# Part 3

# Integrating science and soul

## (creating a grand narrative)

# Chapter 12

# Steps towards an Integral Science

***Questions:***

*What is science now and what can it be?*

*Can science evolve? Can it assist in the evolution of world consciousness?*

*What attributes might an integral scientist have?*

*How might we integrate soul and science in education?*

## Introduction

This is my culminating chapter where, with a great sleight of hand, I attempt to draw upon the experiences of my own journey in trying to integrate science and soul in *my teaching*, in order to try and integrate science and soul on a grand scale…. Possibly creating a model which can inform science educators globally. Yes, these are my tentative steps towards creating a grand narrative. This grand narrative has been recently birthed, yet to grow up into a fully fledged theory. It is problematic. I hope though that it can be the basis of good dialogue and that the problems become a spur for greater creativity and insight.

In this chapter I summarize my experiences which I have richly tried to describe in Part 2, using many tables or maps. This has the benefit of providing schemas to enable us to perhaps see the shape of the environment, but leaves behind the richness and the meaning of that environment. So this chapter needs to be seen in the context of Part 1 and Part 2.

## What is science?

Some definitions courtesy of Google:

- The pursuit of knowledge and understanding, from the Latin term *scientia*, which means 'knowledge'
- Science is from the Latin root *scire*, to know. The earliest origin of the word is related to cutting or splitting apart. Knowing is, in a sense, the art of being able to separate ideas from each other.
- A particular branch of scientific knowledge; ‘the science of genetics’

- Skill: ability to produce solutions in some problem domain; "the skill of a well-trained boxer"; "the sweet science of pugilism"
- Science is a process for evaluating empirical knowledge (the scientific method), a global community of scholars, and the organized body of knowledge gained by this process and carried by this community (and others). Natural sciences study nature; social sciences study human beings and society.
- A method of learning about the physical universe by applying the principles of the scientific method, which includes making empirical observations, proposing hypotheses to explain those observations, and testing those hypotheses in valid and reliable ways; also refers to the organized body of knowledge that results from scientific study
- A branch of knowledge based on objectivity and involving observation and experimentation.
- Studies that normally encompass courses based on a knowledge of facts, phenomena, laws, and proximate cause are designated Science (e.g. Biology, Chemistry, Computer Science, Geography, Geology, Mathematics, Nutrition, and Physics).
- Those branches of study relating to the phenomena of the physical universe and its laws, a connected body of demonstrated truths with observed facts systematically classified under general laws; the study of relative, modified Principles which can be proven through physical measurements and through physical senses.

What do you think of these definitions? What do they reveal about the beliefs of the authors?

What definition of science would you write?

## What does a scientist do?

When I was a scientist in a paper mill I didn't really ask myself what science really was. I just went and did whatever was necessary to do to achieve my inquiry goals, using all the skills at my disposal to understand and improve the complex multi-variate system which was a paper machine. Perhaps it is helpful to share with you what I was doing… is this typical of scientific activity?

I would do those things you might consider science – pouring over drafting documents, designing experiments, determining effective measurement protocols, taking measurements, writing computer programs to analyse data, sitting for hours at my Fourier analyser to discern patterns in the masses of data, looking up literature, coming up with connections and theories, testing these, discussing with members of my multi-disciplinary team (chemist, mechanical engineer, process engineer and myself as physicist) to get feedback on my thinking and gain other perspectives before I would write a technical report of my findings.

Then there are those activities that you might not consider science… chatting with people around the mill, getting inside the machine and experiencing for myself as much as I could as it hurtled along at 790m/s, hanging around the machine shop watching the guys grind the rolls, crawling over dismantled gear boxes, doodling, drawing cartoons of the dilemmas we were facing and writing poetry when I was really stuck with a problem, allowing for incubation time.

And that was just the 'inquiry process' used to gain knowledge about the system. Then there was how we reported 'this science knowledge' to the stakeholders at the mill and the process of implementation of the science - engineering solutions or issues, operator training issues, time frames, costings, weighing up options, impact on machine downtime, impact on market and on the environment. To be an effective part of these dialogues I had to move outside my 'scientist hat' and learn production, engineering and economic language. I also found that the science didn't speak for itself; I not only had to be an effective communicator and marketer of the science but also a player in the games between the different departments, learning how to get everyone on-side, giving them ownership in the process, and undertaking considerable negotiation to get some of my ambitious experiments done.

I began to realize that science was not value neutral – the science questions I asked were influenced by the needs of the stakeholders and budget constraints. I was doing a pragmatic science.

And just being a scientist in a large mill situation, asking questions of the people around me, had another impact as well. After asking a machine operator about why they might change a particular variable on the machine and what they observed as a result, they began to be scientists themselves. Previously a lot of their interaction with the machine controls were like a kid playing a complex interactive computer game – they had learnt ways to make the system work through trial and error, without working out the underpinning rules. And here I was interested in understanding the *why*, respecting their experience and 'know-how', and interested in what they were doing. So the operators started questioning their habitual actions, looking for causes and effects (which is hard in a multi-variate system), coming to me with deductions which I could then test with more rigor.

The act of me doing science rippled beyond my own scientific activity, creating a community of people thinking scientifically. Perhaps the system I was studying was more than *paper-machine* it was *man + machine* and in order to understand that you need to build goodwill so people can let you into their heads and actions.

So where does the line of being a scientist start and stop? For me doing science wasn't just about getting knowledge, it was about being an agent of change with that knowledge, and then being able to scientifically test the impact of the agency.

And then there is the notion of the scientist in a global community of scientists, sharing knowledge, giving feedback, presenting formally for peer review, adding to global understanding. Yes, I was involved in this as well and even though much paper science is done within private business rather than at public research institutions, there is still an openness in sharing information, new insights and successful solutions. Without this global community and open communication channels it would not be possible to make the advances that have occurred in the technology and operation of paper mills. And the formal papers are only a small part of this communication. There is a 'science club' whose aim is to share knowledge for the common good, to ensure quality of the knowledge and the scientific activity, to be open to question and be prepared to change in the face of competing evidence (within the scientific paradigm).

## So what are the activities of scientists?

There is the **empirical** aspect of it – getting data of the physical world. There is the scientific method which is considered a cycle or rule that one might use in getting the physical data. (Observe, question, hypothesise, design experiment, test, analyse, conclude, compare). There is the **process** the scientist might go through in their whole inquiry, including discourse, imagination, exploring alternatives, incubation, intuition and insight.

There is the **community of scientists** who through the last 350 years have set the rules for how discoveries get accepted to the body of scientific knowledge, have established notions of scientific integrity, and enabled a global discourse of scientific ideas. And then there is this growing body of knowledge, some of which has endured for hundreds of years while other aspects are changing and are under challenge.

And this is just the science of the physical world… there is science of people, societies, culture, spiritual matters; each coming with their own research methodologies, perspectives, habits of mind and notions of what constitutes rigor. Between some of these different approaches there is conflict while the relationships between others have enabled creation of new transdisciplinary approaches.

But wait that is not all. We have the **critiques of science**. While some naïve scientists believe that gaining physical data means they are gaining *the truth* and that it constitutes proof, philosophers would argue that isn't possible. Post-structuralists might argue that language and concepts are products of our own minds and create a lens that we interpret what we see. Critical Theorists would critique the power of science, the colonization by science of indigenous cultures and how it has influenced the way we think in the world today. Feminist critique might challenge the reductionist view that it has. Ethicists would question the use science is put to. And so on.

And then there is the notion of scientists as **agents** in the world, requiring knowledge of cultural conditions which affect that agency, as well as understanding the impacts of their acts of agency, being able to take on perspectives of others and work in multi-disciplinary circumstances.

So the activity of science is actually quite a complex multi-layered one. And the empirical aspect of it is actually one small part. (see Fig 12.1 over page.)

## Science education

So what does it mean to teach science to students from very young children to university training? What is the difference between the *professional activity* of science and what science may have to offer from an educational point of view?

Could science education be a key player in **developing the child**? Helping to develop the rational mind through scientific thinking and inquiry processes (building clarity), tuning into the child's deep need to discover the world, empowering students with knowledge to help them operate in the world today, connecting them deeply to nature and the cosmos (stimulating their souls, developing aesthetic appreciation, respect and natural care, sense of place and being a foundation for ethical development), perturbing them to new development stages?

# The activity of science

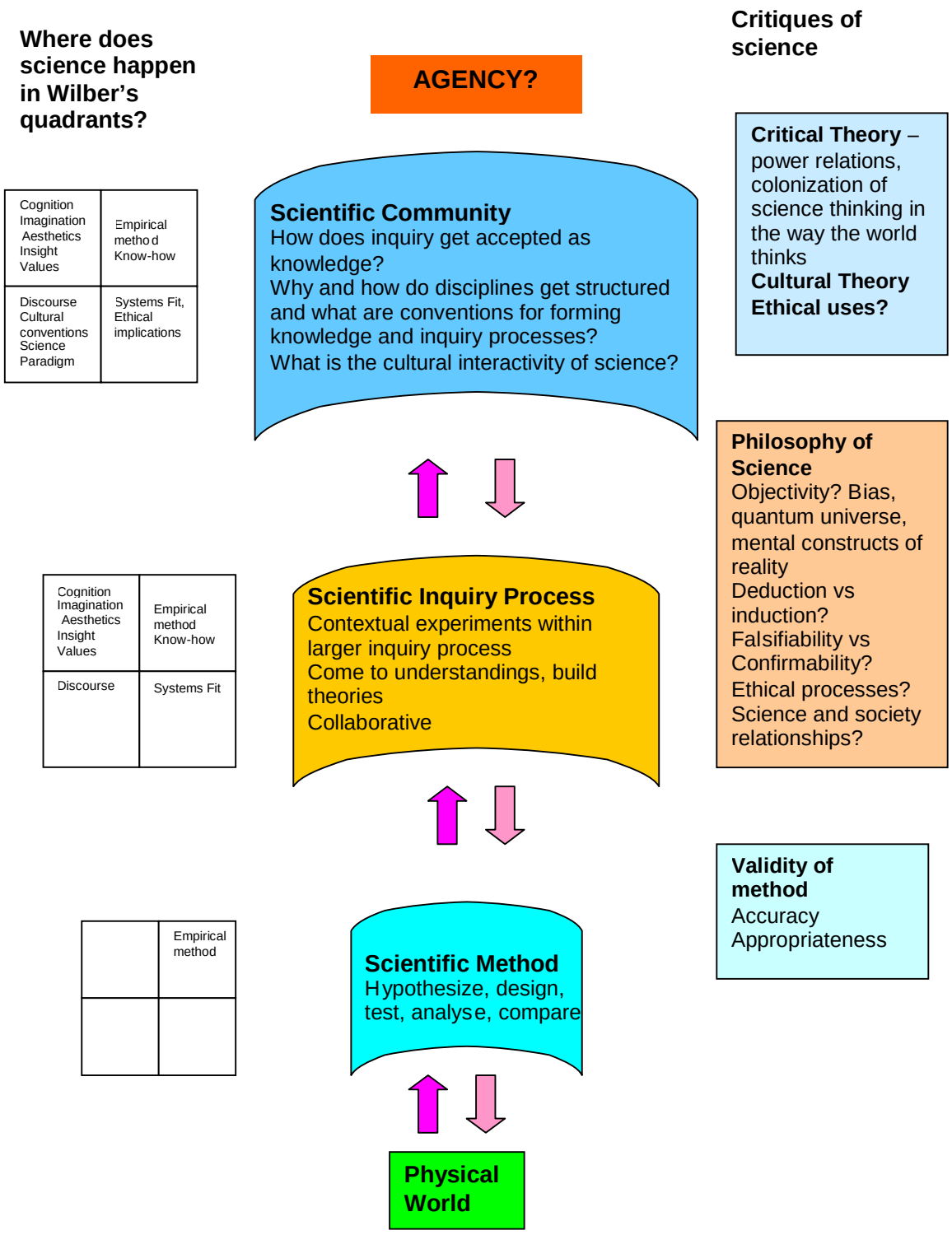


Fig 12.1

What about science education for encouraging students to be scientists… both in the layman sense (community scientists like landcare, wildcare activities) as well as being a professional scientist?

Attributes of **layman science** would include developing inquiry processes, ethical awareness and stance, agency and connection to the natural world which would lead to passionate commitment or engagement.

Students on a **professional science** pathway would need to gain the skills to operate as scientists – not just foundational knowledge and inquiry skills, but also understanding the community of practice in which they will be operating, developing integrity, purpose and passion, becoming critically and ethically aware and being able to operate with agency in complex cultures and multi-disciplinary environments.

But is this **Integral Science**? Or just being more explicit about what is already out there?

For me science is a complex cultural activity and it makes sense that science education should include practical understanding of this culture by enabling students to be scientific ethical agents experiencing the feedback from their communities thus gaining insight into the complexity of relationships. Perhaps this could attract those high school girls back to science, for whom their interpersonal world is their prime concern. But is this really science then?

## Can science grow up?

### Science Circus - 1997

Welcome to my science circus elective. It is a small group of students from Year 11/12 science courses who are interested in developing some presentations and activities for primary school students. They are brainstorming on the board what they could do….

It is interesting listening to them. They are totally focused on what topics of science they think might appeal to young students. They are talking about how they could develop some key concepts in each of these topics. They are asking themselves what might be good props they

could use to develop the ideas. What might be weird enough and interesting enough to appeal to primary students?

I decide to intervene. "It is interesting that you have been thinking in terms of knowledge that you want to get across. Is this how you think of science?"

They stop in their tracks and ask me what else science could be. "A process of coming to know something… an investigation?" I suggest.
"Oh, yeah, the scientific method," says one. "Get them to do an experiment?"
"Oh yeah," says another, "Good idea, what might be a good experiment to do?"
"We would need to give them instructions to follow," said another.
"Umm," I say, "I was thinking more about how you could get the students thinking for themselves… going on their own journey of discovery, the way scientists do."
"Umm, Sue, what exactly do scientists do?"

And it was a mystery for them. Most of them had very little experience of the inquiry aspects of science in their previous courses; they saw science as *knowledge to be learnt*, *experiments to follow* and *procedures and equipment to be mastered.*
One girl mused, "I remember in primary school being given a problem to solve from a crime scene… we had to use forensic techniques to solve a problem. It was great fun."
"How come science isn't like that now?" one boy asked.

So we ended up having a very interesting conversation about what science is. They totally changed their tack and decided to try and get across the notion that scientists are real people, and could be you or me, it is the scientific *thinking* you brought to what you do that makes you a scientist, not what you *know,* nor whether you had complex technology to conduct experiments. They decided to present an interactive skit which used a witch to show the difference between an ad hoc investigation (for the elixir of youth) versus what a scientific one should be. They then planned to give the students a problem to solve in which they could apply their newly gained knowledge of good scientific thinking.

We worked on this over the next few weeks; we even went to a Dr Karl show for young primary school students to see how science presentations were done. My students were horrified that the whole performance was a series of one weird fact after another. The primary kids were rapt,

hands up, wanting to say what they knew. “This isn’t what science is,” said Melissa, “no wonder we have got this view of science if this is what we are exposed to!” Yet, the primary students were full of curiosity, wanting to know more, breathing out in amazement at some of Dr Karl’s’ interesting stories or demonstrations.

Well my students could have challenged / value-added those perceptions about science by going around the city with their own version of what science was, but we ended up changing tack because the group were so interested in wanting to explore what science was and how it fitted in with other ways of seeing the world. Our *science circus* became *philosophy of science*. We ended up having amazing conversations about the meaning of life as well as exploring critiques of science. The students felt a whole new world had been opened up to them.

This experience was an important one for me in trying to ask myself what science really is, and being able to critique the way we teachers perceived our role in teaching it. Students are wonderful mirrors if you give them the chance and they revealed to me that although I thought I was doing a good job in helping them understand this physics I was teaching I wasn’t really creating a true reflection in my classes of what science really looks like as community of practice. Were my own students *being* scientists or rather learning *about* science? Doing experiments that helped you understand the content or confirm other people’s theories wasn’t really what real science was about, was it?

Also, instead of philosophy of science as an add-on in an elective, I realized that it should have a place in my teaching of physics. When I started looking at the course with this in mind I realized that particular topics lent themselves to some of the big philosophy of science issues. I could ask in electrostatics as we were determining the charge of the electron *“How do we really know an electron exists? Has anyone seen one?”* Students begin to realize that all the experiments are just seeing the *effect* of the electron, not actually seeing it *directly.*

Through this they challenge their own prior assumptions and how we come to know and create knowledge. They become intrigued in the historical development of an idea and who did it and why. They discover that social contexts have as much influence in acceptance of ideas as does the virtue of the idea. We discover when we explore the topic *Light*, that the wave theory of light was actually discovered one hundred years before it was accepted as knowledge, because it conflicted with Newton’s version. So knowledge doesn’t appear out of nowhere, it is politically

constructed. When I tell the students that the current text book's version of quantum theory is flawed, they are initially appalled as text books are seen as unquestioned sources of truth. And then they move on and become critical and discerning thinkers.

Yet, in mid 2005, I was observing a third year university chemistry class and interviewing students. One said to me the best way to teach chemistry was in lecture format where knowledge could be handed out, *"Because these formulas are cast in stone, they don't change, there is nothing to discuss, you just need to learn them."*

Creating experiences for students where they *be* scientists is a key concern of the Tasmanian Essential Learnings curriculum for K-10. This is a thinking curriculum where students are engaged in inquiry processes that enable them to both experience a process of *coming to know* (inquiry) as well as developing or constructing *knowledge*. Thus science is seen as both verb and noun.

What does it mean to *be* a scientist at different development stages and what type of knowledge is being developed? My physics students were keen to discover not just knowledge of the physical world, but also the critique of how that knowledge was developed from a philosophical point of view. They could challenge the objective view that science appears to have. They are at the level of the *self authoring* mind.

**Perspectival Levels**

**Pre-conventional:**
- Fluid Mind
- Unsocialized mind

**Conventional:**
- Socialised mind
- Self-authoring mind

**Post-conventional:**
- Pluralistic mind
- Systemic mind
- Integral Mind

**Transpersonal:**
- Psychic mind
- Subtle mind
- Causal mind

But if you are a young child exploring your world, you are just beginning to experience objectivity and dis-identifying yourself from your complex interactions with the world. Experiences which ask you to look for empirical evidence of your assertions according to some disciplined rules is helpful in teasing out what is real and what is magical and thus useful in helping children to attain the next perspective view.

So young primary children at the concrete stage moving from *unsocialized mind* to *socialized mind* are going to need a different sort of science to students moving from *socialized mind* to *self-authoring mind* who are now able to deal with abstract concepts and can see the scientific method itself as something to investigate. The younger students have enormous curiosity in the

world and want to collect lots of quick intriguing facts as well as *be* scientists in exploring their world.

There is a real concern now at Year 11/12 level and at the university that the way we currently teach science is not going to engage those students coming through the Essential Learnings K-10 thinking curriculum. These students will be used to experiencing science in a much broader way than what we currently do; they will have started to experience science at the *self-authoring mind* level and are now looking to develop themselves further. Our prime concern until now has been disseminating a body of knowledge and developing rigor in the use of standard experimental procedures - which is really still at the *socialized mind* level. Our challenge is to re-vision what science courses look like for these students so that we can assist both their growth as well as help them master our current wisdom and yes, perhaps they could even add to it.

Can our concept of what science is grow as well? Not only might there be ways of thinking about science teaching suitable for different development levels of our students, but also science itself could be different at the different stages. Each stage of science might be suitable then for different contexts or fields of inquiry. As in spiral dynamics, could the integral scientist be able to tune into the necessary level appropriate for the job at hand?

The difficulty is when we don't realize the options; when we get stuck into thinking science is just at the *socialized mind* or the *self-authoring* one, or when our own personal growth might be limited because we identify so much with one of the levels because our job requires us to adopt that perspective. The key to development up the stages is dis-identification with the lower one. At the stage you are at, it owns you, rather than you owning it. (Kegan 1982)

Do you remember my student Scott, our overly rational philosopher in the Chapter 2 on Integral Theory? He is at the *self-authoring mind* level. He manipulates with ease ideas, theories and critiques of theories. But he does this from the *eye of the mind*. He sees the rational mind as a tool which will help explain the whole of reality, even while philosophically he questions whether there is one to begin with.

Scott is questioning his beliefs, but even this questioning is shaped by the epistemological methodology he using. So moving into the *plural mind* is more than just challenging your belief structures; it is an ability to engage with other ways of knowing and being. Can science courses

help in this or is this where student's experiences in art, literature or drama can help? Can art, literature and drama be part of the science learning experience? Can they be developed as tools for a scientist's toolkit?

How has my teaching helped in entrenching Scott? Or perhaps he needs to experience the necessary flourishing at a level before moving on? What is my role in his development? What tools might help them? What has physics got that speaks to where he is at and where he might become? What is the difference between all those tools I can use in the teaching of physics and this tool which is physics?

As teachers are we identifying too much with one stage as well identifying with what our role is? How can we dis-identify? Does the act of reflection, of teasing out *who you are, why you are* help? Is self-realization something that happens only to a fully enlightened being, or is self-realization the ongoing process of realizing self *now* and thus enabling dis-identification from what has been owning us, so we can own it and continue in our healthy development as human beings?

What type of self-realization practices might be suitable at the different stages? What might meta-cognition look like for the different stages? We tend to associate meta-cognition with just thinking and reflecting on our own thinking processes. Yet it is clear that as one moves up the stages, one can begin to reflect on:

1. **Socialized mind –** how am I thinking about that?
2. **Self authoring mind** - the rules which shape our thinking (e.g. through philosophy of science),
3. **Plural Mind** - the language which shapes our thinking (cultural embeddedness)
4. **Systemic Mind** - the self-stages which shape our thinking.

In my work with university science lecturers (see Appendix 3), I was assisting them in making explicit their scientific and thinking processes and helping them to unpack the hidden rules of science activity. As a result of this they were able to re-conceptualise their roles as teachers – and begin to teach more congruently with what they were actually doing as practicing scientists. Most were operating as scientists at the *self-authoring level* (even though they might be

operating at higher levels in other aspects of their lives) but teaching science at the *conventional level*, just in the same way that my physics students in the science circus were planning to teach primary school students. It seems we teach at the level below that which we have made explicit.

At each level we need heuristic devices that can help us make what we do explicit. So the inquiry model for primary school students operating at the *socialized mind level* is extremely valuable for them in realizing that scientific inquiry has different facets which need to be moved through with rigor. (see Fig 12.2) Different types of thinking can be easily demarcated – *lets' put on the science hat (getting evidence) or the imagination hat, or the history hat.*

The scientific inquiry model which I developed for my physics students (and which was used successfully by physics lecturers) was valuable for those wishing to explicate scientific inquiry at the *self-authoring mind level*. (see Fig 12.3) At this stage students can move with discernment between different ways of thinking and focus realizing that they are all part of the process of inquiring as a scientist.

An inquiry model suitable for the *plural mind level* might be Wilber's 8 indigenous epistemologies. (see fig 12.4)

In the same way, we could consider what **discourse** might look like for the different levels and what suitable heuristic devices might be useful. My

**Scientific Inquiry process**
***– socialized mind***

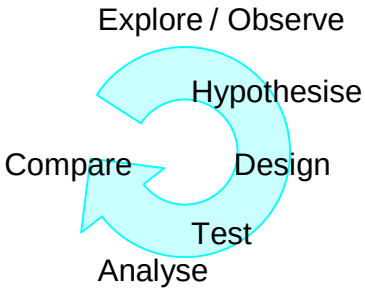


Fig 12.2

**Scientific Inquiry Process**
***– Self-authoring Mind***

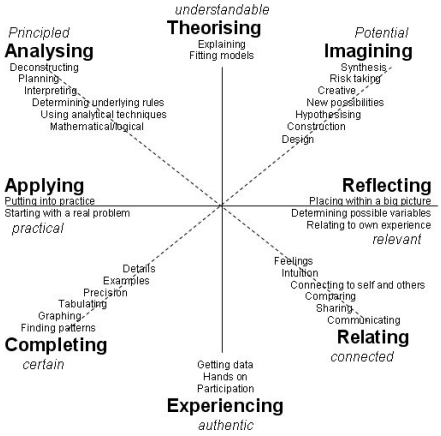


Fig 12.3

**Integral Inquiry epistemologies**
***- plural mind***

| | |
|---|---|
| **I**<br>Phenomenology<br>Structuralism | **IT**<br>Autopoesis<br>Empiricism |
| **WE**<br>Hermeneutics<br>Cultural anthropology | **ITS**<br>Social autopoesis<br>Functionalism |

Fig 12.4

'critical thinking' model for discourse (see Chapter 9) is appropriate for the *self-authoring level*, but the trivial consructivists' concept challenge model is more appropriate for students operating at the *socialized mind level* as they are not yet ready to challenge their belief structures.

My need to have students write their lab books from *their personal point of view* was me mixing up a *plural mind* postmodernist approach with a *self-authoring* science approach. I was trying too hard to put my own plural mind understanding of science into practice, rather than realizing that I first needed to develop students' reporting skills at the *self-authoring* level. So it is okay for me to write this thesis in a personalized, culturally reflective manner, because I have already mastered scientific and economic reporting – I can break the rules knowingly at a post-conventional level. Which is very different to someone breaking the rules at a pre-conventional level.

By being aware of the different stages of science I am able to understand my own dichotomies – particularly the physics versus spirituality one. I can see that spirituality can *infuse* my teaching of physics at the *self-authoring level* (through sense of wonder, deep meaning, existential questioning), but at the *plural mind* and *integral level* it becomes an *equal partner* in inquiring into the Kosmos.

## Mapping science on the perspectival stages

I am now going to introduce a table (see Fig 12.5) based on the perspectival levels where I map what science might be like at each stage, detailing the different facets of science which I have explored briefly above, and in much more detail in the previous chapters. It is a work in progress.

The basic structure of the table is an amalgamation of the work of Kegan (1982), Wilber (2000b) and Cook-Greuter (2002) put into an integrative framework by Gordon (personal communication, July 6, 2005 and forthcoming paper). I have only recently used this as an organizing structure – previously I was using the cognitive development model of Egan (1986). I have found this new structure to be much more powerful because of its logical sequencing – the notion that the next stage can now manipulate what was amorphous to the previous stage. It also differentiates the upper stages better than Egan's model. However, I have used my

understanding of Egan to help me assign certain science experiences to different stages as he has some very useful insights about how teaching techniques should change for the different stages.

I have used my own experiences in science education to tease out what science might look like at the lower stages but have relied heavily on the descriptions that Cook-Greuter uses at the higher stages in her research on *Leadership Development Action Logics* to speculate on what science at the higher stages might look like. Like me, Cook-Greuter (personal communication 2005) has found in her research that leaders teach at a stage lower than the one they operate at.

The perspectival stages relate to personal development stages (**I**) rather than the spiral dynamic cultural memes (**WE**). I have used perspectival stages deliberately to show how science can be linked to the development stage of the individual, so in planning science education from kindergarten to university we can marry it to the evolving individual. I have color coded the stages to show how they link with the spiral dynamic levels because we can also think of these as cultural memes in which people (who might be at other perspectival levels) operate.

I am offering this schema as a heuristic device which educators or scientists can use to help reflect on their practice. Some of the aspects may be better placed in different stages and may be debatable. It is a work in progress. Please bring a critical eye to it. How useful is it for you? What further testing would you like to see?

How well do you think the premise holds that science can grow in the perspectives? And what might be the possibilities for science as its practitioners move towards the *integral mind?* What are the implications for what we teach in our schools, universities and science education training?

**Fig 12.5**

| Possible Stages of Science and Scientific Thinking | |
|---|---|
| **Pre-conventional**<br><br>***1st person perspective***<br><br>*Immersed in perceptions and impulses.* | **Fluid Mind**<br><br>The world is magical. Subjective experience. Self is the prime cause. |
| ***1st person expanded***<br><br>*Treats perceptions and impulses as objects to manipulate and reflect on, making it possible to create categories embedded in its own point of view.*<br><br>**Egocentric, magic, pre-operational** | **Unsocialized mind**<br><br>Naïve science based on personal experience.<br><br>Keen to understand and make sense of the world.<br><br>Acts upon objects to see what happens and makes deductions based on what they see. Sees connections between things. But might assign cause and effect incorrectly… *"Bees make honey so we can eat it."*<br><br>Sense of wonder and awe in reality… things being what they are.<br><br>Connects with nature (immediate environment) by being in nature, observing, doing, caretaking, cultivating, telling stories, imagining themselves taking on animal and plant forms. Sense of place and being present. This connection is a foundation for development of the ethical and caring self. |
| **Conventional**<br><br>***2nd person perspective***<br><br>*Treats categories as objects to manipulate and reflect upon, making it possible to internalize society's rules and values.*<br><br>**Socio-centric, mythic, concrete operations**<br><br>**Looking for knowledge** | **Socialized mind**<br><br>A key aim of developing scientific thinking here is to develop objectivity. The self is becoming separated from the world and the world becomes an object which can be manipulated by rules. There is a danger in becoming too objective and distant – needs to be balanced with connective experiences of the world as well.<br><br>o Science is procedural, empirical (look for evidence in physical world)<br>o Simple inquiry cycle ***(Observe, explore, hypothesize, design, test, analyse, explain, compare)***<br>o **Rigor** is in the meticulousness of carrying out the procedures; the accuracy and precision, the trustworthiness of the data and the deductions.<br>o Students are keen to **find the truth** and believe there is one. Keen to find out how things work and why.<br>o Developing **procedural skills**, following rules<br>o Reflection on processes and trustworthiness<br>o **Precise language** rather than fuzziness, debate, follows discourse rules |

| | |
|---|---|
| (trivial constructivism) | o **Presentations** in 3rd person objective voice according to a set standard.<br>o Look at **patterns** and how to categorize<br>o Look at exploring the nature of **simple relationships** and discerning cause and effect, learning to control variables<br>o Mapping **webs of relationships** and seeing self in context with others and the world<br>o Looking at **feedback** and simple system dynamics<br>o **Sense of wonder** in the patterns, connections, symmetry of nature.<br>o **Sense of connection** to the web of life, the earth, the universe – sense of place and responsibility.<br>o Keen to understand the **nitty gritty** - building conventional scientific knowledge – *collecting* facts and explanations. Likes to go deep into something and become an expert knower. Is curious and finds the world fascinating.<br>o Explores **the weird**, the amazing, the extreme in order to find what is normal.<br>o **Creativity** expressed in designing experiments, making models, discovering patterns for themselves, telling stories, imagining what is possible, creatively explaining their own understandings of conventional science.<br><br>**Nature of science:**<br>o Helps us come to know how the world works and to solve problems<br>o It has heroic scientists with inventions which change people's lives. We need to be aware of consequences of our actions and follow up.<br>o Science theories are being developed and refined and sometimes changed.<br>o Science has ethical dilemmas which can be debated.<br>o What makes science different to other ways of inquiring into the world? |
| ***3rd person perspective***<br><br>*Treats rules as objects to reflect upon, making it possible to create its own ideology and identity.*<br><br>**World-centric, rational, formal operations**<br><br>**Looking for understanding**<br><br>(social constructivism) | **Self Authoring mind**<br><br>Now that the student has learnt objective procedures they can be more critical of the methods used and more involved in developing own inquiry pathways. They can incorporate other ways of knowing.<br><br>o Expanded **scientific inquiry** process which goes beyond the experimental method (includes discourse, peer review, abstraction (ideas and tools), problem solving, modeling, intuition, connecting to bigger wholes, searching for alternatives, playing with ideas, imagination.)<br>o **Expanded notion of rigor** to include breadth, depth, connectedness, usefulness of inquiry etc. (It is not enough for the procedures to be rigorous, they need to be appropriate - can now select with discernment from a scientific toolkit of processes.)<br>o Interested in *how* particular explanations have been derived – want to **construct own understandings** rather than accept others. |

| | |
|---|---|
| | o Questioning own prior knowledge and being discerning in what theories they now choose to believe – **critical thinkers**, now more critical of the notion that there is 'one truth'.<br>o Want to link their big **existential questions** into their inquiry and for the inquiry to be relevant to them.<br>o Can see **linking ideas** within and across scientific disciplines.<br>o Sets up their own **synthesizing meaning frameworks** for their knowledge based on generalizing principles which connect disparate knowledge. These frameworks are in a state of perturbation and flow.<br>o Keen to **discover root causes and reasons**, and explore consequences through time.<br>o Can explore **complex multivariate systems** by modeling and breaking down into causal relationships<br>o Copes with **paradox** by treating as *either/or*, seeking to find a better scientific theory which removes it, or ignores by compartmentalizing.<br>o Develops **mastery within their discipline** – of procedures and knowledge.<br>o Works **collaboratively** with others across science disciplines but may have problems in co-operative inquiry which goes outside science, disdaining the non-rational / empirical.<br>o Can set up effective **discourse** (from a toolkit of possibilities) and understand how discourse protocols can shape outcomes<br>o **Self reflective thinkers** – able to look at self thinking and self processes.<br>o Uses **science to improve the world** – add to knowledge or to fix problems.<br>o **Scientific integrity** based on being true to the science and the scientific method.<br>o **Creativity** expressed in new insights, creative and novel ways to explain what is happening, developing both physical and abstract models or products, finding new solutions.<br>o **Presentation** style in 3rd person but now tailored for the audience (scientific paper, log book, technical report)<br>o **Sense of wonder** in the elegance of formula, the symmetry of theories.<br>o **Sense of connection** to life, nature, the earth or the universe *in time* (past, present, future).<br><br>**Nature of Science:**<br>o Reflects on the nature and history of science; how science theories are developed (complexly and collaboratively), their tentativeness, the role of scientific thinking and its limitations, scientific revolutions and paradigms, the nature of scientific proof.<br>o Explores how science has impacted on society and how society has influenced science.<br>o Has a code of ethics as a scientist and is able to understand the ethical rules, processes and values which are used in making ethical judgments in science.<br>o Believes that science can solve the problems of the world and that the laws of the universe can be figured out in time. |

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| | o Explores the edges of science – what is real science, pseudo-science. Becomes an intellectual skeptic. May bring a scientific/rational eye to their whole life if firmly entrenched in the scientific paradigm. |
| **Post – Conventional**<br><br>***4th person perspective***<br><br>*Treats its own ideology and identity as an object to reflect upon, making it possible to respect diversity*<br><br>**World-centric, pluralistic, postmodern, post-formal operations**<br><br>**Looking for meaning**<br><br>(Critical and radical constructivism) | **Pluralistic mind**<br><br>Students are able to see the perspective of science as one of **many paradigms** or cultural worldviews. They can critique its privileged status and understand how it has shaped the way the world now thinks and how they have been conditioned.<br><br>They understand how our **situatedness in culture** affects our 'objectivity' – our worldviews and language influence the way we construct theories, design experiments, test, interpret and assign validity status. Students now put themselves back into their inquiry (1st person reflections), realizing that they need to make transparent what they are bringing to it. They value the subjective experience as well as the objective.<br><br>Students are able to see the **relativity** of scientific theories and perspectives. They are interested now in the context they were derived and the intentions and beliefs of the scientists. They are interested in how the theories have meaning and significance in the world, as much as wanting to understand them.<br><br>They may now believe that nothing can be true and everything is relative and that it is up to the individual to **choose what to believe**. They can treat scientific theories as metaphors.<br><br>They are likely to broaden their scientific disciplinary skills with inquiry skills based on **other ways of knowing**. They are now interested in broadening their focus from *science of the physical* world to *science + people's experience of the physical world*. (e.g. science education, deep ecology.) They may be interested in more personal and intimate qualitative research methodologies like lived experience, hermeneutics, phenomenology, case studies, co-operative inquiry.<br><br>They can engage in **multi-disciplinary inquiry** (which goes outside of science) by being open to other perspectives on reality and other ways of coming to know the world. Being able to maintain rigor across discipline perspectives might mean ensuring every perspective has an equal voice… even though this may not be appropriate.<br><br>**Discourse** moves from verbal communication to holistic communication – including kinesthetic, drama, artistic. The artistic perspective is seen as a way of helping challenge perceptions and create new perspectives.<br><br>**Paradox** is not an issue because everything is relative – *and/both* can exist without any problem. They can tolerate ambiguity and uncertainty. They can tolerate conflicting disciplinary perspectives by enabling the different voices to speak rather than reconciling them. They are able to engage in dialectical reasoning. |

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| | They are less interested in past causes and future effects as they are with the **immediate present** and how that might unfold. More interested in the process, relationships and non-linear influences. Systems are seen as complex interactivity (rather than specific cause and effect relationships). Prefer holistic compared to linear logic.<br><br>They can see themselves having many **different identities** – old scientific self, subjective self and can have problems integrating these. They are becoming introspective, going deep into their own experience. Values pluralities.<br><br>**Ethical understanding** is much more relative and culturally dependent. |
| ***4th person perspective expanded***<br><br>*Treats pluralities and contradictions, both inner and outer as objects to reflect upon, making it possible to organize pluralities*<br><br>**World-centric, holistic, general systems thinker, post-formal operations**<br><br>**Looking for structure** | **Systemic mind**<br><br>Scientists can extract the essence of theories to determine **big ideas and themes** which they are able to manipulate and integrate into new meta-understandings and frameworks, developing original perceptions of the world. They can see parallel themes across disciplines, contexts and time.<br><br>Scientists can perceive systemic patterns or long term trends.<br><br>They understand that science is done in a **cultural context which creates reflexivity**. Using science to fix problems is naïve without understanding the cultural resistances to change. Science alone cannot fix problems. Systems are *scientific + cultural*. Scientists do more than just find solutions; they become strategic agents in working within cultures to transform attitudes. In order to do this well they might study organizational and cultural dynamics.<br><br>Scientists have a general systems view of reality, and can comprehend **multiple interconnected systems of relationships** and processes. They see gaining and reading feedback as crucial part of their work and lives.<br><br>Scientists deal with contradictions or **paradox** from different knowledge perspectives by seeing them as partial truths which can be integrated in grander meta-system models (e.g. Integral Theory, System Dynamics). They can develop transdisciplinary inquiry which uses research methods across many disciplines appropriately in an integrated way.<br><br>Scientists tend to **think outside the box** as they give free reign to dreams, fantasy and imagination… no longer feeling the need to be constrained by logic…. Thus gaining insight.<br><br>Values authenticity. Truth can be approximated – complex arguments carry more weight than simple ones.<br><br>Engaged in self appraisal and committed to own and other's growth. |

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| ***5th person perspective***<br><br>*Reflects upon systems as objects, making it possible to correlate and organize them into meta-frameworks.*<br><br>**World-centric, holarchial, integral, vision-logic**<br><br>**Looking for true self, true reality** | **Integral mind**<br><br>People working at this level are considered very **fluid and flexible** and can take on roles from any of the earlier perspectival stages with ease, choosing the perspective appropriate for the job at hand.<br><br>They have finely tuned **interpersonal skills** and insight into other's complex and dynamic personalities. They can move into the perspectives of earlier stages to assist others, giving transformational feedback. They may work briefly in organizations, catalyzing sustained transformation. They can be very useful in helping to bring together people from different perspectival stages and helping bridge the conflicts of perspective.<br><br>At a personal level these people are now **wary of the excessive map** making of the human experience that the systemic mind has been making. They realize that the map is not the territory. They realize that the pursuit of objective self-identification and rational, objective explanations of the universe are futile – artifacts of our need to make permanent and material that which is in flux and immaterial. However they understand that this need to objectify and make meaning is an essential part of the development process for humankind and respect the scientific process for others, if not themselves.<br><br>They hope to **unearth the limits of the rational mind**, and to unlearn their automatic, conditioned responses based on memory and cultural reinforcement. They may view the rational mind as a shackle. They now have access to intuition, feelings, dreams, archetypes and other transpersonal states and are able to experience flow states leading to a direct mode of being. |
| **<u>Mystical Levels</u>**<br><br>**6*th person perspective***<br>Theocentric, unitive, transcends and includes all of the above.<br><br>**Being** | **Psychic Mind, Subtle mind, Causal no-mind, Witness**<br><br>**Able to see all experience**, including the rational, as phenomena of being, valuing all states of being. Less interested in the seeking as in the being, focussed in the now. Realize that understanding is an illusion. Comprehend things in a visionary and holistic way in addition to apprehending them through the rational mind. |

A word of caution. Where do the theories of Steiner sit where he has an integrated *spirit-soul-mind-body* system of human development? Here I am just focusing on the development of this thing called science which needs to be done in harmony with the development needs of the whole child. Science can support the flourishing and transformation of several development lines and development of others can support student's experience of science. It should be reflexive and balanced. Science is one of many contexts for a child's growth.

Where are other cultures situated in this story? What about their ways of knowing and inquiring into the world which might take their young children on a completely different journey to Western children? How could these perspectives be integrated on such a map?

## Integrating soul and science in education

The previous table of *science through the perspectival levels* enables us to see that the further up the stages one goes, the more soul aspects are integrated, until one is well into the transpersonal stages of *fully integrated being*. But can soul be a part of science at every stage? Is soul in science more than the WOW factor – **W**onder **O**f the **W**orld? In Chapter 10 I suggested, based on the work by Cajete (1994), that science education has a role to play in providing young children with a sense of place in nature which is foundational for further development of ethical and soul capacities. But is there more to soul in science than this?

How was soul present in my physics classes? Perhaps it enhanced students' experiences; stimulating curiosity, existential questioning, passion and creativity; creating a quality of attention, mindfulness and reflection; deepening relationships and sense of natural care and ethics; supporting transformation; connecting to nature and self; encouraging deep meaning and experiences; and providing a place where students could be and express their whole selves.

It provided the motivation and the nurturing environment for students to explore what it meant to be scientists; assisting in better thinking and inquiry, higher participation and collaboration, greater discernment, autonomy and initiative.

It seemed to me that students went on an inquiry journey which had many similar experiences to a spiritual journey.

| **Spiritual Journey** | **Science Journey** |
|---|---|
| Inspired by a deep need to find truth, meaning, purpose, wholeness or place in the universe | Inspired by a need to understand the universe |
| Contemplation / reflection / insight – going deep into self and experience | Imagination / reflection / meaning / insight – going deep into nature and phenomena |
| Service / ethical practice / vocation / wise action / mindfulness | Caring / developing ethical practice / looking for vocation / attention |

| | |
|---|---|
| Inquiry – discernment / deep questioning / integral | Inquiry – self aware, critical thinking, inquiry processes |
| Turning points /consciousness transformation / awakening / experience of a dimension beyond self | Turning points / transformation of perspective |
| Deep relationships | Dialogical and caring community |
| Sense of place / being at home in the universe | Sense of place in nature and cosmos |
| Self expression / creativity | Expression of own questions and ideas / creative meaning making |

Fig 12.6

Perhaps there is a reflexivity between building soul capacity and building science 'thinking' capacity? As we assist students on their science journey we also plant the seeds for a greater personal one. As we nurture students with soul in our classes we enable them to explore themselves as well as the discipline knowledge and processes.

There has been a lot of work globally in recent years about developing curriculum to encourage thinking. The Tasmanian K-10 *Essential Learnings* is centered around thinking, inquiry and *Teaching for Understanding*. This is already having an impact on how various Tasmanian high schools are reconceptualising their science curriculum, which will in turn have implications for the delivery of science in year 11/12 colleges and universities.

Harpez (2003) has suggested that one can think about the **Thinking Curriculum** in three ways:

1. Giving students **thinking tools** (e.g. De Bono)

2. Development of **thinking dispositions** (e.g. Costa and Kallick's (2000) *Habits of Mind*, and Perkin's *Thinking Dispositions*) which build attitudes and capacity for creative and effective thinking.

3. **Teaching for Understanding** pedagogies (e.g. Project Zero at Harvard University) which use generative questions for student-centred inquiry, carefully planned to deliver understandings valued by the teacher or the course.

Perhaps, in my physics class I was building *Habits of Mind* without necessarily intending to? Costa and Kallick's *Habits of Mind* are based on what creative and effective thinkers and enterprising people do. These qualities could be interpreted from a purely pragmatic point of

view or could go deeper, based on the sort of spiritual qualities that Grof (1993) describes. Below I have correlated the *Habits of Mind* with the *Qualities of Spiritual Maturity,* showing how soul might be a deeper expression of mind. As we aim to build capacities for *thinking,* can we also build capacity for *soul*? (See Appendix 2 for fuller descriptions of each category.)

| **Qualities of Spiritual Maturity** (Grof 1993) | **Habits of Mind** (Costa and Kallick 2000) |
|---|---|
| Faith, trust, and inner security | Persisting |
| Physical, emotional, mental and spiritual clarity | Thinking and communicating with clarity and precision |
| Serenity | Managing impulsivity |
| Living in the present moment | Gathering data through all senses |
| Love, compassion and service | Listening with understanding and empathy |
| Expressing the creative soul *(my addition)* | Creating, imagining, innovating |
| Personal freedom | Thinking flexibly |
| A sense of wonder, mystery, and reverence | Responding with wonderment and awe |
| Honesty and authenticity | Thinking about thinking (meta-cognition) |
| Responsibility and discipline | Taking responsible risks |
| Connection with the earth, nature and everyday life | Striving for accuracy |
| Hope, happiness, joy, and humour | Finding humour |
| A sense of purpose and place in space and time | Questioning and posing problems |
| Tolerance and patience | Thinking inter-dependently |
| Wisdom and understanding | Applying past knowledge to new situations |
| Gratitude, humility and willingness | Remaining open to continuous learning |

Fig 12.7

So in thinking about a science curriculum and science education it might help us to think about *science thinking* or the *science mind* as nested within *soul* (see Fig 12.8). Soul is pervasive and ever present… not something considered as a small aspect of a curriculum. So what might be the aspects of scientific curriculum based on *thinking*? Perhaps in addition to *thinking pedagogies,*

*thinking tools* and *thinking dispositions* we could also consider *ways of knowing*, *cognitive development* and *curriculum metaphors.* What might their corresponding *soul* aspects be?

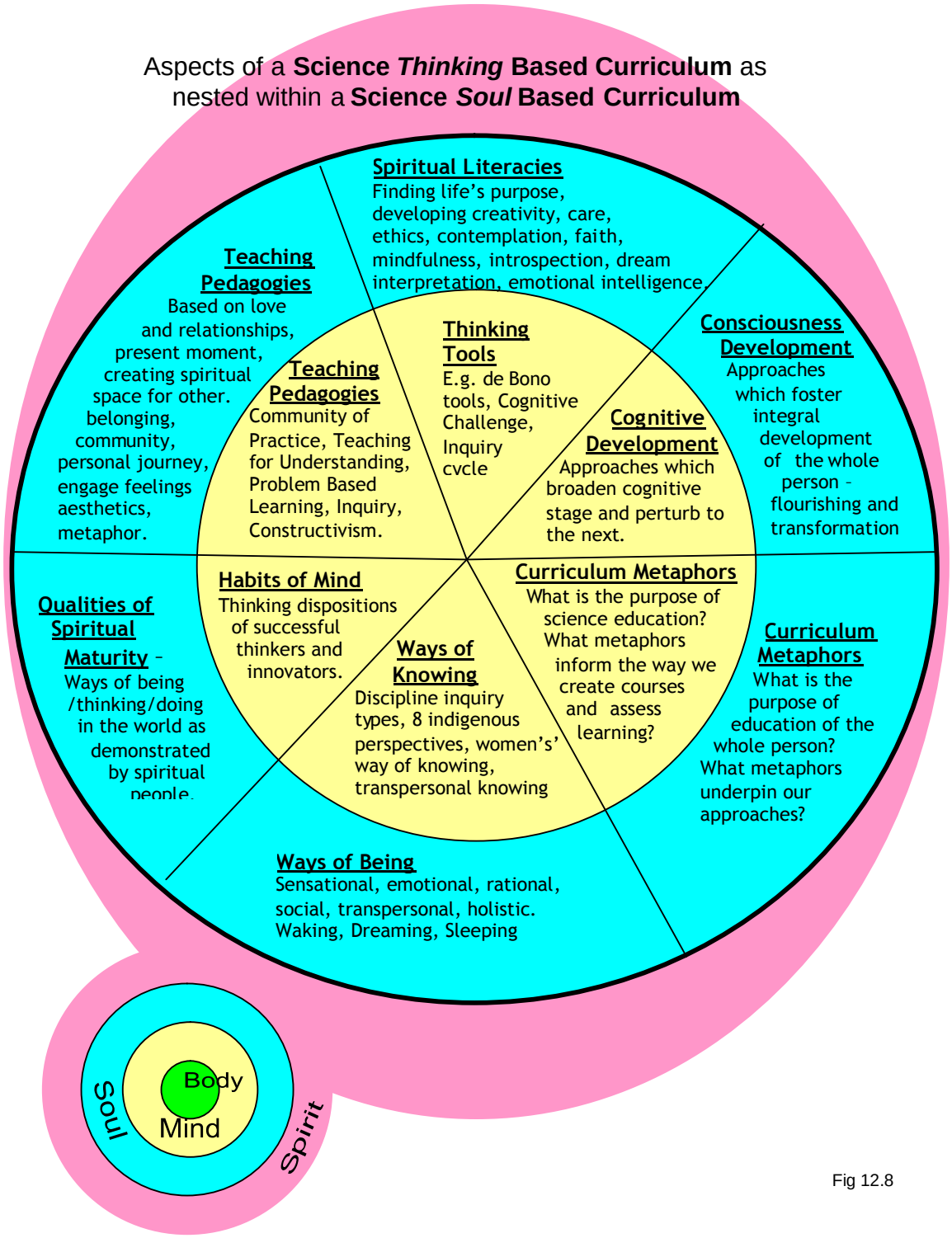


Fig 12.8

So perhaps a rich science curriculum can draw on *mind* and *soul*, helping students to integrate these in action. So science creates a context which enables development of the whole person and soul supports the development of the scientific self. However, where this becomes problematic is when the curriculum metaphors that support science learning are in conflict with curriculum metaphors which support development of the whole person. How does one resolve this? Moving to a different way of thinking about science? And what is the role of the teacher in all this?

## What is science looking at?

For science and soul to be truly integrated we would need to ask *what is science now looking at?* Is it still in the realm of **IT** and **ITS** or can we allow for an integral science which looks at the world of **I** and **WE**. Do we need to provide demarcations for social science and natural sciences?

And what about the spiritual dimension? Can science look at the causal and subtle states as well as the gross? For example, study of subtle **IT** might take us into alternative medicine – acupuncture, vibrational medicine or yoga. Study of the subtle **ITS** might help us explore biodynamics – the interaction of cosmic energies in soil and plant systems. Study of subtle **WE** might take us into Jung's collective unconscious or Sheldrake's Morphogenic Fields.

And is science limited to the *eye of the senses* and the *eye of mind*, or can it also use the *eye of the spirit.* What might it mean to use these with discernment and integration?

What paradigms are we in when we conduct science or teach science? How does our view constrain what we might consider as a context for science research?

## What might it mean to be an integral scientist?

In the Chapter 11 I included Gordon's (forthcoming) recommendation for what an *Integral Teacher* could be like which was based on Wilber's 8 indigenous epistemologies. Using a similar approach I have asked what an *integral scientist* might look like based on Wilber's quadrants.

| | |
|---|---|
| **I** Holistic Being | **IT** Master of Discipline |
| **WE** Perspective Taker | **ITS** Systems Thinker |

Fig 12.9

1. **Scientist as a Holistic Being** – being aware of personal development lines; feelings, intentions, values, ways of thinking, cultural and perspectival limitations of own thinking. Reflecting on own being and becoming. Aware of soul and the sense of purpose and meaning that they bring to their vocation. Based on a deep sense of the inner self and connection to life and others.

2. **Scientist as a Master of Discipline** – aware of the tools that the discipline has – empirical methods, inquiry processes, intimacy with that they are trying to know, critical discourse, process of knowledge consensus, innovation to commercialization, ethical appropriateness of research methods. Understands critiques of the epistemology of their discipline and the cultural situatedness of the discipline. Aware of the limits of their own knowledge and skills; questioning their claims to know. Based on a passion to discover the wonder and mysteries of the world and a commitment to assist in world understanding, quality of life or evolution.

3. **Scientist as Perspective Taker** – able to understand and inhabit the perspectives of others in their field, other discipline approaches and those affected by the science or the issues that they are investigating. Able to understand cultural perspectives and the obstacles to change. Can use other perspectives as lenses for their own research thus questioning its usefulness, ethical dimensions, meaning and appropriateness for the whole. Based on meaningful and compassionate relationships with others and a deep need to be of service.

4. **Scientist as Systems Thinker** – able to zoom into different holon levels and understand the impacts of what they do at each layer. Recognizes their interactivity within the whole. Able to map the cultural, political and social systems as well as scientific systems and to question their research as to its impact, effectiveness and sustainability. Based on an openness and sensitivity to the feedback that the system provides them.

**A tentative summary…**

## What might we think of when we think of *integral science*?

- ***who* it is that is doing the science** - bringing our whole selves to our engagement with science, and the action of being scientists - integrating heart, mind and soul – becoming an integral scientist.
- ***stages of science* -** different stages of science suit people at different perspective levels or cultural memes.
- **science *as transformation*** - the act of doing science fosters development and transformation of the human being who is in process of doing it, particularly in the stages from *impulsive mind* to *socialized mind* to *self-authoring mind.* Science is one thread of human development.
- **science *thinking* nested within *soul* –** soul qualities support effective science practice, and science provides a context for developing soul capacities.
- ***what* we look at in science** - not just physical (gross) world but also looking at subtle and causal states
- ***how* we do science – scientific epistemologies** - the research tools and methodologies – broadening these to cover all epistemologies and all dimensions of being.
- ***what context is it in***? – understanding the interactivity, cultural embeddedness, paradigms, limitations, power relationships, system effects and ethical dimensions.
- ***why* are we doing science?** – personal understanding and growth, connecting with nature, inquiring into the universe, advancing the world, consciousness evolution, service to others, development of an ethical and wise self?
- ***how do we teach science?*** – Science thinking nested within soul - pedagogies, curriculum metaphors, habits of mind/being, ways of knowing and being, literacies and tools for thinking and soul, consciousness development, role of teacher.

## Conclude 1: The problem with transforming science?

2005. I am sitting in a packed auditorium at the CSIRO Marine Laboratories in Hobart. It is an informal lunchtime seminar where one scientist, Dr Jaci Brown, is giving a talk about her role of *Scientist in Residence* at a local girls high school for six weeks. Her specialty is climate change modeling and so she worked with teachers at the school to create learning activities for Year 7 classes through to grade 10 classes on the topic of climate change.

Jaci is describing how she introduced ideas of climate change to Year 7 Maths classes using graphs and system feedback diagrams and how difficult it was for students to grasp the concepts. She used lots of analogies and tried to bring it back to students' personal experience. She explains how she introduces one graph to the class: "Here is a pie chart which shows how much of each gas we produce. All of these affect climate change…See this piece of the pie chart – these are hydrocarbons - these are the gasses in your hairsprays and deodorants…. By just switching brands to a pump action you can help to reduce these emissions in the atmosphere." She tells us that many of the girls were shocked asking *"Why weren't we told about climate change?"*

Now who is in the audience at this seminar? Leading climate change scientists, the Australian Senator for climate change, representatives from the Greens who have put together educational packages for schools on climate change and sustainability, and some teachers.

The scientists in the audience are shocked that the students hadn't even heard of climate change. "Surely everyone knows?" one says. Someone then responds saying that because of the way that the media represents it, the science seems uncertain. "But we are about 95% certain… the case for it is mounting up… the only thing we don't know is to what extent the climate will change," exclaims another scientist in response.

The Senator says that the problem is that the media is giving equal air time to both sides, rather than giving more weight to the science. "Scientists from oil companies come on and say there isn't a problem, but no-one from the public side of science gets up and puts the alternative case. We need our public scientists to be more public!"
"But I can't do that," says one of the scientists, "I would lose my integrity as a scientist … I have to be seen as impartial… I cannot be associated with a cause."

Jaci suggests that a big step forward in educating the public would be scientists going into schools or doing what she is now engaged in – preparing learning activities on climate change for teachers to use across Tasmania. There is agreement among the scientists of the importance of public education as these are people who are very concerned about the impact of climate change on the earth and would like to see public behaviours changing to more sustainable living. One scientist says "Perhaps then people would know enough to vote for a government who is prepared to sign the Kyoto protocol." (Australia is one of a few Western countries who has yet to sign.) Another says "And start living more sustainably themselves."

The Greens representative says that it isn't just about getting information out there… that information alone will not change behaviour… there needs to be ways of ensuring students can engage in sustainable change. "It is more than just teaching students the ideas of climate change… we need ways to change the culture of how they operate in the world."

I suggest that perhaps a Year 7 student trying to understand system changes at a global level also needs to experience systems at a more local level … where they could gain feedback and see the consequences of their actions and be able to modify them. A global system doesn't give them feedback so it is a bit like a blackhole. But we don't just have to stick to science systems … we could look at cultural. So a student could suggest to their Mum to buy a new type of hairspray and then see what helps her sustain that or hinders that and devises ways to overcome obstacles. Or the students in a school could sign a declaration for non-hydrocarbon hairsprays and if they can stick to this for one year then there are rewards or celebrations…. getting positive reinforcement for their actions.

Then the senator says that even knowing about climate change and having an incentive to change isn't enough. That she has just been to the Pacific Conference for climate change where Pacific Islanders have ample evidence of how sea levels are rising and have had to deal with increased incidences of extreme weather. "But they are not doing anything about it because they are coming from a fundamental Christian point of view…. They see it as the second coming and are saying … bring it on! What do you do when the worldview of a group doesn't even accept the need to change?"

There is a stunned silence. “So I went to key Christian leaders in Australia and told them what was happening and asked them what their role was in challenging this viewpoint,” she continued.

If I could read the mind of everyone there I would have heard “This is a big issue…. Bigger than we think. What do we do now?”

I start to think that we have really moved away from a scientific issue into one of culture – how do you understand the cultures of others, how they come to know, why they might change their positions? Could we understand this problem better if we brought a **spiral dynamic** lens to the situation? For example, Esbjorn-Hargens (2005) has looked at likely responses to a program to increase recycling based on the cultural meme someone is operating at… so someone in the **blue** meme might do it because they are told to, someone in the **red** meme would not do it and rebel, someone in the **orange** meme would do it because it made good commercial or scientific sense and someone in the **green** meme might do it because they care. So understanding the various memes within our society helps us to design appropriate strategies to educate and transform behaviour.

And would it help to understand which cultural perspectives the different players might be coming from in this seminar? Would it be beneficial to analyse the processes we are using in looking at the issues and the perspectives we are bringing?

What cultural perspectives did the participants have? So are the climate scientists operating within an **orange** meme in their practice *as scientists*, but fall into a **blue** meme way of operating in their ways of thinking of *how* to educate others and bring about change? (It will be OK if we just tell them.) Is the Senator operating in the **green** meme as a change agent, understanding pluralities and looking for ways of activating others? Are the scientists operating within a **green** meme in terms of their private concern for the planet and their desire to make a bigger impact on public opinion, yet feel that they have to play a role within a well defined science culture in order to retain their status as scientists?

What might be a systemic approach (**yellow** meme) in looking at this issue, I wonder? Are we perhaps seeing the glimmerings of it just in this interactivity between different cultural memes and perspectives in this seminar? (And each person might be bringing multiple-perspectives in

tension.) Would it be useful to name what is going on here so people could see how their defined (and non-defined) roles are an important part of the whole, rather than feeling their positions are too far removed from each other? Would a spiral dynamic or integral map help in understanding where all approaches to this issue might fit, how they might be needed and what might be missing? So perhaps spiral dynamics could become a useful heuristic tool in helping explore complex issues which involve both culture and science.

How might someone operating at the *integral mind* (**Turquoise** meme) perspective work with this group or with this issue? Perhaps they might use individual strengths, look for weaknesses, search for other 'experts' to fill gaps and find ways of creating the glue between all participants that could yield emergent understandings and sustainable ongoing actions. Perhaps they might be open to synchronicity and serendipity; to understanding perhaps there is more to this issue than solving it… the very process of coming together to solve something like this is in fact an opportunity for global transformation and evolution in consciousness. They might look beyond the strategic into a place of visioning… and look to engage others in a process that can speak deep within their souls … enabling the space for flourishing or transformation.

So what is the role of a 'real scientist' in all this? How can scientists reconcile a need to maintain their integrity as scientists with their need to be a global citizen? Should scientists have the skills to make their science accessible and knowable by the public as well as with their usual audience of the scientific community? Should they be able to see the cultural obstacles to people using their information and plan around that? At what point do they move from being scientists to being advocates or agents of change… or is that best left to the cultural experts, or the politicians?

Should scientists be seeing science as a continuum of perspectives, realizing that they can choose where they locate themselves for particular studies or issues? Should we be encouraging science graduates to see themselves as growing not just in mastery of discipline but also mastery of perspectival and cultural levels?

But the story doesn't end there.

The courses that Jaci designed in collaboration with teachers from a high school were converted into learning sequences available to all high schools in Tasmania. Immediately after they became

public, the climate change topic for Year 10 science students was highly criticized by one science department within the university. They believed that the topic of climate change was far too complex for a high school student to understand. They would much rather the teachers focused on teaching the students 'real science', providing proper foundations for undergraduate science courses which would then be the basis for any proper science research on climate change. Which meme are these departments coming from?

Underlying their concern are some key assumptions about the role of high school science programs and what they are for. But how many students actually progress to do university science from Year 10? No more than 10%. So what is the role of high school science? If this is the last time a student does science in their education then what would you like them to leave with? Partial knowledge which are building blocks for non-realized future studies? Understanding the complexity of global issues, helping them to be informed, responsible global citizens? Building moral awareness and capacity? Building a desire to know more about the world and their role in it, no matter what career path they take? (These are the new *green meme* criteria underpinning the *Essential Learning* curriculum for K-10.)

Is it possible to build some foundations *for later* studies while creating some meaningful learning *for now?* Perhaps this requires us to perceive new metaphors for science knowledge – not merely the Newtonian building blocks but perhaps as well more holographic or integral notions of knowledge construction.

And what about the CSIRO scientists' role in promoting awareness of climate change? Just two months after this seminar the government expressly forbade any scientists in the division to speak directly with the public, and some of the scientists who had made predictions based on the number of people likely to be dislocated from the Pacific as a result of sea level rise were gagged; they were told that they were not to discuss anything related to 'policy' and to stick to 'science' (Cohen 2006). Yes, the Australian government has a clear idea of the demarcation between science and policy. To change science in Australia then requires much more than changing science education… it requires changing the very culture of how science is perceived, used and valued within the fabric of our society.

## Conclude 2: The possibilities of transforming science

2000. I am at the beach with my four and a half year old nephew, Glen. It is something we have been doing together every couple of weeks.

Today we have been walking along, looking at the sand squiggles from buried seashells and picking up interesting treasures. Glen suddenly looks at me and says "How come that sand over there (points to the dry sand) is different to that sand there (points to the wet sand.)"
"Hmmm," I say, giving me time to think. What does he mean? Hasn't he realized that that sand there is wet and that one over there is dry? I decide not to pre-empt him and to find out what he is thinking. "Why do you think they might be different?" I ask in as neutral way as possible.
"Well," he says, "I was thinking that this (points to the dry sand) might be salt from the sea."
"Interesting idea," I say, "how might you test that?"
He looks at me blankly.
"Could you taste it and see if it tasted like salt?" I ask.
"Yes!" says Glen eyes lit up, and he carefully tastes a bit. Then he shakes his head and says that it doesn't taste like salt. "I don't know why it is different then," he says a little despondently.

I point to the waves coming in and ask him if he thinks that they might have anything to do with it. He looks for a while and decides to get some water and put it on the dry sand.
"I am trying to see if it turns into that sand (points to the wet sand)." he says.
The dry sand looks wet but certainly hasn't changed to the muddy texture and yellowish tinge of the wet sand. He shakes his head and says that water doesn't do it.
"Do you think you put on enough water?" I ask.

He thinks about it and picks up some of the dry sand and carries it below the waterline. He plonks his little pile on the wet sand in the path of a wave. When the wave passes there is no pile of sand remaining. "Where has my sand gone!" he squeals. "It has disappeared."

He acts quite shocked. I say that perhaps there wasn't enough sand and as it got wet it might have flattened out. He looks at me for a while then goes and gets a large mound of dry sand, putting it in front of a wave. It gets wet and doesn't disappear. It looks exactly like the muddy wet sand. Glen is really excited, hopping around. "It is the same sand!" he says. "The only difference is whether it is wet or not."

Phew, I think. I am exhausted. That was amazing. I was so glad I hadn't just told him the answer right away. It was really interesting being privy to his thinking. I thought about how much I took for granted about the world, and how much is so incredibly new to him. How excited he gets about the littlest thing. How can I help him retain that sense of curiosity and intrigue?

So we continue to walk along the beach, still exploring, searching for treasures. But there is more to life than science I think.

So I say to Glen, "You know we have spent our whole time at the beach being scientists, experimenting with sand, looking at what makes those squiggly lines in the sand. Maybe for a change we should be something different."
"Like what?"
"What about being artists?"
"What do artists do?"
"Well artists look at the world in a different way….how things look – how beautiful they are – the patterns… does that make sense… they look at the scenery, the sky."
"Ok."
So Glen looks at the sky and the waves and the beach. After a while he says. "You know the clouds make very interesting patterns. And look here in the water. The sky is in the water."
Wow, I think.

"Do you want to try something different again?" I ask. "Let us try being monks."
"What do monks do?"
"Well they are interested in experiencing the world fully, they breathe deeply, smell the air – can you feel it as you breathe in – the tanginess, the salty smell? They listen carefully to all the sounds being very quiet. Can you hear the waves, the birds, the cars? They look at the waves and just watch them rolling in…. can you see the rhythm of the waves? They walk slowly and feel the sand on their feet and the earth underneath them."
Glen is doing all this and then suddenly he twirls around.
"What are you doing?" I ask him smiling away.
"I can't help it, I feel so good."

He stops twirling and says "Can we play our imaginary game now. I would like to call the sea serpent…. *Sea serpent, sea serpent, come to us, we are your friends and I promise to care for you.*" (This is an invocation he had invented on a previous trip.) "Now," he says, "let me get out my magic box of treasures." He presses the magic button on the top of his finger and his invisible treasure box opens.

"What are you taking out today?" I ask.

"I am not taking anything out," he says, "I am putting something in."

"What are you going to put in?" I ask, thinking maybe he would put in the feather he had found.

"I am putting in the whole world!"

"The whole world! … why are you doing that?"

"Because the whole world is a treasure."

"All the animals and plants and everything?"

"Yes the whole lot. I am putting it in here because someone has to keep it safe."

## Conclude 3: Visioning

Sit with me now in this space.

Let us vision together.

Where do you want to go?

Where do I want to go?

# Afterword

Owl quietly closed the book. “Hmph,” he said, “I think that something definitely needs to be done.”

The other animals looked at him, nodding.

He huffed and puffed a bit and blew out his chest. “I will be definitely writing a letter to the editor,” he said.

“What will be in it?” squeaked Piglet in anticipation.

“Definitely an F,” said owl.

“Oh.” said Piglet.

“Well I am going to do something too,” said Piglet donning a cape and sword. “I am going to be a warrior fighting for what I value. I am going to change the world.”

“Yes,” said Christopher Robin, “I am going to change the world too, but by being a transformed being living in the world.”

“What does that mean dear?” asked Kanga.

“It means I am going to change what happens in my school by being an enthusiastic and caring learner in my school. My teachers will just not know what hit them!”

“Hmmm,” said Rabbit, “I’m not sure about this going off and doing your own thing approach. I really think we need a committee. Hey Tigger, come and be on my committee!”

Tigger was jumping off a large tree stump and was very focussed. He suddenly realized all the animals were looking at him and exclaimed “I think I just felt momentum! I am just going to keep practicing until I get it right!”

Eyeyore started kicking the book with his hoof. “You know it is all a con,” he said. “We started out thinking there was going to be an answer and there are only more and more questions. Where is the answer?”

“Oh dear,” said Kanga, “I think you have missed the point. To come up with ONE answer is reducing everything to Flatland. It is the plurality of questions which keep the tensions alive and enable us to live with depth and humanity.”

“Well how are all those questions going to help you with Roo?” sulked Eyeore.

“Well I think right now I might spend some time with him. Be really present with him and just see what emerges. I am so busy being Mum that I have forgotten to be present in the moment, even with myself. I think that is what I am going to do right now.”

“And what are you going to do Pooh?” asked Christopher Robin, lovingly kicking the prone bear with his foot.
“Uh, what, uh, what?” said Pooh acting as if he had woken from a deep sleep. He looked at all the animals staring at him and yawned. “Did I miss anything?” he asked. “I was just having a very nice dream. It was about all my friends, sitting together having a picnic. There was lots of honey and condensed milk and we all had a very good time.”
“Even me?” squeaked Piglet, who often fell into holes and got mud on his clothes.
“Yes, Piglet, even you” smiled Pooh, patting his friend on the shoulder. “What is a bit of mud now and then when there are elevensives to follow.”

# Epilogue

Now at the end of any good story the author has a duty to tie up the threads and leave the reader with a sense of closure, even if the aim of the writing has been for the purpose of opening up. I have tried to tie up the threads of science, but what about my own threads?

Here in this autobiographical study I have invited you to enter deeply into my life world, to engage with my character and invest quite a few hours of your life in following this character's journey. So should there be a happy ending along with a glorious sunset? What happens to me?

Will I continue in science? Well I can't imagine going back into the physics box and teaching it again despite the wonderful experiences I have had with my classes and my love of the subject. Maybe opportunities might open up for me in education of science educators, who knows. I am really unsure of my direction and in the fullness of time it may become clear. Meanwhile, I am preparing for my next art exhibition in April 2007, called *"One day Mrs Higgins woke up and decided to be surprised."* It follows my 2005 exhibition of *"The seduction of Agnes Scornethope."* (see www.users.bigpond.com/rsstack/art)

I am also working with refugees from Africa and have helped in setting up a befriending program as well as assisting in the research and writing of testimonies in helping relatives of refugees to be able to immigrate to Australia. This has been an enormously powerful and moving experience for me, pushing me to new understandings of cultural difference and the implicit barriers in our society that marginalize other ways of knowing, being, and community. I might now use my newly developed ethnography skills to perhaps explore this area further.

Later this year I will be facilitating a ceramic sculpture course for African women (mothers and daughters) which will be linked to a trauma counseling program (many of these women have been raped and tortured.) But meanwhile I am building bridges between their community and ours by dancing with them as they teach their next generation their traditions.

And I am back in a Year 11/12 college, teaching journalism to keep me grounded in teaching reality, yet bouncing against that bottle again as I try to express openly my own holistic being as a teacher. Perhaps I can do something about that bottle in the process – maybe it can grow.

And despite the long days of writing where the fridge has gone empty and my husband has had to be creative in sustaining physical life, we are still a happy couple and will continue to be active in the global community, waving the holistic and integral flag.

And although I still have chronic fatigue, I am getting a lot better. I hope that this process of writing might help me to recover, helping me to name and then dis-identify with those habits of mind which constrain my soul and my health. I certainly stretched too far in this journey of mine – going on a marathon of transformation, rather than shorter excursions with time for integration. My illness has forced me to integrate in multiple ways of being and although I would not wish to experience this process again, I value what I have gained from it.

Perhaps now I am moving to a better understanding of the meaning of balance. But perhaps not. Perhaps I am just as precariously positioned as before, waiting for the next perturbing thing which will create the disequilibrium needed for growth. And perhaps that is part of the process of awakening. Perhaps as I become more

awake I can allow myself to *be* and see in ways that enable harmony and wholeness. But until that time I am still stretching…

*Awakening*