Music educators can no longer ignore the possibilities afforded by computers and the related fields of science and mathematics. Abundant evidence exists that our sophisticated space-age children are ready to explore these possibilities and to deal with them in creative ways.

In November 1967, the Masterman School, a public school in Philadelphia, Pennsylvania, for gifted children, was awarded a grant of $316 from the superintendent of schools' to establish an electronic music laboratory. Creation of the laboratory was a logical outgrowth and extension of the MENC-Ford Foundation Young Composers Project that has been in operation in the Philadelphia Public Schools for the past three years.

In organizing the electronic music laboratory, fifteen children from the sixth, seventh, eighth, and ninth grades between the ages of eleven and thirteen were initially chosen to participate. The response to this program was so enthusiastic that the laboratory was immediately expanded to include thirty-eight members, and a waiting list was established.

The qualifications for membership are that each child must (a) play an instrument, (b) indicate an interest in music composition, and (c) express a serious desire to explore the realm of electronic music and to learn the techniques involved in writing for this medium.

The laboratory is in operation five days a week, sometimes until 4:30 P.M., although the actual working time is dependent on the regularly scheduled music activities, which vary from day to day. The group is scheduled to meet one period a week, and the remainder of the time is spent in independent taping of the compositions. Each student has a permanent partner, and the pair may work at any time that the music

The students involved in the Julia R. Masterman School's electronic music project are living proof that the supposed gap existing between the artist of today and his public need not exist, and will very probably almost cease to exist in a generation. These students, given the opportunity of working in pure sound (much as a painter works directly with paint on canvas) and without the necessity of learning the elaborate symbol system of traditional notation have produced music that is astonishing in its imagination and very unselfconscious in technique. It is almost frightening to contemplate what results these young composers would achieve if given a full-scale synthesizer to work with. The dozens of pieces produced already belie the crudity of the machines used: Their very limitations are used by young ears as assets.—Andrew Rudin, Director, Electronic Music Studio, Philadelphia Musical Academy, Philadelphia, Pennsylvania.

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room is available and it is convenient for them to be
excused from other classes.

After a short period of experimentation, it was found
advisable to limit the number of students recording at
one time because of the aggressive temperament and
individualism of this age-group. Nowhere can the old
adages "Three's a crowd" and "Too many cooks spoil
the broth" be more readily applied than to the writing
electronic music by gifted children. With the wide
choice of frequencies, filters, and tape speeds, the
composition can quickly be distorted from its original
graph into an unrecognizable, meaningless form. Each
individual must be guaranteed the right to develop
his musical composition in his own way without inter-
ference.

Once recorded, the compositions were played for
various general music classes so that composers could
profit from audience reaction. Each composition was
also played during the scheduled weekly session of the
laboratory for an audience of other student composers.
These sessions were designed to be evaluative.

In supervising a program of this kind, the teacher
must constantly remember that his role is to give direc-
tion, provide guidance, and make suggestions that may
or may not be accepted by individual composers. In
a pioneer field such as this, one should always be aware
that arbitrary rules of right or wrong do not exist. Any-
thing is possible within the boundaries of sound and
sensation, if it is an honest, aesthetic, and artistic
expression of the way in which the composer relates
to his environment.

At no time should the instructor assume the role
of a dictator, guided by an outdated philosophy that
only the "teacher knows best." With the establishment
of an open-minded, flexible atmosphere, unhampered
by the dusty rules of tradition, the teacher will be con-
stantly amazed and inspired by the students' novel
ideas and creative approaches to musical composition.

Caution! Although anything is possible, everything
should not be permitted. In this incipient stage of a
student's musical development, the disciplined experi-
ence of creating logical compositions within the frame-
work of accepted musical form is imperative. Although
students should become aware of the concept of alea-
toric composition (eleven of the twenty-six members
in the first class purchased John Cage's book, Silence),
the use of indeterminacy and chance elements in com-
position should be reserved until the students have
demonstrated their understanding of and competence
to compose in various musical forms. Concurrent with
a rigid adherence to traditional form, the children
can be given a measure of freedom of expression to
avoid stifling the possible creation and development
of new musical structures.

The first meeting of the laboratory proceeded with
a step-by-step introduction: (a) Diatonic, pentatonic,
and twelve-tone scales were reviewed, and the class
discussed Western semitones and Oriental quarter
tones. (b) The group heard a recording of a micro-
tonal chant sung by Tibetan monks. (c) An explana-
tion was made of how a sinusoidal tone, produced in
a vacuum tube, differs from the tone of any known
musical instrument, in that it has no overtones. (d) Two diagrams were drawn on the blackboard: a draw-
ing of the irregular curve of a conventional tone,
coupled with the symmetrical sine-curve produced by
an electronic tone, and a diagram of the thousands of
tones within the limits of audibility, each of which
can be isolated only by electronic means. (e) Musique
concrète, aleatoric writing, and John Cage's silent com-
position of nonmusic, 4'33", were mentioned. (f) A
description was given of the method of notation, em-
ploying graph rather than manuscript paper. (g) Two
recordings of electronic music were played: Lemon
Drops, because of its delicacy, was deliber-
ately chosen to ease the listener gently into this new
world of sound. Futility, on the other hand, was sel-
ected to test the reaction of the group to the harsher
elements of electronic music. One might conjecture
that the children would immediately reject the second
composition as a meaningless conglomeration of noises,
utterly foreign to their accepted ideas of music. The
reaction to Lemon Drops was favorable, but when
Futility was played, the response was somewhat akin
to a standing ovation. At the unanimous request of
the audience, it was repeated.

The transition from listening to composing was ac-
complished with ease. Junior high school students
found little difficulty in expressing themselves in what
could have been viewed as an alien sea of sound. Not
only were electronic sounds acceptable and pleasing
to their ears, but the students displayed a technical
understanding far greater than one might expect. Four
of the boys asked permission to stay in the music room
during the lunch period to listen to more of the record-
ings. When the instructor returned, they presented
their first composition, Variations on Futility, using the
audio-generator, orchestra bells, timpani, cymbals,
and a narrator. Amazingly enough, some segments of
this composition were quite effective.

With the unexpected stimulus of Futility, the enthu-
siasm for the project exploded in all directions. Nu-
merous compositions were quickly submitted, along
with urgent requests for immediate taping. Many of
the children wrote poetry and narrations to accom-
pany their music. The art teacher soon began to en-
courage her students to illustrate their compositions.

As a next step, the young composers visited the
Princeton branch of the Princeton-Columbia Elec-
tronic Music Center. Composer David H. Steinbrook
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described electronic music and demonstrated the potential of the electronic equipment at the Center. Valuable ideas and impressions were also absorbed by visits to the electronic music studios at Columbia University, the Philadelphia Musical Academy, and the University of Pennsylvania. In May 1968, twenty-eight members of the group attended the dress rehearsal of Michael White’s electronic music drama, Metamorphosis, based on the story by Kafka, in Philadelphia.

As a direct result of the meeting with Mr. Steinbrook and after considerable research at the Franklin Institute, a scientific society and museum in Philadelphia, William Serad, age thirteen, submitted a technical report, complete with schematic diagrams, on the possibility of using an analog computer for writing electronic music. William thought that this computer would be useful in the writing of such compositions as "Study in Square Roots" or "Cube Root Canon." His report was later discussed with Robert A. Moog, president of the R. A. Moog Company, Trumansburg, New York, manufacturers of electronic equipment, who agreed that this idea was feasible. With this encouragement, William constructed a four-sound, push-button switch, serial sequencer, which he used in writing an electronic canon. He has since made a working model of a tri-amplitude mixer module. Another member of the class, Randy Kaplan, age twelve, was inspired by the linear controller at Princeton to build a threesound, push-button switch, serial sequencer with mixer. The teacher will not always understand every wire and transistor, but he can always tell if the equipment operates properly, and he can assist his students to use such devices musically.

For a teacher who a short time ago was reluctant to change a fuse, the effect of this electronic activity has been revitalizing. In order to keep pace with the class, it has been necessary to learn a new vocabulary, brush up on basic acoustics, and keep The Audio-Cyclopedia constantly at hand. To this end, the instructor enrolled in an electronics course, taught by an engineer at RCA, and now proudly holds a certificate in electronics. Background for the teacher was further improved through participation in a course in electronic music directed by Andrew Rudin, composer at the Philadelphia Musical Academy. Communicating competently in the electronic medium compels the music educator to learn new skills and to broaden his horizons. The results are well worth the effort. The electronic medium may prove that music education can make its own distinctive contribution to the contemporary demand for more creative, innovative, and experimental programs to meet not only the needs of individual students but one of the great challenges of our time.


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students are forced to listen and to discriminate. Comments on the record jackets by composers are helpful when they provide details about the equipment, the structure, and other considerations of the composing process.

After a year, the student of electronic music should possess a great deal more understanding of traditional music as well as a broad experience in the contemporary idiom. Throughout the year the student continues to discover new sounds and new techniques. His musical vocabulary expands with his listening experiences. Even more important, he gains perceptions of musicality. His sensitivity develops and he begins to perceive music as a communicative art.

As a final project in the course, each student submits an original electronic composition. These pieces are three to five minutes in length, are taped, and must be scored. Each student is also held responsible for identifying, by sound, excerpts from several different electronic compositions.

The electronic music class meets once per week. There are five sections. While each student is assigned to one section, he may sit in on as many other sections as his schedule will permit. By scattering the classes during most of the school periods, any interested student is free to enroll. In conjunction with this schedule, seven independent music periods are arranged in the same manner. These periods enable an individual or small group to carry on independent projects.

A majority of the students taking the course now own some electronic equipment. They experiment at home. As an encouragement, students are permitted to borrow the tape recorders, record player, and any of the small equipment, such as the tape splicer and editing pen.

Students, teachers, and administrators in Greenwich High School were electrophonically inducted this past year. Electronic music’s sphere of influence spread to several departments: students in the humanities and physics classes discussed electronic music and utilized it in their final projects; the drama coach requested electronic music to enhance a production of Orwell’s Animal Farm; students participating in the film festival, sponsored by the art department, found that electronic music intensified the visual effects. From the music department, six original electronic compositions were selected and performed in a program along with original traditional compositions. A light show accompanied the electronic compositions and added another emotional dimension.

Electronic music has made its mark and found a place in the high school music program. We hope it will continue to provoke student interest, for that is the one ingredient that makes any student want to work and want to grow in his understanding of music.