challenges and opportunities, set operational targets and strategies and conceptual targets and strategies.
2. National face-to-face meetings will be held annually piggy-backed onto the CONASTA conference with a national workshop. Teachers from remote regions (equity and access groups) attending this workshop can then stay extra days and participate in CONASTA.
3. National video conference/ webinars around emergent themes will run for a month at 2 points in the year. The exact month will depend on preferences and the themes will determined by seeking input from teacher leaders, engaged academics. Possible themes could be around common features or challenges with experiments or around SU, SIS or SHE. The themes could also be around operational or conceptual matters.
4. A range of national science, education and engineering conferences occur across the country. To extend the scope of ASELL in Schools, the relevant academics will disseminate at these conferences and connect with each other to share their work, networking internally and with others. The intent will be to increase the influence and visibility of the project.
5. A regular newsletter (likely to be monthly) will be developed and relayed to all folk involved in the project and others who are interested. ASTA social networking capabilities will be sought to increase the penetration/impact of the project.
6. Each state will have state meetings either face-to-face or video-conference linking the people in the outer circle.
7. Each state will scope and work with relevant state Science Teachers' Association activities.
8. Conversations around regional, remote, equity and access will be explicitly embedded in the above activities.
9. Specially designed forums and networking activities will be designed and deployed around regional, remote, equity and access.

F. ASELL Processes

There are three key platforms to ASELL(Schools), which were proposed in the original, Priority Project proposal:

i) Teacher/Academic partnerships (for "Teachers Scholars")
ii) Teacher/Student workshops (for "Teacher Leaders")
iii) School outreach & dissemination (for all teachers).

These three activities mesh well with the ASELL Philosophy. The Teacher/Academic Partnership is the outer circle. At this level, real, meaningful, deep relationships are built between the teacher and 3 academics. It produces an exemplar experiment, which is the inner circle of the concept map. Connecting the two (the middle circle) is the workshop as a PD exercise.

Attached are 3 flowcharts that clarify the details:

FLOWCHART 1 (outer circle): The Teacher / Academic Partnership

The Teacher/Academic Partnership starts with a teacher self-identifying with a desire to address a weakness in their teaching/understanding/resources that they have identified themselves. As this is a laboratory project, clearly the weakness must concern experimentation. The most likely scenario is that a teacher does not know how to run an experiment that addresses a particular curriculum element. Maybe they cannot find a "good" experiment (missing science), or maybe they have a good experiment but cannot link it securely with the curriculum (missing education), or maybe they have a nice experiment with no contextualization (missing engineering or application).

The teacher must be prepared to put an effort into solving this problem. Generally, this will mean coming to university and meeting up with ASELL and academics. The first discussion is with ASELL to define the problem. ASELL will identify/find 3 academics (science, engineering, education) who are willing to help the teacher.

All 5 people get together to define and discuss the objectives for the term. The issue is explained to the academics. There needs to be some consistency around the country about the material that is being developed. So we need an ASELL Schools version of the Educational Template (do we need a better name?). The template needs to include everything that we need to be addressed during the term. I have called this the "Franchise meeting", which means simply that there are a number of things that have to be done in the ASELL model, and any number of things that might be extensions of that.

FLOWCHART 1

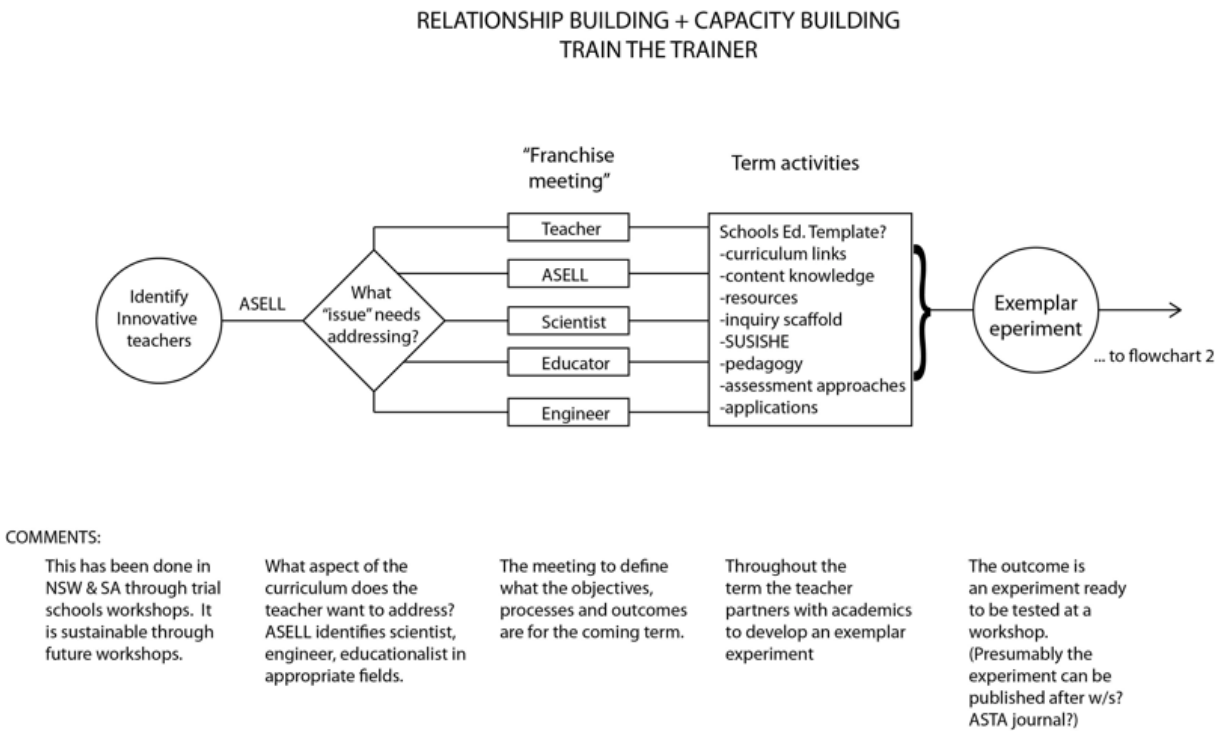

Figure 3: Process flowchart for the Teacher Scholar (represented as Innovative Teacher here)/ academic interaction.

The template needs to address the following:

- What part of the Australian Curriculum:Science is being addressed?
- What aspects of SUSISHE are being addressed? (For the uninitiated, which was me until 2 days ago, SUSISHE is my word for S.U. (Science Understanding), S.I. (Science Inquiry), and S.H.E. (Science as a Human Endeavour).
    - SU = content knowledge = scientific concepts/principles/knowledge
    - SI = higher level inquiry skills, such as data interpretation, communication,…
    - SHE = applications of science, how their learning has a place in the real world.
- What is the underlying scientific concept? What misconceptions are there for students (& teachers!) How can these misconceptions be avoided, or corrected?
- We need to develop the "ASELL Inquiry Scaffold", or adopt / adapt an existing one. We might use MKO's 5 or 6 dimensions of inquiry as a start. But we need to have a consistent scaffold. The new experiment need to be measured against this scaffold (not all experiments need to address all aspects of inquiry!)
- What is the underlying pedagogy of the experiment?

- What applications are there? Can any of these be built into the experiment, or into an extension of the experiment? Is there good source material about where this science is being used? (e.g. industry body websites?)
- How might a teacher assess students' work? (Note: real examples of student work to be collected later to enhance this aspect.
- What resources are required? Where are they sourced? How much do they cost? Cheaper alternatives? Info for technical staff
-

The ASELL person facilitates this conversation and makes sure everyone understands what is required. Tasks should be allocated to each academic, and a time management plan developed. I'm not sure what the time commitment would be…. maybe 1-2 hours per week on campus with academics? For the academics, this might mean 2 hours every 3 weeks, for 12 weeks (i.e. 5 meetings of 2 hours). For the teacher, this will mean these meetings plus independent work (e.g. analysis of curriculum, reading and understanding science content, reading about where these concepts/skills, etc are used in applications, or other issues in their use (economics, legal, environmental). Probably the whole team should get together 2-3 times in the term.

The outcome is an Exemplar Experiment, which will go to a workshop (Flowchart 2)

FLOWCHART 2 (middle circle): The Teacher / Student Workshop

This part of the process has been well-tested now. ASELL manages a workshop at a school. Participating schools are identified through whatever means we have (university links, education body links, advertising to Principals, etc). The w/s is one day in duration, 9am-3pm for students, and 9am-5pm for teachers. The workshop is attended by ASELL, the teacher who developed the Exemplar, and, ideally, the 3 academics. 4-5 "similar schools" are invited to send 4-5 teachers and 4-5 students (aim for 20 teachers & 20 students). "Similar schools" have an aspect of their teaching in common, e.g. from the same region, or selective, or catholic, etc. This is to try and build meaningful bridges between similar schools, and so that the issues at a workshop will be similar.

Teachers are invited to contribute an experiment themselves – looking for 2 more experiments.

There are 3 experimental slots in the day (1 hour each), but this can be modified to suit experiments (single or double period). Experiments are surveyed for engagement and inquiry (new instruments needed).

There is one session on inquiry for teachers…. Explain the inquiry scaffold, explain how it addressed aspects of SUSISHE, explain where the experiment fits into the curriculum.

During the inquiry session students are given a session on careers in science. This might be given by a university science marketing team (you can raise this with your Dean), but it has to be not university recruiting! Only very subtle advertising allowed (e.g. brochures available).

But the careers session cannot be university branded. Ideally, we will attract someone from the real world to come in and explain the value of a science degree to them or their business (again not marketing, but inspirational). Note that this need not be necessarily a practicing

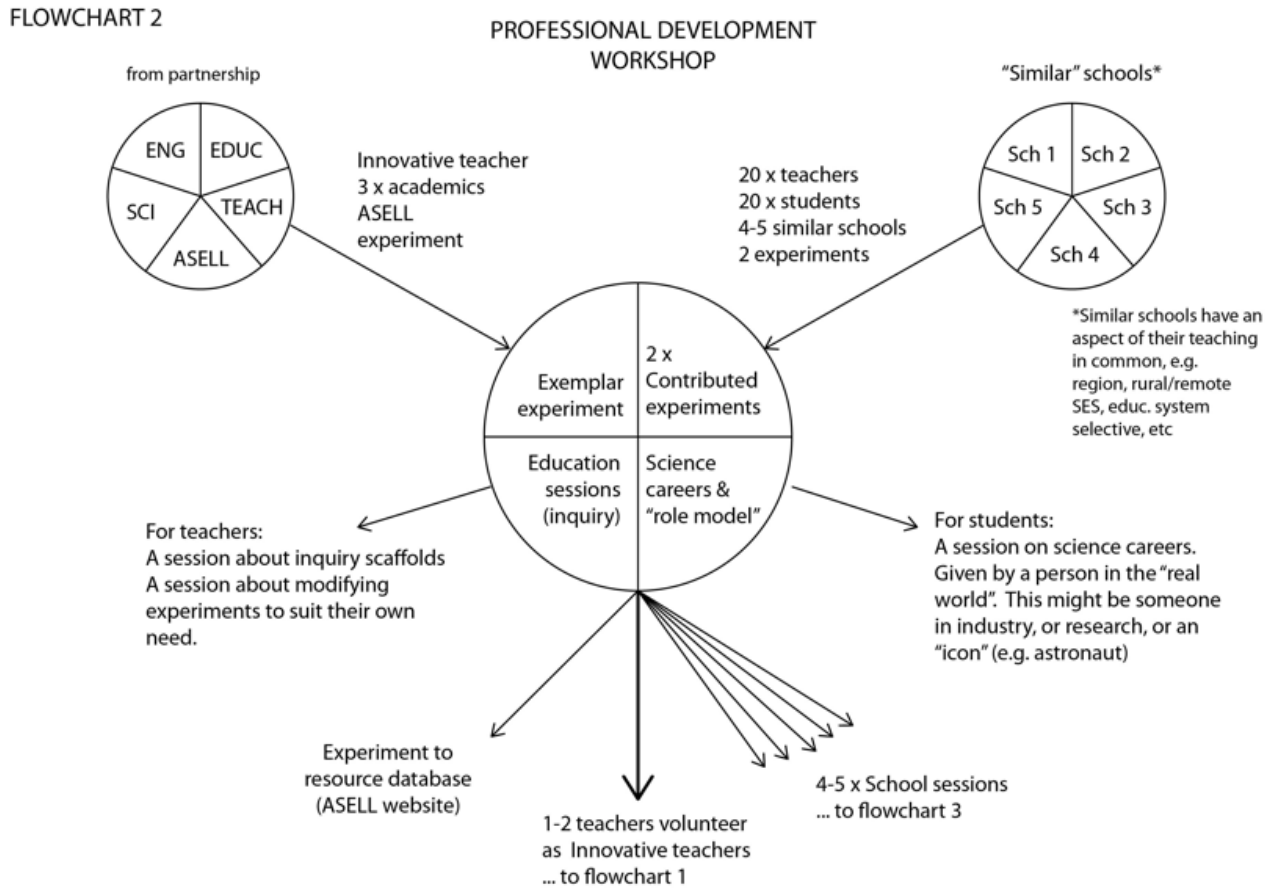

Figure 4: Process flowchart for ASELL workshop. (Teacher Scholars are represented as Innovative Teachers here)

scientist, but someone who found their science degree to be crucial to their later success. This is where you science alumni/marketing teams might also be useful.

We finish the day evaluating the 3 experiments and exploring how each can be tweaked to suit the needs of individual classrooms. For example, tweaking inquiry up or down for weaker or stronger students, or changing application to suit region (e.g. mining, agriculture, etc).

The outcome is a tested exemplar experiment ready to be put on the ASELL website. At the w/s we recruit, hopefully, 1-2 more Teacher Leaders who want to spend a term developing an experiment, and a school volunteering to host a w/s.

FLOWCHART 3: Outreach & Dissemination

This aspect of ASELL(Schools) is untested. The flowchart shows what we propose to do….

ASELL organises school visits to each of the participating schools – perhaps put aside one week in the following term and visit one school per day? One of the participating teachers agrees to run the exemplar experiment in their class. ASELL helps with this. This tests

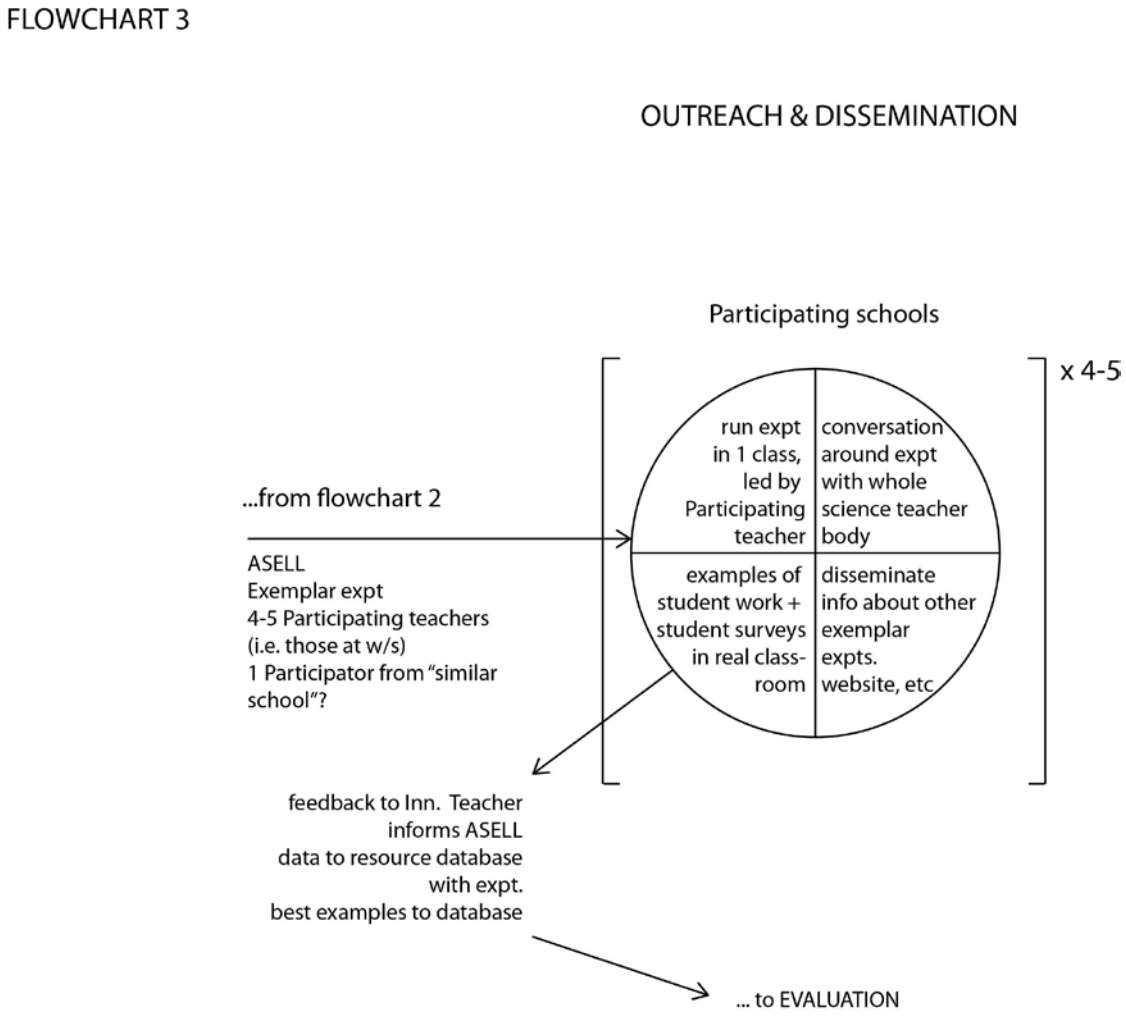

Figure 5: Process flowchart for school visits.

whether tech notes and teacher notes are well-explained. ASELL facilitates a discussion around the experiment. Talk about inquiry, curriculum, modifying expts to suit need, etc.

After the class, ASELL surveys the students (with school permission and ethics approval – this will need to be organised ahead of time). The teacher will hopefully allow ASELL to record anonymized student work to use as assessment examples. The session finishes with advertising about other Exemplar experiments being developed and how teachers can become involved if they want (Participator → Leader, or Novice → Participator).

We might invite a "participator" from one of the other similar schools at the w/s to come along to chat to teachers? This would build bridges between these similar schools.