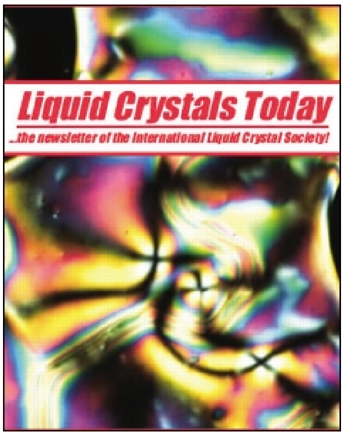

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Liquid Crystals in Education

Gregory P. Crawford[a]
[a] Xerox Palo Alto Research Center, USA

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Education

Liquid Crystals in Education

Liquid Crystals Beyond Research and Development: An Educational Perspective

Gregory P. Crawford, Xerox Palo Alto Research Center, USA

The advancement of liquid crystal science and technology has been a truly interdisciplinary effort which combines basic principles of physics, chemistry, and engineering. The success of liquid crystal materials in flat panel displays and electro-optic applications can be attributed to the collaborations of scientists in various fields and the unique interface between academia and industry. Many scientists and engineers engaged in liquid crystal research are also educators in their respective disciplines and/or area of expertise. Those in academia routinely teach undergraduate and graduate courses in physics, chemistry, and engineering, and those in industry often find themselves teaching technical short courses and seminars. Many of us have visited elementary and high schools in the USA to speak to students about careers in science and engineering, and to present some eye-catching demonstrations that excite students about science and technology.

It is the hope of *Liquid Crystals Today* to capitalize on the vast amount of interdisciplinary research and education excellence in the liquid crystal community to create an interface between liquid crystal science and technology and education in an attempt to bring our rich field to a wider audience. We wish to incorporate educational contributions in forthcoming issues of *Liquid Crystals Today* that utilize the fascinating properties of liquid crystals to demonstrate basic underlying scientific principles and/or articles describing contributors' experience with liquid crystals as a teaching tool.

The educational component of liquid crystal science and technology has great potential, but to date has gone largely untapped. In fact, many introductory science textbooks, especially those at the elementary and high school level, have yet to acknowledge liquid crystals as a phase of matter. This is somewhat startling because most students at any level can immediately identify the acronym LCD, but often they do not realize that liquid crystals are a genuine phase of matter. As a teaching tool, liquid crystals provide a unique way to link science and technology, and provide great examples of materials that demonstrate the link between the various scientific disciplines [1]. From spectacular optical effects to the intricacy of flat panel displays, liquid crystal science and technology is rich in physical phenomena that can be exploited for educational purposes.

Since there are many levels of education in which we participate, we hope to accommodate articles that are appropriate for all levels of education; from visual demonstrations for elementary students to experiments that can be implemented

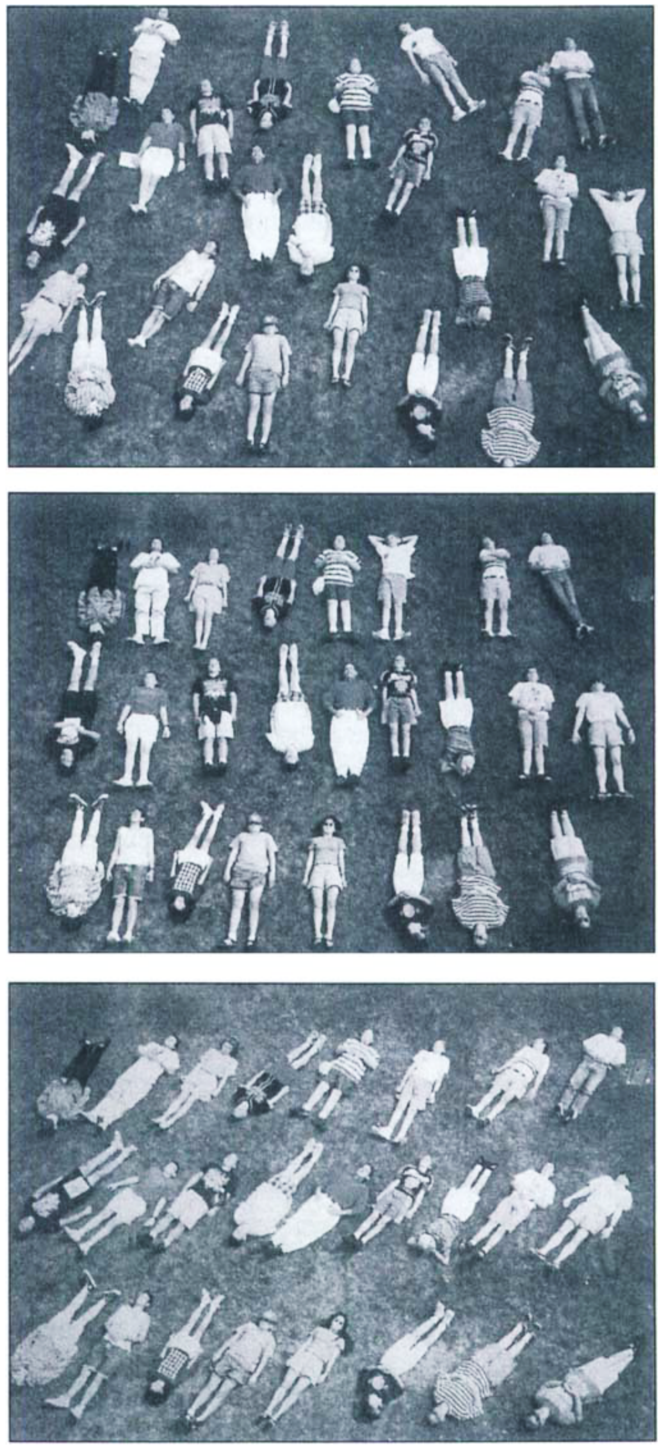

Figure 1. High school students simulating the nematic (top), smectic A (middle), and smetic C (bottom) phases of matter. The students participated in an educational program funded by the National Science Foundation's Science and Technology Center ALCOM at Kent State University, Ohio, USA.

into the undergraduate university laboratory. Relatively simple experiments illustrating various aspects of physics and chemistry are extremely visual and exciting – what better examples of phase transitions are there? Some experiments using liquid crystals are as easy as rotating a twisted nematic (TN) cell between crossed polarizers on an overhead projector to demonstrate polarization rotation. Another simple demonstration is to heat a TN cell above the clearing temperature of the liquid crystal, and as it cools, students can optically observe the phase transition. The polymer dispersed liquid crystal (PDLC) display (commercially available, Reference 3) provides a great example of light scattering and index matching [2]. No longer will you have to submerge a glass rod into glycerin and watch it disappear to demonstrate index matching; the PDLC offers an example of index matching implemented into modern technology. Cholesteric liquid crystals are useful for demonstrations concerning circular polarization, colour, reflection, temperature, etc. Very inexpensive demonstrations can be performed using a flashlight, polarizer, and quarter wave plate to show how circularly polarized light interacts with the planar texture of a cholesteric. A piece of temperature sensitive cholesteric film (commercially available, References 3 and 4) is an ideal tool to observe the concept of heat flow traversing from points of higher temperature to lower temperature. Other experiments, such as those that take advantage of the electro-optic properties of liquid crystals [5], may be more complicated and suitable for advanced high school and undergraduate science students.

In many cases demonstrations and experiments require very little or no resources to perform. High school students who spent a week learning about liquid crystal properties and applications at the National Science Foundation's Science and Technology Center for Advanced Liquid Crystalline Optical Materials (ALCOM) at Kent State University decided to have a little fun by simulating several of the liquid crystal phases (Figure 1). Such a simple exercise provides students with a feeling of how molecules order in the various liquid crystal phases.

There are many eye-catching and exciting experiments that can be performed with liquid crystals to teach basic principles of science and engineering. Experiments involving liquid crystals have tremendous potential because of the visual impact they have on students at any level. We encourage the members of the liquid crystal community to participate in the educational aspect by sharing their thoughts and experiments using liquid crystals for educational purposes. The goal of the education column is to facilitate an ongoing dialogue between scientists and educators so that liquid crystals science and technology is accessible to a wider audience. If you wish to share your ideas on educational aspects of liquid crystals, please contact Greg Crawford, Xerox Palo Alto Research Center, 3333 Coyote Hill Road, Palo Alto, CA 94304; CRAWFORD@PARC.XEROX.COM

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