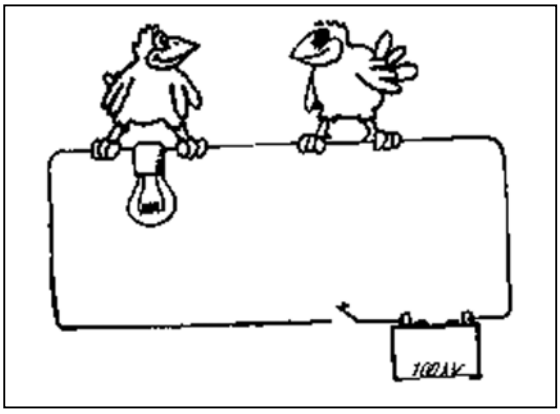
Teaching –learning module compiled by the PARSEL consortium
as part of an EC FP6 funded project (SAS6-CT-2006-042922-PARSEL) on
Popularity and Relevance of Science Education for scientific Literacy

The high-voltage Bird

Teacher Materials

Objectives/Competences

This task is embedded in the curriculum of electric current. Usually, students are trained to calculate and not to argue about physical facts. In this ecample, they have to show their understanding (and misconceptions) about the basic facts of the theme and use arguments for their assumptions.



Task description

The task is very simple: the students discusse the picture with their neighbour and try to find out what happens, when the switch is turned.

Developer: Stefan Burzin and a Teacher Group of the Sinus-Programme
based on an idea of Lewis C. Epstein, Thinking Physics, Insight Pr, 2nd ed. 1984
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Examples which show the different ways of developing the questions

Time	Activites and comments
0:00	The class watches the picture for a few moments and students mumble.
1:10	When the teacher asks what they think of the picture, their first idea is that one of the birds seems to be blind because it doesn't get power.
1.30	They came to this conclusion because of the eyes of the birds but soon abandon the idea with some laughter.
2:00	Then someone says the picture reminds him of the birds sitting on high-voltage power lines but don't get shocked, but if they touch both positive and negative poles they do.
	The left bird obviously bypasses the lamp and has to compensate the current.
2:30	After that, there is a few minutes silence and the class sums up what they found out: the left bird gets shocked because he bypasses the lamp.
3:00 - 7:00	The teacher ask how the bird does this and a student says the bird is not directly a cable but still closes the circuit. Longer disussion with some repeat elements guided through the teacher One Student draws a line through the bird which demonstrates the way the current runs.
	The students notice none of the birds is earthed which would be fatal, but the teacher puts them back on the track about the left bird and the way the current runs.
7:50	Someone adds that the current also runs through the lamp, the lamp and the bird are connected in parallel which results in laughter and further babbling while the original answer continues to be quite specific.
9:00	The teacher has to calm the class down and the student repeats that the bird has a greater resistance and therefore recieves less current. must be one half of the whole potential
9:30	They then precise this and conclude that both bird and lamp receive the same current.
10:00	When they get back to the other bird and why he does not get shocked, someone throws the term potential into the round.
10:30	The left bird sits on two poles and therefore on a greater potential which is due to the fact that the lamp is a consumer and has a resistance.
11:00	The teacher asked for more ideas and the students were quiet.
12:00	The teacher adds a new slide with birds on electric power lines.
12:30	The studends add ideas to interprete the pictures. The teacher brings the word "earthed" and ask for the interpretation, which was not completed by the students but by herself.
14:30	More explanations are given with strong help of the teacher.
16.30	End of the task

Table 1 – Example 1

Time	Teacher´s activity	Students´ comments and answers
unitl 1:00 min		desciption: electric circuit with lamp, power source, switch, two birds
1:30		the birds are voltmeters or something, you need them to find out the difference of potential
2:00		the question is wether the lamp will light up or not, I say it will, because it always does with these voltmeters
2:30		the switch is not closed, it wont light up
3:00		one of them is an amperemeter in series, the other a voltmeter in parallel

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3:30		i wondered what happens when you flip the switch
4:00		no bird gets a shock because they often sit on high voltage power lines and they can fly or something
4:30		the birds are not earthed and therefore nothing happens keyword difference of potential
5:00	teacher: what is the difference to high voltage power lines teacher shows pens to be used with the slide.	
6:00	why is there a difference in the electric potential? because the lamp uses something. - volts? - no, currrency	the left bird gets shocked, he sits on a difference of potential; the other one doesn't.
7:00	which one would live longer?	the left one would die.
7:30	if the birds would be voltmeters: which bird would be what?	the one on the lamp is a voltmeter
8:00	the left shows the currency, is the other one good for that too? -:	I think yes
8:30	is it connected in series? -	I think so
9:00	what should we do to use him as a real voltmeter. teacher concludes: we would clap our hands befor flipping the switch.	you would have to cut the cable between his feet to make the right bird show the current

Table 2 – Example 2

Time	Teacher´s activity	Students´ comments and answers
1:00	T: is it a poor bird or not?	he won´t get a shock, the switch is off and he has to touch both lines birds on high voltage power lines don't die either
1:30	T: switched off - what happens? nothing	of course nothing, no current flows
2:30	T: switched on - what happens? (1 minute of thinking)	S1: the bird does not take damage S2: of course it does, because of the difference of potential
3:30	T corrects: battery is regularly connected	nothing happens because the battery is not connected…
4:00		he stands on both poles of the lamp, thats why something happens
4:30	T: how would he have to sit so that nothing happens?	if there was no lamp, nothing would happen. beside the lamp
5:00		couuld it be that the lamp does not light at all? - good question, what kind of circuit is this?
5:30		in series... no, in parallel so where is more current?
6:00		same, same, then: through the lamp, because the bird has got a higher resistance. laughter, then:

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	T: exactly correct	
6:30	T: the bird has got a lot higher resistance, thats why the lamp recieves more current	
7:00	T: the bird will die anyway, because he sits on the difference of potential. now what about those high voltage power lines?	
7:30	T: you have to do some experiments laughter	student: how many volts could a bird survive? joke,
8:00	T: what about birds on high voltage power lines	birds on high voltage lines dont touch the ground, thats why they don't get a shock
9:30		if a bird touches two lines, it gets a shock
10:00	T: that's difficult, but there is at least no flow of current	student: if a bird first touches a line and then the ground, would it discharge? -
10:30		T: why do storks die because of high voltage power lines? S: because they get shocks when touching two lines
11:00		could a spark jump over if a bird sat on a line and came too close to another?
11:30	teacher draws picture	
12:00	what does it depend on, if there is a spark between someone hanging at a high voltage power line an the earth?	voltage and distance
12:30		depends on currency
13:00		depends on material of the shoes, wet hands
13:30	T: what else does it depend on, where ist the electric power runnign through? T: air is a poor power transmitter, vacuums have got a small resistance, wet air helps too	the body and the air
14:00	T shows the slide again. What happens when you place the bird next to the lamp?	
14:30		a small amount of current runs through your body
15:00		a very small amount, because the resistance is very high
15:30	teacher draws the bird parallel to a piece of wire: what sort of circuitry is this?	
16:00	you learned that there is no difference of potential everywhere. that's not really true: a little current flows here	parallel.
16:30	depends on the sort of current	When current flows through the body, your heart beats faster -
17:00	T: something gets lost...	S: current? energy.
17:30		S: voltage, because there is a small resistance
18:00	T: if the bird had ist feet further away from each other, something would happen	
18:30		A student comes back to the man hanging at a power line. if the guy hanging fom the high voltage line: when he lets go and hits the ground, will he discharge
19:30	T: the question is whether he would charge at all. his capacity is too small, but it happens.	

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	T: no	Student: if you built a lamp into the bird, would it light? - if you built a lamp from the material of the bird, would it light?
20:00	T: if you only access one wire of a high voltage line, nothing happens, you need two. it's the same as with a power outlet: you need two conductors.	

Table 3 – Example 3 (The teacher uses a picture with only one bird sitting parallel to the electric bulb.

Bibliography

Lewis C. Epstein, Thinking Physics, Insight Pr, 2nd ed. 1984#

Description (in German) http://sinus.lernnetz.de/aufgaben1/index.htm?group=1&ugroup=1

Hints for the teacher

Students should be able to argue about facts using their basic knowledge instead of calculating numbers. This example is about life and death and can't be calculated. The expected effects are spontaneous interest and motivation to solve the task.
Students have to know techical terms like current. The approach in class is to present a foil at the beginning of the lesson and give students a few minutes to express their ideas. The results are presented in class conversation.
Further questions are: why do particularly swans die of high-voltage power lines? What is so dangerous about high voltage?

As their motivation will be fairly high, working on the task should be done in two minutes and the following class conversation should not take longer than five minutes. Most students know what will happen when the switch is turned on but won't be able to explain why. Tendencies are to fall back into early learned explanations (the current chooses to...

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