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Full concept maps are given to the students for specific topics covered in the courses. An example of a concept map handout appears in Appendix A. HyperCard stacks containing the Voyager Videostack resources have been developed to present portions of the concept map and to access images held on the videodisc. The use of the videodisc, a Macintosh computer, and a NView video projector allows the lecturer to rapidly switch between the concept map and the video images. This enables the students to quickly build visual associations with the concepts. This union of word and image has allowed the development of courseware that takes the traditional lecture presentation into a new dimension.

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Concept Maps and Interactive Video

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BACKGROUND

Research and experience on human learning and problem solving has lead numerous science educators to investigate concept mapping techniques. Based on Ausubelian psychology, concept mapping is a visual method which allows teachers and students to clarify relationships between concepts associated with a particular topic. Concept mapping is seen as a promising tool to increase meaningful learning in the classroom. It is useful in planning curriculum, instructing students, and evaluating student understanding. While the technique is certainly not limited to science, numerous science educators have found concept mapping to be a valuable teaching/learning tool.

Ausubel (1968) emphasized that the difference between meaningful learning and rote learning hinged on the ability to anchor ideas in a cognitive structure. Rotely-learned material can only be related to cognitive structures in a verbatim form which results in an isolated or

arbitrary association. Concept mapping has been shown to be a valuable tool which will increase meaningful learning (Novak, Gowin & Johansen, 1983). A simplified concept map for electric charge can be found in figure 1.
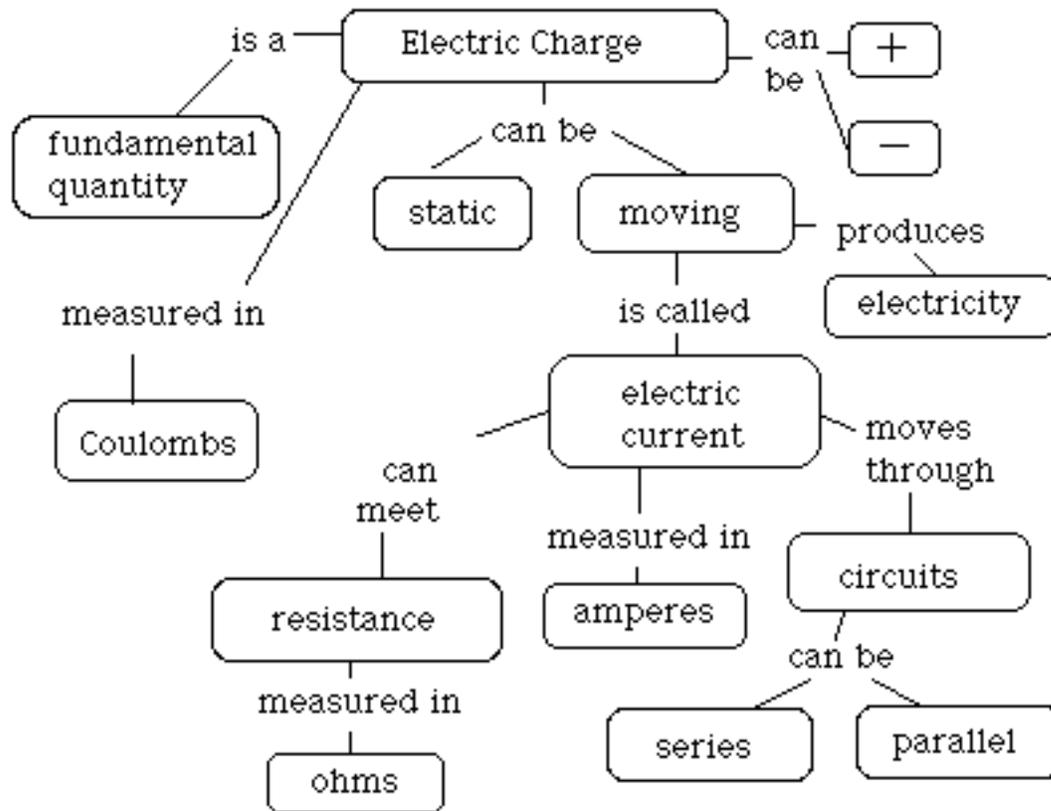
Fig. 1. A portion of a concept map which shows the relationships between terms associated with electric charge.

INTERACTIVE MEDIA

Too often science instruction creates a situation where terms are memorized without any real understanding. The use of "interactive multimedia" has served to illustrate terminology in conjunction with a lecture presentation. While the traditional twenty to thirty minute film may be useful, the same major points can frequently be made with shorter multimedia displays. The concept map-interactive videodisc project is based on the belief that students can make greater links with lecture materials if the video materials are tied briefly, but immediately, to the instruction.

The advantages of interactive video make it an ideal tool for instructional purposes. The ability to quickly access a pictorial database of photographs, graphics, and short film clips

stored on a videodisc provides an opportunity to illustrate the concepts under discussion. Elliot Eisner (1991) referred to words as "image surrogates." Eisner states that "...there is an icon -- a stylized image of reality -- underlying any term that is meaningful" (p. 49). Words are meaningless unless a learner can relate the concept directly to a meaningful image. Too often science instruction has settled for increasing student vocabulary at the expense of student understanding. While a concept map can supply a holistic view of the relationships between concepts, the pictures on a videodisc can be used to actually illustrate the "image" behind the words used in the maps.

Videodiscs can contain up to 54,000 frames or pictures in either film sequences or single images. The images are stored in uniquely numbered concentric circles that can be quickly accessed by a laser beam. Although a remote control unit or a laser barcode reader can access the images, the use of the computer allows sophisticated HyperCard programs that can branch in response to different inputs or selections.

A sample of the HyperCard stack that controlled the videodisc during the lecture presentation on compounds can be found in figure 2. Each stack developed for the physical science course has been controlled by video resources from The Voyager Videostack software. While similar authoring resources are available from other vendors, it is necessary to purchase some version of resources to add to the HyperCard software in order to control the videodisc play through the computer.
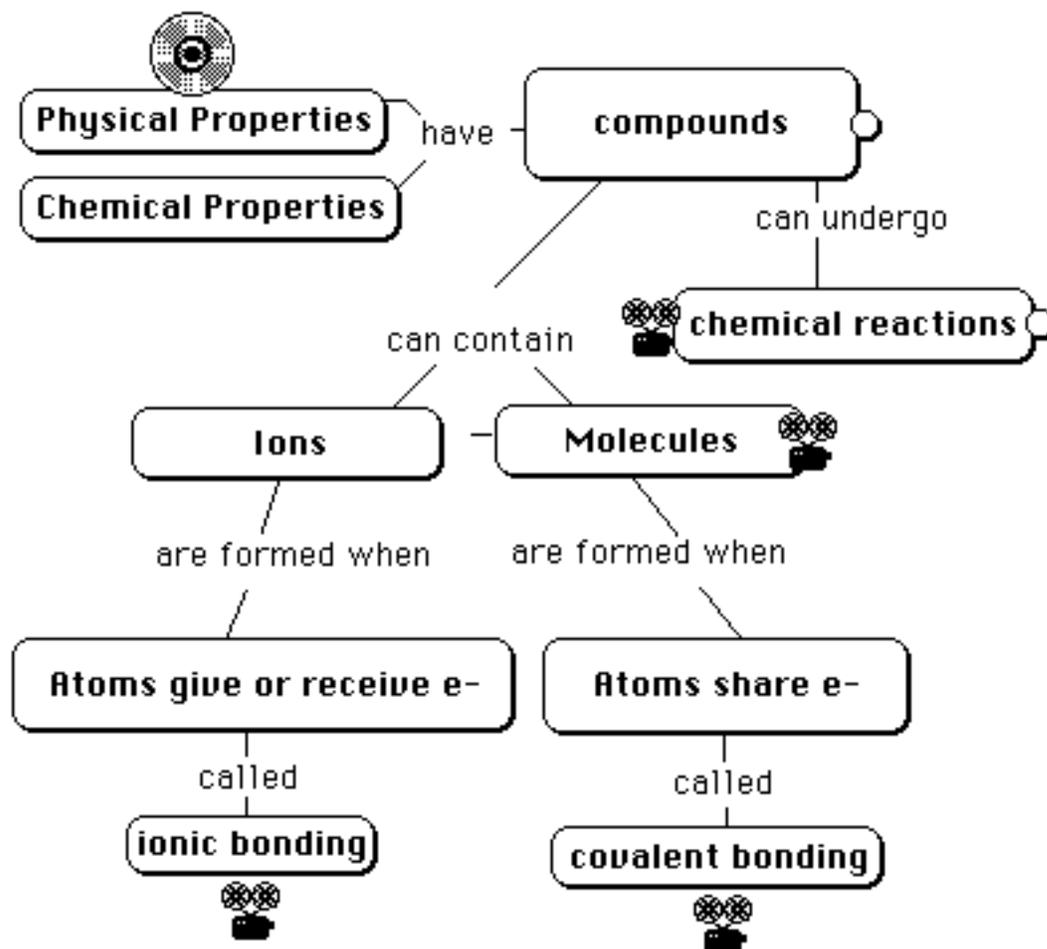
Fig 2. A card from the HyperCard stack which controls the interactive videodisc presentation for compounds.

THE EQUIPMENT CONFIGURATION

The use of a videodisc, a computer, and a big screen video projector allow instructors to develop courseware that takes the traditional lecture presentation into a new dimension. This configuration of equipment is referred to as a Level III Videodisc System controlled by a computer interfaced to the videodisc player. It combines the power of a computer with the audio and visual information stored on the videodisc. The controlling software determines the level of interactivity. Authoring level HyperCard software must be used along with video resource software to develop instructional packages and control the player.

Two types of videodiscs are produced, the constant linear velocity disc (CLV) and the constant angular velocity disc (CAV). The CLV format is used for linear applications such as movies, documentaries, concerts, etc. It is considered the "Extended Play" format. While the linear track length is held constant, the rotation speed varies from 600 to 1,800 rpm, depending on the distance from the center of the disc. This format allows more frames to be stored on the

disc, but this format does not allow the random access of individual frames. It is possible to search by chapter stops or time.

The CAV format is the most useful format for education. It is considered the "Standard Play" format. One side of a 12" disc can hold up to 54,000 video frames (30 minutes of motion video) which can be used in interactive applications. The videodisc rotates in the player at a constant speed of 1,800 rpm. One frame is stored on each of the 54,000 circles allowing access to any frame location within a few seconds. A single frame can be "frozen" for study. The two audio tracks can be played individually or simultaneously.

The equipment for the project can be described as follows:
- Macintosh II si computer with 5 meg ROM
    HyperCard software and The Voyager VideoStack Authoring software
- Pioneer CLD-V2400 Laserdisc Player with remote control
    D-SUB 15 pin connector to 25 pin connector in computer.
- A VHS videotape player
- A small color monitor for instructor viewing
- An overhead projector (4000 lumens by Dukane)
- A 50 watt powered monitor speaker with phono input and volume control (Anchor An 1000)
- A multimedia LCD panel by nView Corporation accepts VGA, Mac II, or video input. Input sources are selected via remote control. Produces 32,000 true colors and projects full-color images. (640 x 480 resolution)
- A video input switcher for multiple video input and one output

BUTTON SCRIPTS THAT CONTROL THE VIDEODISC PLAYER

The scripting level of HyperCard, a Macintosh system software, is ideal for the creation of concept maps because it easily combines text and graphics on to cards that are similar to 3 x 5 cards. The concept terms can be typed into buttons without any directions or scripts. Labeled button or icons can "hold" specific directions, which in this case, control a videodisc player. Samples of three buttons and two script appear in figure 3.
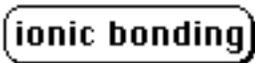
No script is needed.	on mouseUp	on mouseUp
This serves as a label.	video framemode	video sound, 1, on
	video search, 3451	video framemode
	end mouseUp	video search, 4587
		video play, till, 8956
		end mouseUp

Fig 3. Buttons and scripts from a concept map created with HyperCard and Voyager Videostack software.

The ionic bonding button is just a label that can be moved easily on the card, allowing proper positioning of the concepts. Linking words can be typed and lines can be drawn using the painting tools within HyperCard. This was illustrated in figure 2.

The creation of custom button is very easy because an icon editor is located in the File menu. The button that resembled a videodisc was used to access a single frame or image. A series of single frames can be created similar to a timed slide show with a timed pause command between each video search line. For example, "wait for 5 seconds" would show the image for 5 seconds before the next image was displayed.

The film projector button was designed to link with a script that would find, then play, a film clip or movie. Since two sound tracks can be stored on a videodisc, it is important to designate the proper sound channel. Many discs have one sound track for English and the other for Spanish. Once the starting frame is accessed, then the play command starts the film clip and stops it when it reaches the end frame number.

STUDENT REACTIONS TO THE PRESENTATIONS

Students were surveyed to determine what conditions foster the most meaningful interactive video/ concept map lecture. A sample of their comments can be found in the following list:

• The diagram enhances the lecture...The videos let us see what we are discussing looks like in real life.

• Sometimes its better to see things on the screen rather than hearing it.

• It helps when the concept maps are up on the screen so you can see how things are connected.

• We think that this equipment is great. [The presentation] explains things in full detail and that makes it easier to take notes. We like this form of class because sitting through lecture tends to get boring.

• Makes it easier to understand because it gives example. Makes things more interesting.

• Nice to see modern technology used. Like not taking notes and actually understanding material!

• Reemphasizes everything - helps put it into long-term memory.

Suggestions for improvement centered on better lighting conditions which would allow easier note taking while keeping the lecture hall dark enough for proper video visibility. This problem will be addressed with dimmer switches on side lighting.

Presentations that ranged from approximately 10 minutes to approximately 30 minutes have been tried. Most students prefered one or two shorter presentations per lecture mixed with more traditional lecture and small group work. Students have suggested that the variety helps them to "stay awake" compared with showing a film or videotape in a darkened room.

The preliminary results of the Northwest's instructional project indicate that the multimedia presentations have been a successful way to increase student attention in large lecture courses. Additional faculty members will participate during the Fall semester of 1993. Research related to student achievement with or without the use of the interactive video / concept map presentations will continue.

References

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APPENDIX A

MENDELEEV — developed by — PERIODIC TABLE — organized by — ELECTRON CONFIGURATION

PERIODIC TABLE — shows — SYMBOL

PERIODIC TABLE — shows — ATOMIC MASS — is — Average of isotopes

PERIODIC TABLE — shows — ATOMIC NUMBER — is — # of Protons

COLUMNS — similar in — ELECTRON CONFIGURATION

COLUMNS — called — Groups or Families

Groups or Families:
*Alkali
*Alkine earth
*Halogens
*Nobel gases

ROWS — called — Periods

PERIODIC TABLE — classifies — ELEMENTS

109 — up to — ELEMENTS

ELEMENTS — have — Isotope Forms

ELEMENTS — react to form — Molecules — Chemical Formula

ELEMENTS — have — Chemical Properties

Isotope Forms — each have — Mass Number

Isotope Forms — vary in — Neutron Number — described by — Atomic Nomenclature

Chemical Properties — determined by — Valence Electrons

Valence Electrons — are — e- in outer shells

Valence Electrons — shown by — Lewis dot structure — :Cl:

Valence Electrons — can be — Gained / Lost / Shared

Gained — to — Fill outershell — by non metals

Lost — to — Get down to full shell — by metals

NUMBER LOST OR GAINED — results in — Net Charge

NUMBER LOST OR GAINED — is — valance