The chi wheel

What's the mystery?	Can people really move objects through the power of their mind? In this lesson, students witness the amazing chi wheel, which claims to work by focusing chi energy. Students test hypotheses to obtain scientific explanations about how it really works.
Domain(s)	Physics.
Subdomain keywords	Hypothesis, particles, density, particle model.
Age group	11 to 14 years old.
Expected time for the mystery	Approximate time for teacher preparation: 15 min. Approximate time in classroom: one 50-min lesson.
Safety/supervision	Students need to be careful when using hot water. Be aware that spillages may occur and that the floor may become slippery, causing a hazard. Disclaimer: the authors of this teaching material will not be held responsible for any injury or damage to persons or properties that might occur in its use.
Preparation and list of materials	**For teacher demonstrations:** A piece of paper around the size of a post-it stamp, an eraser, needle, or pin to make a chi wheel. For instructions, search for 'psi wheel' on the website 'Wikihow'. Water balloon filled with cold water (keep this in the fridge before using), bowl, cold water from the tap, warm water. **Each small group of students will need:** Large beaker of cold water, 4 polystyrene cups, hot water, food colouring, disposable pipette.
Learning objectives	Students will describe how the spacing of particles changes as a fluid is heated and use this to explain why hot fluids rise.

Guidance notes for teachers

This classroom-tested teaching plan uses the four innovations of the TEMI project, as detailed in the *Teaching the TEMI Way* book (TTTW). You should read this companion book to get the most from your teaching.
The TEMI techniques used in this teaching plan are: 1) productive science mysteries (TTTW section 1), 2) the 5E model for engaged learning (TTTW section 2), 3) the use of presentation skills (showmanship) to engage your students (TTTW section 3), and 4) the apprenticeship model for learning through gradual release of responsibility (GRR) (TTTW section 4). You might also wish to use the hypothesiser lifeline sheet (available on the TEMI website) to help your students document their ideas and discoveries as they work.

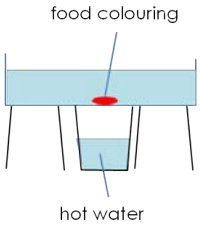
Engage: capture students' attention.

Tell the class you can move things with the power of mind. Show them the chi wheel and explain that it works by sending out chi energy from your hands (see the resources section below for a video).

Invite a student to try the wheel. They will find that it does not move immediately. Stop the student before it moves. Secretly (so the rest of the class can see what is happening but not the volunteer) warm your hands in hot water then try. Show that you can get it to work.

Ask the class for their ideas on how it works. They should be able to suggest that warmth from the hands it making the wheel turn.

Explore: collect data from experiments.



Explore 1: experiment to test the hypothesis that hot fluids move. Students are guided on how to use the hypothesiser lifeline. They carry out an experiment to show that hot fluids rise.

Explore 2: why do hot fluids rise? Explain the effect of heat on particle spacing, and thus density, and how this can explain why a warm fluid rises. Then students are challenged to test the hypothesis in a further experiment. Fill a water balloon with cold water and float it in a bowl of cold water. Ask students to use particle diagrams to write a new testable hypothesis.

Explain: what's the science behind the mystery?

Students link their answers to the previous questions and provide a complete explanation for the original mystery of the chi wheel. More able students can explain how the temperature of the object, its position and the distance it is from the wheel affects the speed of the chi wheel.

Extend: what other related areas can be explored?

Demonstrate with a homemade hot air balloon (search on 'Wikihow') or use a video to show what happens when a hot air balloon is filled.
Discuss with students about how filling the balloon with hot air makes it rise.

Evaluate: check the level of student scientific understanding.

The students are challenged to apply their new ideas about particles in order to explain why a hot air balloon rises when inflated.
Student responses can be used to assess their understanding of the learning objective.

Showmanship: tips on how to teach and present this mystery.

The engage part of the lesson is the place for showmanship. Present the chi wheel as a mysterious phenomenon. When the student volunteer is trying out the chi wheel, ask them to send chi energy from their hands to move the wheel. When you perform the trick, pretend that you are using chi energy. During this part of the lesson, do not be scientific!
We also suggest not revealing the learning objective until after the engage stage is complete so as to maintain the mystery.

GRR: teaching skills using Gradual Release of Responsibility

Demonstrated enquiry (level 0): this takes place during explore 1. The teacher reveals to the class a basic explanation of what makes the wheel spin (the warm fluid rises). They use the hypothesiser lifeline to develop the hypothesis with students.

The students are shown the experimental set up for explore 1. They make an experimental prediction supported by the hypothesiser lifeline and then try the experiment. They will see that the food colouring rises in the colder liquid and can use the lifeline to conclude that their hypothesis was correct.

Structured enquiry (level 1): this takes place during explore 2. The teacher adds a scientific explanation to the hypothesis in terms of the effect of heat on particle spacing, and thus density, and how this can explain why a warm fluid rises. The students are then challenged to test the hypothesis in a further experiment. A water balloon is filled with cold water and floated in a bowl of cold water. The students are then asked to design a test based on the hypothesis of the effect that the heat will have on particle spacing and density. They use particle diagrams to help them predict what will happen. The only sensible suggestion which would show anything different is to put a balloon filled with cold water into a bowl of warm water (which will sink). The teacher then carries this out and the students make conclusions about their hypothesis.

Solving the mystery: students are led towards the explanation by using ideas about the particle model and how warmth from your hands causes the air around the chi wheel to become less dense and rise.

Resources

Instructions on how to make a chi wheel:
http://www.wikihow.com/Make-a-Psi-Wheel

Video clip: Psi Wheel revealed (TEMI Youtube channel – playlist)

Video clip of hot air balloon being filled: hot air balloon lunch (TEMI Youtube channel – playlist)

THE STUDENT WORKSHEET CAN BE COPIED AND USED IN THE CLASSROOM. Note that, in some cases, answers to earlier questions may be found later in the student worksheet.

The chi wheel

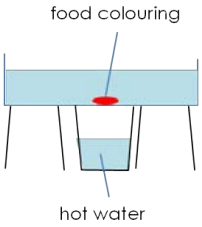
Some claim that the mysterious chi wheel proves that people can move objects with only the power of their minds.
Can you use science to explain how it really works?

Engage: what's interesting?

Task	What did you observe? How did your teacher get the chi wheel to move?

Explore: what's happening?

Task 1 One hypothesis is that warm gases and liquids rise.
Set up the experiment. Use the hypothesis to make a prediction: what will happen when you put the hot water under the food colouring?



Task 2 Carry out the experiment.

Task 3 Describe what happened. What does this tell you about the hypothesis?

Task 4 What happens when particles are heated? Use this to explain your hypothesis that hot fluids rise.

Task 5 Watch your teacher carry out another experiment using a balloon.
Use the lifeline to design a test to back up the hypothesis and write a prediction.
Use particle diagrams to help you.

Task 6 Your teacher will carry out your test. Are your ideas correct?

Explain: what's causing it?

Task	Use what you have learnt about particles to explain how the chi wheel works.

Extend: what's similar?

Task	Watch a hot air balloon being filled with warm air. What happens?

Evaluate: what's my understanding?

Task	Apply what you have learnt to explain how a hot air balloon works.