

The Materials in Your New TV:

The Liquid Crystal Display

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Abstract

This module provides students with an introduction to liquid crystal display technology, with an introduction to the components of the LCD, including the glass substrates, electronics and liquid crystals. It is based on a video developed by Corning, Inc. focusing on their LCD glass product with additional information on other components. A follow-on module provides information on the liquid crystals themselves.

Student learning objectives: The student will be able to

- Explain the components of an LCD system
- Describe the process for making LCD glass
- Illustrate a typical glassy structure
- Define a liquid crystal
- Discuss the applications of liquid crystal displays

MatEd Competencies Covered

6C Apply concepts of electricity

6D Apply concepts of light

7E Illustrate the general nature of glass

14A Distinguish structure, properties and behavior of glass

16A Distinguish effects of processing and manufacturing variables on material properties

Key Words: Liquid crystal, liquid crystal display, glass, glass processing, glass structure

Type of Module: discussion with PowerPoint presentation

Time Required: one period

Pre-requisite Knowledge Required: None

Target Grade Levels: Advanced high school, introductory college courses

Table of Contents

(to be completed)

Equipment and Supplies Needed: Computer and PowerPoint projector with Internet access

Curriculum Overview and Notes to Instructor

This module is part 1 of two lessons focused on liquid crystal displays (LCDs). This module provides an introduction to the LCD, and focuses on the glass substrates used in the process. A lesson on the more detailed nature of liquid crystals is provided in part 2.

The PowerPoint presentation is self-contained. Each slide should be presented and discussed.

Slide 2 introduces the LCD display--ask the class what they know about LCDs.

Slides 3 – 7 discuss glass structure, processing and products. Each can be discussed in terms of what the students know and what their questions are on each of the subjects.

Students who want to know more about glass manufacture should be referred to reference 1.

Slide 8 provides the lead-in to a video, "Window to Information" by Corning. This is an introductory video on making an active LCD display. This LCD display is of the type used in HD TV's and other electronics. It is recommended that you review the Corning video prior to teaching this module. The video may be found at: http://www.corning.com/r_d/technology_exploration/consumer_electronics.aspx Click on Window to Information and choose English.

The menu at the bottom left of the screen contains the following sections:

- Corning and LCDs
- LCD Applications
- What is an LCD?**
- Corning manufacturing process**
- Eagle 2000**
- Eagle XG**
- Corning LCD glass innovation
- etc

It is recommended that you use the 4 sections in bold, which omits some of the commercial nature of the video while providing the information needed to understand an LCD and the glass substrates. These 4 sections take about 10 minutes (total) to review.

Slides 9 – 14 are a follow up with more details on the LCD and its components. They provide the opportunity to discuss each component of the system. Much more detail is available on the Internet for interested students. In particular, students may be referred to reference 2 for more detail on how LCD's work and their components. As appropriate, you may also want to review the web sites referred to in references 1 and 2 to enhance your background.

Module Procedure:

1. Ask the students: "What is actually IN an LCD Display?" Discuss
Definition of LCD—Liquid Crystal Display
What makes it work?—integrated circuits
What is the basic substrate for the system?—glass
2. Show the PowerPoint and discuss each slide, as appropriate as discussed in the instructor notes. Show the Corning video as noted after slide 8 of the PowerPoint presentation.
3. Conclude with a general discussion. The questions listed under evaluation may be used in this regard, as appropriate for your class.

References:

1. Making glass: <http://www.youtube.com/watch?v=WBA8KrGkQZ4>
(video shows process of making standard float glass, 7 min.)
2. How LCDs work: <http://electronics.howstuffworks.com/lcd.htm>
(includes a more detailed discussion than the Wikipedia slides given in the PowerPoint).

Acknowledgment

The authors wish to thank the reviewer for his clarifying comments.

Evaluation Packet:

Student evaluation questions (discussion or quiz):

1. What is the basic process used in making LCD glass?
2. Why is precise control of the glass-making operation so important?
3. What property of the liquid crystal is essential for LCD operation?
4. Why are the electronics mounted on the glass substrate instead of being separate components?
5. Did the module load properly (including the video portion)?
6. Were you able to understand the information provided on the video?

Instructor evaluation questions:

1. At what grade level was this module used?
2. Was the level and rigor of the module what you expected? If not, how can it be improved?
3. Did the discussion/PowerPoint work as presented? Did they add to student learning? Please note any problems or suggestions.

4. Was the background material on LCDs sufficient for your background? Sufficient for your discussion with the students? Comments?
5. Did the discussion/PowerPoint generate interest among the students? Explain.
6. Please provide your input on how this module can be improved, including comments or suggestions concerning the approach, focus and effectiveness of this activity in your context.

Course evaluation questions (for the students)

1. Was the discussion/PowerPoint clear and understandable?
2. Was the instructor's explanation comprehensive and thorough?
3. Was the instructor interested in your questions?
4. Was the instructor able to answer your questions?
5. Was the importance of materials testing made clear?
6. What was the most interesting thing that you learned?