A junior version of the “whole game” of science

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This paper provides more detail and practical examples of what is meant by a "junior version of the whole game of science" in the paper *Primary science education for the 21st century: How, what, why?*

One way of laying the foundations for developing depth of understanding in science could be to provide opportunities for young students to play a junior version of the “whole game” of science. NZ teachers are familiar with the concept of modified sports for young players—this is the same idea but in science, rather than in cricket or rugby.

David Perkins (2009) argues that schools frequently attempt to make complex ideas accessible to learners by breaking them down into little pieces but as a consequence the “big picture” often gets lost. He suggests that junior versions are a way of providing “threshold experiences” that make challenging knowledge and practices accessible even to young students without losing the holistic nature of the activity. According to Perkins, a “whole game” is generally some kind of inquiry or performance. A whole game is never just about content—students are trying to get better at *doing* something. It involves problem finding[1] as well as problem solving, and requires thinking with what you know and pushing further. It involves explanation and justification. It is situated in a social context and involves curiosity, discovery, creativity and working with others.

Many projects that require students to design something could be considered junior versions of the game but some provide opportunities for students to interact with ideas that are central to the discipline of science more readily than others. For example a project that asks students to design an imaginary animal to *live in a given habitat* requires students to think about structure and function, adaptation, ecology. On the other hand a project that requires students to simply create *any* imaginary animal, although perhaps an interesting art activity, does little to develop key biological ideas.

Bailin (2002) describes a design project in where primary aged students use key biological ideas. In this project students are asked to design a habitat to house insect “pets”. The students have to find out about insect habitats; observe insects in their natural habitats; develop a set of criteria for a good habitat based on their research; design a habitat for an insect of their choice; and share and

[1] According to Perkins (2009) problem finding involves working out what a problem is really about. “It also involves coming to good formulations of problems, formulations that make them approachable. Often it also involves redefining a problem halfway through trying to solve it, out of the suspicion that one may not be working on quite the right problem.” (p26)

critically discuss each others' designs in relation to the criteria. In the course of these activities the students are encouraged to pose questions and pursue their own inquiries as well as explain and justify their choices.

A project that requires students to select the best site for developing a school garden is another example of a junior version of the game of science. Students could measure and record rainfall, type of soil, wind direction and strength, and the number of sunshine hours etc at various sites in the school grounds. They would also need to research the preferred conditions of the plants they are intending to grow and then use this knowledge and their data to make decisions.

Junior versions of the whole game need not be extended investigations though. Some junior versions of science can be "played" within short time frames. One example is the "rolling marbles" activity[2]. In this activity the students roll marbles down identical ramps. One ramp is set up so that the marbles roll off the ramp on to carpet, and the other so that the marbles roll on to bare floor. Students mark the spots where the marbles stop with coloured stickers. Structuring the investigation in this way (i.e. pairs of ramps) reduces the demand on children's memories by displaying more of the overall investigation simultaneously; makes data recording quick and easy so repeats are manageable and engaging; makes comparisons obvious; and makes effects of "unfair" management of variables more immediately obvious. In these ways even very young children are able to participate actively in an investigation that looks at the effect of different surfaces on the distances marbles roll, and begin to develop a sense of what is involved in science investigations.

Throwing and catching an air-filled balloon that also contains a water-filled balloon is another short activity that meets the criteria of a junior version of the game of science[3]. This balloon moves in unusual ways, and students are challenged to draw on their science knowledge to explain why it behaves in the way it does. In our experience people of all ages find this activity captures their interest and stimulates questions for further investigation.

Presenting students with a number of similar-looking substances (for example salt, sugar, baking powder, flour, citric acid, talcum powder etc) and asking them to design tests to identify them could also be considered a junior version of science[4]. This activity would involve students thinking about the properties of different materials and what they know about established scientific methods and strategies to design appropriate tests. It has a strong focus on problem-finding.

Almost any science topic could be designed as a junior version of the game of science. The teacher needs to think about what the topic would look like if it:

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[2] For more details of this activity see Assessment Resource Bank item PW4111. http://arb.nzcer.org.nz/

[3] For more details of this activity see Assessment Resource Bank item PW2548. http://arb.nzcer.org.nz/

[4] On its own this activity may not be particularly engaging but as part of a larger unit on forensic science for example it could fulfil the criteria of being immediately meaningful and also building toward some bigger goal.

- involves students trying to get better at *doing* something, rather than just acquiring content knowledge;
- focuses on *problem-finding* rather than just problem-solving;
- requires *thinking* rather than just following instructions;
- emphasises explanation and justification, and;
- promotes curiosity and open-mindedness.

Importantly, though, teachers also need to think about how the activity develops an understanding of the purposes and methods of science. Activities ideally should develop ideas that are significant within science and also have personal significance for the learners. Experiences should be immediately meaningful and engaging but should also build toward some bigger long term goal. (Perkins, 2009).

References

Bailin, S. (2002) Critical thinking and science education. *Science & Education*,*11*,361–375.

Perkins, D. (2009). *Making learning whole: How seven principles of teaching can transform education.* San Francisco: Jossey-Bass.