

## Sample lesson – a constructivist approach – the Candle

This illustrates the 6 phases of the active learning lesson in download 1.1  
(This lesson could be adapted for classes from KS2 to KS4)

### 1. Material must be meaningful to teacher and worthwhile to learner

The first step is to have material that is useful to the learner, and is understood by the teacher. We get pupils to take notice of something, and be curious about it.

IMPACT: Have a birthday cake with burning candle at the front of the class. What is going on when a candle burns?

### 2. Learner must have appropriate background ideas, experience, ability and teacher must take these into account

The next step is to see where the pupils are in their thinking through elicitation questions. Research shows that children often think the wax slows the burning, or is there to hold up the wick. Use a concept cartoon (or multiple choice question) with these two ideas, and also that wax is the actual fuel (that which burns). Ask pupils to whisper to their partner their choice (10 seconds), then get the class to vote.

ELICITATION: Get some reasons for each choice – for example “Perhaps wax slows the burning of the wick, after all a fat candle with lots of wax takes longer to burn than a thin one like those on the cake?”

These two stages: Impact and Elicitation have been labelled ‘*starter activities*’ by the KS3 strategy.

### 3. Learner must be motivated – must want to learn

Without motivated pupils all our efforts are wasted. Keeping the pupils motivated and on task is not always easy, but teacher enthusiasm for the subject matter helps, and this implies that the teacher’s subject knowledge is good.

### 4. Learner must have new ideas/skills presented (by listening, reading or watching)

This is where traditional teaching comes in. We cannot expect pupils to discover everything anew. We have already seen that pupils create their own naive interpretations of natural phenomena – we cannot expect them to have the same inspirations that scientists had. New experiences and new ideas need to be presented to the children, but to be effective they must be embedded in these other stages. Teachers need to *intervene* with a new idea (or clarify an idea suggested by some of the pupils).

INTERVENTION: Pupils need to realise that their initial idea doesn’t work so they are given an alternative. Since fatter candles contain the same length of *wick* as thin candles, yet give out much more light – couldn’t the wax be the fuel, just like oil of an oil lamp? Pupils could blow out a candle and then try igniting the white ‘smoke’ coming from the wick to see the flame jump back and relight the candle. If you see wax as a fuel, this provides you with powerful

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evidence: wax, evaporating from the still-hot wick, recondenses as a smoke trail and ignites. But if pupils still prefer the wax-is-a-flame-retardant idea, they may only 'see' the wick re-lighting and will decide to reject the wax-is-fuel idea – it seems sensible that fat candles burn slowly because there's so much wax to melt out of the way, slowing the burning of the wick. If we left teaching at this point pupils may 'learn' by heart that 'wax is a fuel' and get marks in teachers' tests, but 'know' in *their* reality that the 'wax is a flame retardant'. When teaching stops here pupils may remain trapped in their naive ideas, and the science they 'learn' in school would simply enable them to pass exams, then promptly be forgotten.

### **5. Learner needs time to reformulate the ideas/skills etc. to make them become a part of their understanding**

If you tell something to a pupil the chances are they will forget. They need time to translate from your intervention (teaching) into ideas that belong to *them* – the idea of *ownership*. Many times we are tempted to ask a class, 'Do you all understand?' and we get back the obliging chorus of 'yes'. The 'nod of agreement' from pupils hides a chasm of misunderstanding. The best way to check if we understand an idea is to communicate it to someone else. The act of explaining is only possible if you understand it properly yourself. This is why so many teachers say, 'It was only when I started to teach that I fully understood'. We need to give pupils this same opportunity to teach new ideas to others, or themselves.

REFORMULATION: In our example, pupils could be asked to make a work-sheet for next year's class to compare a candle, an oil lamp and a Bunsen burner, especially the fuels each uses (wax, oil and gas), and to explain why the candle and oil lamp need a wick but the Bunsen doesn't.

### **6. Ideas and skills must be used and applied**

However well an idea is understood, it is likely to fade in the memory if it is not used. The idea of a spiral curriculum, where topics are revisited frequently, is obviously important, but in every topic we must make links to previous topics and everyday experiences. Pupils should not see topics in science as isolated things that they have 'done' but as forming a part of a network of interconnected ideas. Concept mapping is a powerful way to encourage the making of links

USING IDEAS: Wax is clearly a fuel. Candles need a wick so the wax can evaporate and so catch fire. They used to be made of tallow, animal fat, which is also used as a fuel store for the animal. So the topic links to the topic of burning and respiration where fuel and oxygen combine forming carbon dioxide and water, and where energy stored in the fuel-oxygen system is transferred.

Based on Chapter 6 (pp 53-3) of  
Ross, K., Lakin, E. and Callaghan, P. (2004) **Teaching Secondary Science**. (Second edition)  
London: David Fulton