

# THE JOURNEY INSIDE

The ISTE newsletter of classroom ideas and hardware information.

US\$3.00

## The Disk Drive in Action

Many of us have never seen the inside of a disk drive. Do you or your students ever wonder what is happening when all that whirring and buzzing and clacking is going on? I enjoy showing students of all ages the inside of a disk drive. Not only does it help them understand what all those strange noises mean, but it also makes them more sensitive to the importance of handling floppy disks with care.

If you have an Apple "Disk II" (the older drives with the black front), then you will find it relatively easy to demonstrate the mysterious inner workings of a disk drive to your students. These older drives are quite simple to take apart so that students can actually see what happens when the disk drive is running. You don't have to be a mechanical genius, and you won't damage the disk drive if you follow the given steps carefully. (If you have newer drives, I would advise discussing this idea with a technical expert, such as the repair person at your local computer store, before you begin.)

### Taking Your Disk Drive Apart

- Be sure your computer is turned off. Better yet, unplug it.
- Turn the disk drive over. Remove the four screws on the bottom.
- Carefully slide the cover backward so that you don't pinch the ribbon cable that goes from the disk drive to the computer.
- Put the disk drive on the table with the door facing you. On top you see a green circuit board containing chips and other electronic parts.
- At the front right-hand edge of the circuit board is a white plastic plug with a tiny multicolored twisted wire coming from the plug toward the front of the drive. Gently pull the plug toward you until it comes loose. Notice that the four pins that fit into the plug match four asymmetrical holes; thus, you can't make a mistake when you plug it back in.
- Remove the two small screws at the front edge of the circuit board.

- Now, gently pull the board toward you. It is held down at the back edge by holders that are part of the black plastic frame on which it sits. Flip the board toward the back of the drive. You can then see the moving parts of the disk drive.

Note: Your drive *may* have a metal plate covering the drive mechanism. With a piece of masking tape, mark the front edge of this plate. (If you put this plate in backwards when you are finished, the drive won't work.) Lift the plate up to remove it. It simply snaps onto the metal arm below.

- Now you can see that the twisted wire attached to the white plug you removed earlier goes through a couple of clamps along the side of the black frame on which the circuit board sits. This wire runs all the way to the back of the drive mechanism. Carefully remove the wire from the clamps. Then push the white plastic plug back into the board.
- Now you can examine the mechanical parts of the disk drive in some detail. There is a small black arm that comes from the back of the drive mechanism. Flip the arm up gently and you will see a tiny pad on the underside. This pad cleans dirt off your disk and presses the disk against the read head. The white spot below the arm—usually rectangular—is the read head. (Did you know that an Apple 5.25" disk is read from the back? That's why it's a bad idea to lay a disk down, label side up, on a dirty table.)

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## Welcome Letter From ISTE

I imagine that many of you who have received *The Journey Inside* newsletter are wondering, "Who or what is ISTE?"

The International Society for Technology in Education (ISTE) is a nonprofit professional society of educators working to improve education. ISTE has thousands of members who are classroom teachers—classroom teachers who are committed to helping their students understand and make effective use of technology.

ISTE has played several roles in Intel's *The Journey Inside* project. For example, ISTE helped to write the materials for students and teachers, and to do the desktop publishing of these materials. ISTE also developed and publishes the newsletter you are now reading.

It is relatively easy to learn to use technology in an unthinking, mindless manner. It is more difficult to have an understanding of how and why the technology works. That is the underlying philosophy of *The Journey Inside* project. ISTE is happy to be able to take part in assisting you and your students.

ISTE provides a wide range of services to its members. ISTE publishes a dozen different periodicals, runs both a Gopher and a World Wide Web server, sponsors conferences, offers teacher education courses through distance education, and sells a wide range of books and courseware materials. If you want to fully participate in the educational uses of computer technology, consider becoming an ISTE member.

*Dr. Dave Moursund*  
Executive Officer  
ISTE

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ISTE provides an interactive forum for national and international dialog concerning the appropriate use of technology in education. We support the unique needs of educators by improving access to instructional tools, initiating and endorsing relevant legislative policy issues, and holding special conferences. By joining ISTE and demonstrating your support, you are helping us to achieve the following objectives. **Leadership:** Provide national and international leadership for using technology in education. **Professional Community:** Provide an environment for, and encourage development of, a professional community of individuals interested in technology in education. **Information and Materials:** Provide individuals and groups with high-quality and timely information and materials that support use of technology to improve learning and teaching. **Research, Development, and Implementation:** Encourage research, development, and implementation of appropriate technologies to improve learning and teaching. **Infrastructure:** Develop and administer an organizational infrastructure that empowers the ISTE community to achieve its mission. **Alliances:** Develop and maintain strategic alliances to enhance the ability of ISTE to accomplish its mission.

— Continued from page 1 —

Note: You can gently move the whole read-arm mechanism—it slides along two metal rods above a large white plastic circle. This sliding back and forth is what you hear as the drive is reading your disk.

- You are now ready to see how the drive actually works. Take a disk and slide it into the drive. You can see how the read/write window on the disk fits over the area where the read head can move. Close the disk-drive door. You see how the disk is clamped in place so that it spins when the computer is turned on and accesses the drive. The motor doing the spinning is under the white plastic circle that holds the center of the disk in place.
- Next, you need to prepare to run the disk drive with the mechanism exposed. Before you begin, take a soft, thick piece of cloth (like several folds of an old t-shirt) and put it over the metal part of the case at the back side of the disk drive. Now let the circuit board fall against the cloth. Be sure there isn't any stress on the small wire. Check carefully to be sure that the board is not touching the metal and that the board is securely braced so that it won't fall. *It is important that the board not touch metal at any time after you turn on the computer.*
- Now, plug in your computer and turn it on without putting a disk in the disk drive. You will see the read arm trying to find a disk. It will move all the way back and "chatter" as it unsuccessfully looks for a disk. Turn your computer off again.
- Put a disk in the disk drive and turn on the computer. You'll see the read arm search for track 0 at the outer edge of the disk. If you chose a DOS 3.3 disk, the read mechanism will skip to the middle of the disk to find the catalog. If it's a ProDOS or Pascal disk, it will read the catalog from the outer edge of the disk. If you use an applications program, the read head will read the outer track and then follow the directions for finding various parts of the program.

### Preparing Your Lesson

If you plan to use this activity in your classroom, take the disk drive apart and test the disks you want to use before your students arrive. It's easier to prepare this activity when curious students are not present. Spend time selecting appropriate disks. It is particularly instructive to use a disk the students are familiar with and let them see the disk boot up. It's also lots more fun if the read arm

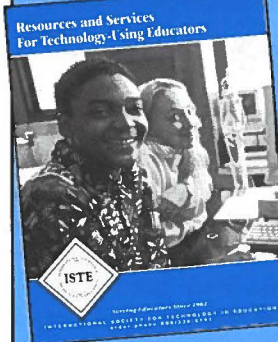
moves around a lot. You might try something like the old *Apple Presents Apple* disk because it is clear that the computer reads a picture from the disk and then displays it on the screen. When you press a key on the keyboard, you can see the disk drive search for the next piece of data. Have the disks you plan to use ready beside the computer. During the lesson, you might also take an old disk apart so that students can touch the disk itself and see how it turns inside its case.

The demonstration works best with only four or five students around the computer. Plan some seat work for the rest of the class while each group has a chance to observe at the computer. If you have collected a "show-and-tell" kit of transistors, circuit boards, various kinds of disks, pictures of various computers, and the like, you could use this time to pass these items around the class.

When you gather your students around the computer, they should be as close as possible to be able to see the monitor and down into the computer. The diagram on page 4 gives one possible arrangement. You can have the two groups of students switch sides occasionally so that they can get closer to both the disk drive and the computer.

— Continued on page 4 —

## Be Resource-full!



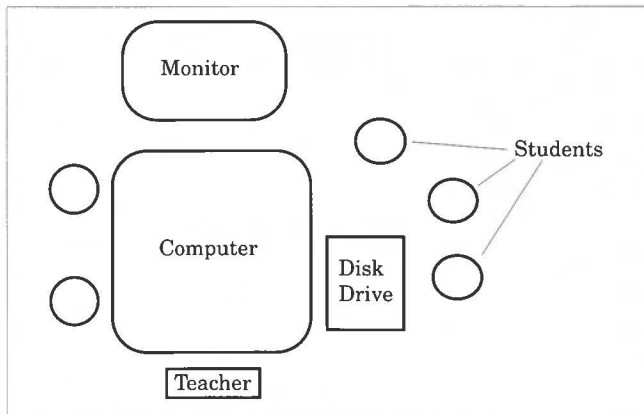
Be resource-full with the International Society for Technology in Education's free guide—*Resources and Services for Technology-Using Educators*. Our guide is full of the resources and services you need—people, products, conferences, courses, special interest groups, organizations, and more.

ISTE is a nonprofit, self-supporting organization dedicated to the success of educators just like yourself. ISTE publishes a wide range of products from application-based curricula to directories of educational resources. As a service to our members we also offer other publishers' products that have been carefully reviewed and selected for you.

If you've attended one of Intel's *The Journey Inside* workshops, you will automatically begin receiving your own copy of ISTE's *Resources and Services for Technology-Using Educators*. Our Resource Guide is published three times a year.

If you don't already receive ISTE's *Resources and Services for Technology-Using Educators* and would like to—call ISTE at 800/336-5191 for your free guide.

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Possible seating arrangement.

## Teaching the Lesson

Begin the activity with the computer off. I generally take the top off the computer while showing how a disk drive works. You can point out the CPU, RAM chips, ROM chips, interface cards, and sound and video ports. On an Apple IIe, these are printed on the board and easy to identify. Let students touch the chips. If you have been using the computer, the chips will be warm, even hot, so advise caution.

Next, explain how information goes from the disk drive, along the cable, through the interface card, and finally to the big board in the computer (the motherboard). Then, demonstrate how a disk goes into the disk drive, showing the read-head and read-arm mechanism as previously described. Finally, start a disk by turning on the computer. Talk about what is happening. Let students press keys on the keyboard in response to prompts from the program. Use this time to emphasize that the disk is a very sensitive mechanical device. Point out the importance of putting disks back into their sleeves so that they don't get dirty. You might even put a damaged disk in the drive and show the students how the disk drive simply can't find information on it.

It is important that you encourage questions. I have found that students of all ages (including adults) are a little overwhelmed when they see a computer in pieces. They seem hesitant to touch it or even get very close to it. Middle school and secondary students are sensitive about being viewed as dumb by the hacker types in the class who seem to understand all this mysterious equipment. Be sensitive to those problems and perhaps plan your groups accordingly.

When you are finished with this activity, simply reverse the steps described above. Begin by unplugging the computer, just to be safe. As you put the drive back together, be sure to tuck the little wire back into its slots and tighten each screw carefully. Soon your disk drive will be back to normal, and you and your students will better understand the inner workings of your computer system. □

by Sharon Yoder

Full article, including graphics,  
available in *The Computing Teacher*  
(1990, Volume 18, Number 1), published by ISTE.

## Question & Answer

### Question:

What is meant by the term "tinned wires"?

### Answer:

Wire is tinned by dipping the ends into liquid solder. This process holds the fine strands of wire together to create a strong, longer lasting strand and enhance the connection strength. However, tinning the ends makes the connections harder to secure. Since the wires in the chip kit have been tinned, you may want to purchase alligator or P-clips. You and your students will find the circuit activities easier to complete if you use these tools.

### Question:

Is a floppy disk software or hardware?

### Answer:

Many computer users mistakenly refer to the floppy disk as software. The mistake is a very natural one because much of the software we use is moved to our computer from floppy disks. During this process, there is little need to distinguish between the software and its storage component, so we use the term software for both purposes.

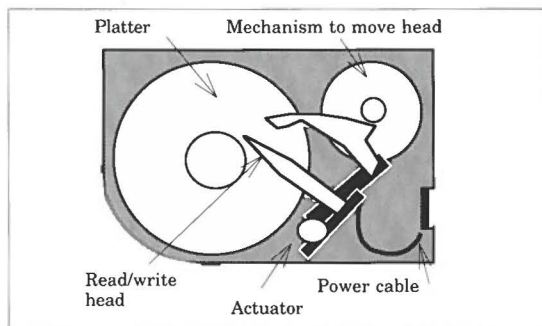
One way to decide if you can refer to an item as hardware is to determine if you can touch, see, and feel the item. Using this approach will help you to remember that the floppy disk is part of the hardware your computer uses.

It might be useful to use an analogy to help you and your students distinguish between the software and the floppy disk. Software is like the music you hear when listening to an audio tape or CD. You cannot see or touch the music but you can react to it and are aware of its presence—similar to software. On the other hand, you can hold or carry the tape or CD—like your computer system's hardware. □

## The Hard-Disk Drive

If you have only just begun your journey with computers, you may still be puzzled by the role of the hard-disk drive (hard drive). You may still think that the 80 MB or 120 MB drive you have provides more space than you could possibly use. Wrong. As your computer experience develops, your demands for storage will increase. Before you decide to add a new drive, learn how your drive functions and what factors would influence your purchasing decision.

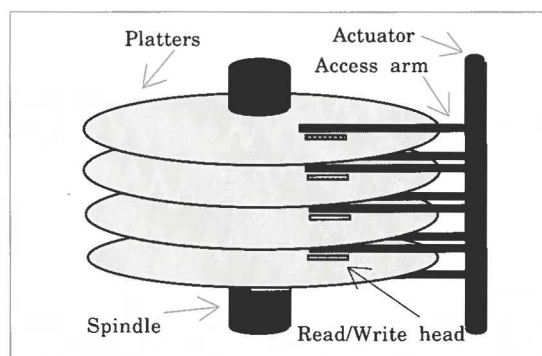
Do you know how a hard drive is constructed and how it manages to both read and write information? Of course, there are variations in the way a specific drive is created, but the following diagram gives you an inside view of a typical hard-disk drive. The information will help you understand the role of each component you see.



Because of the nature of the magnetically stored data, the hard drive is carefully constructed. In essence, the hard drive is sealed to create a miniature “clean room,” much like the fab. Air is drawn into the hard drive through a micropore filter and circulated. This creates a positive pressure inside the drive that helps prevent contaminants from entering the drive case.

### The Platters

Inside a hard-disk drive you will see platters sitting on a spindle (see following diagram). Such platters are often made of glass or aluminum and



coated with a thin magnetic film. A glass platter can hold more data. In addition, the magnetic

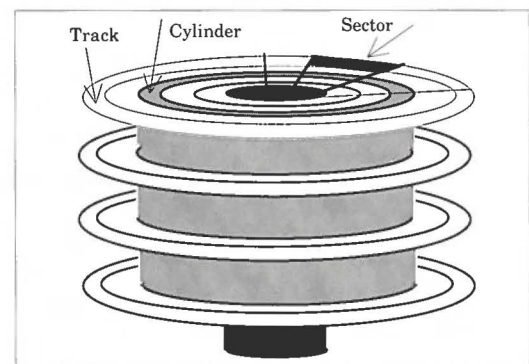
coating can be varied to increase the density of data storage. The diameter of the platters varies but is most frequently 2.5" or 3.5". Increasing the number of evenly spaced platters adds storage capacity.

Each platter has two read/write record heads—one for each side of the platter. These heads are responsible for aligning the magnetic particles in such a way that data can be recorded and read. The head does not actually come into direct contact with the platter to either write or read the data.

A small electrical motor is needed to drive the platter. The fast spinning of the platter helps create a cushion of air keeping the record head aloft. The head usually rides about 0.5 microns above the platter—a distance considerably smaller than the diameter of a human hair.

### Format of the Platter

Data are recorded onto the platter in a specific pattern. The tracks, or concentric magnetic grooves, are placed onto the platter with the read/write head. This occurs when your hard drive is formatted. Each track is then divided into sectors (see following diagram). Each sector can hold 512 bytes of data. In addition, each track with the same number on all the platters is assigned a cylinder number. All track “0s” are on cylinder 0.



Your computer keeps a record of which sector is used to hold each file. The “address” information includes the sector, the platter, and the side of the platter used. The Macintosh stores the information in the directory files, which are placed on the outside track of the platter. The DOS machines, however, store this information in the File Allocation Table (FAT).

The hard drive combines both electrical and mechanical components in a complex but efficient system. Despite the seemingly delicate nature of the parts, hard drives are amazingly resilient. The tight seals prevent contaminants from entering, and ordinary care in handling will ensure that your drive continues to function for a long time. □

## Calendar of Events

### IMAX Film Schedule

Intel's IMAX film, *The Journey Inside: A Learning Adventure in High Technology*, supports the information in the education kit. The film is currently playing at a number of theaters, and other bookings will be announced through 1995. For availability in your area, contact your local IMAX theater.

#### Through June 1995

Science Museum of Virginia  
2500 Broad Street  
Richmond, VA 23220-2054  
804/367-1013

Reuben H. Fleet Space Theater  
Balboa Park  
San Diego, CA 92163-3303  
619/238-1233

Edmonton Space and Science Centre  
11211 142nd Street  
Edmonton, Alberta T5M 4A1  
Canada  
403/452-9100

Sapporo IMAX Theater  
North 1 East 4 Chuo-ku Sapporo-shi  
Hokkaido, Japan 060  
81-11-207-5255

#### Through July 1995

La Geode  
26, avenue Corentin-Cariou  
75019 Paris, France  
33-1-40-05-79-02

Detroit Science Center  
5020 John R. Street  
Detroit, MI 48202  
313/577-8400

#### Through September 1995

National Museum of Photography,  
Film and Television  
Pictureville, Bradford  
West Yorkshire BD1 1NQ  
England  
44-274-727488

#### Through October 1995

Tamo Rokuto Kagaku-kan  
5-10-64 Kubo-cho Shiba Tanashi-shi  
Tokyo, Japan 188  
81-424-69-6100

Matsuyama Sogo Community  
Center/Cosmo Theater  
7-5 Minato-cho Matsuyama-shi  
Ehime, Japan 790  
81-899-43-8228

#### Through January 1996

Oregon Museum of Science and Industry (OMSI)  
1945 SE Water Avenue  
Portland, OR 97214  
503/797-4000

#### Through 1996

Canadian Museum of Civilization  
100 Laurier Street  
Hull, Quebec J8X 4H2  
Canada  
819/776-7062

### Workshop Schedule

Intel continues to provide workshops for teachers interested in using the program. These free workshops provide ideas and suggestions for using *The Journey Inside: The Computer*. Teaching methods, activities, and reference materials are included in these presentations.

April 18, 1995  
Firth School District  
735 N. 600 E.  
Firth, ID 83236  
Chris Wilmes: 208/346-6848

Groveland Elementary School  
165 N. 370 W.  
Blackfoot, ID 83221  
Betsy Goeltz: 208/785-8829

June 16, 1995  
NECC Conference  
Baltimore Convention Center  
Baltimore, MD 21204  
ISTE Preconference Activity

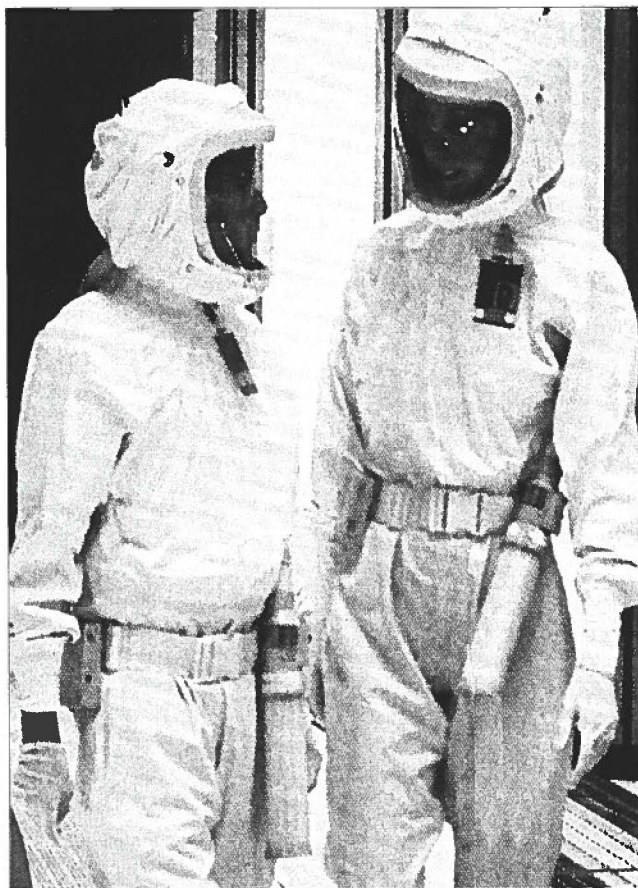
Pending: April 17 & 19, 1995  
District 91 & District 251  
Idaho Falls, ID  
Doug Poole: 208/525-7555

Workshops will continue to be offered. There have already been a number of requests for the upcoming year, but the schedule is still open for more requests. If you are interested in organizing a workshop for your area, contact Irene Smith at ISTE, 1787 Agate Street, Eugene, OR 97403-1923, 503/346-2375. Workshops are scheduled on a first come, first serve basis. □

## California Students Enjoy IMAX Film

*The Journey Inside: The Computer* lends itself to discovery learning through many modalities of teaching, especially through cooperative, collaborative modes of learning. Our participation in the program began when we took a field trip to the Reuben H. Fleet Space Theater in San Diego's Balboa Park to see Intel's IMAX film, *The Journey Inside: A Learning Adventure in High Technology*.

Prior to viewing the film I gave the students a brief description of the film and its key messages. We reviewed new vocabulary they would hear and some of the things they would see. They were amused by the idea of "bunny suits" and just what



*Examples of bunny suits.*

such a suit would look like. Along with the prefilm activities, I sent home a letter to my students' parents/guardians explaining what their child would be seeing in the film and experiencing in the next few weeks of science class.

The students enjoyed the film very much, particularly the scenes involving the tour through the fab and seeing how everything works. They were amazed at the cleanliness required in the

room where computer chips are made. A favorite scene was the one in which Jimmy put on a virtual reality helmet and flew through the inside of a microprocessor, described as being "as complex as a city, but no bigger than a fingernail." The students were able to relate many of the scenes and analogies in the film to the lessons covered in the classroom kit.

The city analogy carries over well into the classroom and supports the intermediate lesson in Unit One. The students enjoyed the comparison of a city to a microprocessor and understanding that just as traffic lights control the flow of cars on streets, transistors control the flow of electricity in a computer chip.

I was able to reinforce concepts like this with the hands-on materials from the "chip kit," which provided many exciting opportunities for the students to learn about how a computer works. My students constructed actual circuits, enabling them to understand how and why electricity flows through a computer chip. Experiments like these sparked lots of interest in my students.

I feel very fortunate to have the opportunity to implement this program for my students. I've learned a great deal myself, and plan to continue using *The Journey Inside: The Computer* in future science classes. □

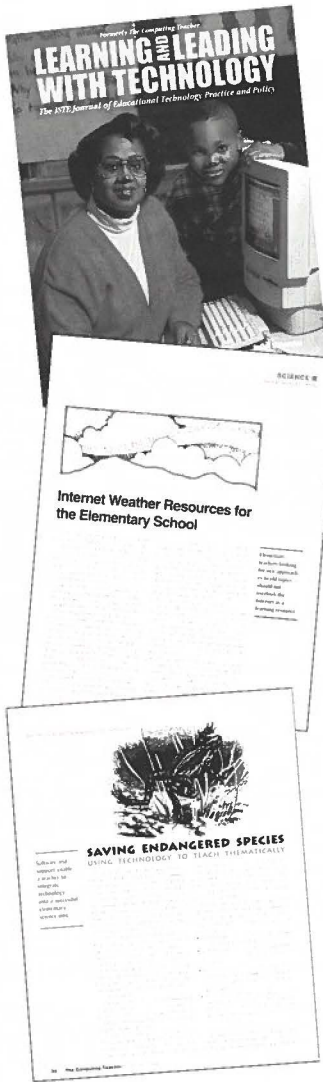
*Eileen Grady-Romero*  
Chula Vista Junior High School  
Chula Vista, CA

## Film Activity Guide Available

Intel has an activity guide available to help teachers effectively use the IMAX film experience. This guide includes a brief summary of the film and prefilm information, including key concepts covered in the film, vocabulary, and a letter for parents that is included with the field-trip permission slip. The six postfilm lessons include lesson goals, key concepts, vocabulary, preparation notes, student readings, and classroom activities. A glossary and list of other resources complete the guide. Teachers planning to take their class to the IMAX film or view this film on their own can contact the IMAX theater and request a copy of the activity guide.

Please note that arrangements regarding film schedules, costs, and so on are handled by the IMAX theater hosting *The Journey Inside: A Learning Adventure in High Technology*. Check with participating theaters for specific details. A list of current sites showing the film is included in this newsletter. □

# Make ISTE Part of Your Lesson Plan!



As an active science educator participating in Intel's *The Journey Inside* project, you realize the importance of having access to good teaching materials. The International Society for Technology in Education (ISTE) helps teachers like you meet your curriculum needs.

*The Computing Teacher* is designed for computer-using teachers. Published eight times a year, this magazine focuses on the use of technology in the classroom and on educational technology planning and policy. Beginning May 1995, *The Computing Teacher* will be renamed *Learning and Leading With Technology*.

Most new issues of *Learning and Leading With Technology* will continue to contain a science curriculum article involving the use of technology that has been classroom-tested for you. Your ISTE membership includes the option of selecting a subscription to this popular 72-page, four-color magazine.

Contact ISTE today for details!



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