BSCS Single Topic Films

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The BSCS Single Topic Films represent a unique approach to educational films.

Through the years films have proven to be very effective educational tools at all levels of instruction. They are particularly well suited to the teaching of biology. Information can be presented on film that is otherwise not accessible to the learner. For instance, the teaching of ecology can be enhanced with films that take students to environments around the world. Films can give students an opportunity to look into the smallest of organisms and to observe life in ways that are well outside the capabilities of the average high school laboratory. Events taking weeks to observe can be presented in a few minutes or biological activities which occur in split-seconds can be drawn out into minutes for closer observation and analysis.

Realizing the potential of the film medium the BSCS instituted a study on how films might best be used in conjunction with its total program. The film format decided upon consists of short, silent films in 8 mm cartridges, each focusing on a single main topic and providing experiences that otherwise cannot be developed easily in a classroom or laboratory. Their purpose is not to substitute for activities the students could carry out themselves. The films are designed for students to become active participants in discovering and developing topics as they unfold in the film presentation.

The Nature of the Approach

The BSCS Single Topic Films represent a radical departure from the usual classroom films. They are intended to arouse and encourage an attitude of inquiry. Each film poses questions, raises problems, and presents experimental data in a way that it promotes active participation by the student. Teachers and students are involved in interaction during the film presentation. Neither the film nor the teacher dominate the development of the topic; rather, the role of the teacher is to guide student discussion and interaction.

The films are designed to be held on certain frames or stopped at critical points to allow students to react. The students are expected to supply hypotheses, interpret data, and suggest implications of experimental results, or are invited to offer ideas for additional experiments. The design often calls for the classroom lights to be turned on and the projector turned off for extensive discussion before proceeding with the film.

Teachers are asked to avoid giving answers to problems or questions thus encouraging students to develop concepts by analyzing situations given in the film. Discussions among small groups are suggested in the Teacher's Guide in order to promote participation by all students. Written re-

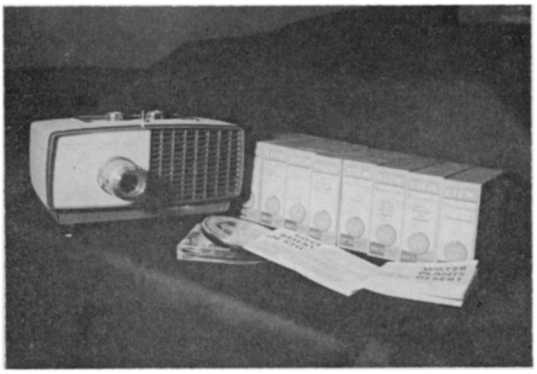

Fig. 1. Experimental versions of several BSCS single topic films.

sponses are sometimes required before verbal discussion so that each student may react to key questions or problems as they are posed by the film.

The usual 16 mm sound film presentation involves students only as passive observers and is often solely fact oriented. Such films only serve to reinforce the authoritarian aspects of science and eliminate possibilities for differing opinions among students. The 8 mm loop format, on the other hand, allows for a more versatile design, requiring students to assume an active role, and enhancing opportunities for presenting science as inquiry. The basic approach in each film is the same; however, they differ not only in subject matter, but also in level of difficulty and in emphasis of the various elements of scientific inquiry. Some stress the role of critical observation; while others involve the interpretation of data, the design of experiments, the formulation of hypotheses or the identification of problems.

The ease of use and relative cost of 8 mm prints and equipment compared with 16 mm were considerations guiding the BSCS decision to employ the use of cartridged loops. Films and projectors must easily be accessible to teachers and students. The problems of scheduling motion pictures and equipment from a central source in secondary schools are well known. Ordering weeks or months in advance results in problems of correlating the arrival of the film with course content. Teachers commonly experience the frustration of receiving a film too early or too late to fit it into their teaching program. A genetics film may arrive while the students are still studying ecology. The scheduling of 16 mm projectors presents another problem for many teachers. Inexpensive films and equipment make it possible for a teacher to have a projector and set of films in his classroom or department at all times, relieving the handicaps of scheduling.

When used correctly 16 mm motion pictures have been and will continue to be helpful in teaching biology. The approach taken in the BSCS Single Topic Film Program is meant to serve as another method of utilizing the valuable medium of film.

An Example

A film dealing with the topic of mimicry is among the first twenty soon to be released by the BSCS for commercial distribution. The Teacher's Guide for this film forms the basis of the following description.

The students first see several examples of convergence in animals that are not closely related. These include the honeybee and drone fly, king snake and coral snake, monarch and northern viceroy butterflies, and the bumblebee and robberfly. After observations are made of these pairs of animals the teacher stops the projector and asks the students what might account for similarities between members of each pair. Following the discussion, student responses are listed on the chalkboard or overhead projector as preliminary hypotheses. Among other hypotheses, students may suggest that the similarities are due to:

1) Chance resemblance. The similarity in appearance is coincidental.

Fig. 2. Part of the Film Committee reconsidering a teachers guide. From left to right: Arnold Lockett, Gerald Scherba, Edwin Phillips, Walter Auffenburg, Manert Kennedy, Roy Gromme.

Visual Information	To the Students	To the Teacher
START FILM & HOLD 11 HOW DO THE RESULTS OF THE FOLLOWING EXPERIMENTS AFFECT YOUR HYPOTHESES?		The experiments which follow involve interaction between the Southern Toad (*Bufo terrestris*) and a pair of look-alike insects, the bumblebee and the robberfly. The Southern Toad strikes at small objects that move. Vision is very important in its feeding.
START FILM 12  HOLD FILM	The term "inexperienced," as used here means that the toad has had no previous encounters with bumblebees. What did you observe?	In this sequence, the toad takes the bumblebee, then blinks, ducks and ejects the bee. (HOLD FILM AT THIS POINT.) Discuss fully, but DO NOT ANSWER these questions for the student. Challenge conclusions versus observations.
START FILM 13  TURN OFF PROJECTOR	The term "experienced" is used here to indicate that this toad has had previous encounters with bumblebees.	The students should understand that two different toads are used; that the SECOND toad has had experiences identical to that of the first toad.
WITH PROJECTOR OFF	How did the second toad react? What abilities must the experienced toad have in order to refuse a bumblebee? Observe very carefully the behavior of the experienced toad in the next sequence.	Encourage discussion at this point. Students should conclude that the toad must be able to recognize and remember past experiences with a similar insect.
START FILM 14 	Again, this is a toad which has had previous experience with bumblebees, but not robberflies. The insect used here is the robberfly.	
15 WHY WAS THE ROBBER FLY REFUSED? HOLD, THEN TURN OFF	We will stop at this point to give you time to list your hypotheses. How would you design tests to determine whether a hypothesis is valid?	You may wish to have students work in groups or individually. After a reasonable time, compile a list of their hypotheses on the chalkboard for discussion. Among others, students might suggest: • toads do not eat dead insects • toads do not eat robberflies • the toad is not hungry • the robberfly is too big to swallow • experienced toads mistake robber-flies for bumblebees • the toad may be sick or unable to react normally • the toad doesn't like the string attached to the insect Include all student suggestions. Opposite your chalkboard list of hypotheses, you may wish to list the designs suggested by the students. Let students criticize experimental designs. Useful designs might include: • feed an inexperienced toad other species of dead insects • feed an inexperienced toad a robber-fly • use another experienced toad • make certain the toad is hungry before offering it the robberfly Other useful designs may be offered by your students. You may wish to collect individual work done by students and react to these at a later time.
START FILM & HOLD 16 HOW DO THE FOLLOWING EXPERIMENTS AFFECT YOUR HYPOTHESES?	The next sequences may help you to eliminate some of the hypotheses you have suggested. If so, the remaining ones may be examined in search of the best available answer to our question; that is, the hypothesis supported by, or consistent with, the results. While only a single toad is shown, the results observed are those obtained in identical experiments using large numbers of toads and insects.	
START FILM 17  HOLD FILM	Note the following sequence. Which of the hypotheses can you now reject after having watched this sequence?	This is a repeat of the experiment involving an experienced toad and the bumblebee. NONE of the hypotheses can be rejected. This sequence serves to verify previous observations.
START FILM, HOLD 18  HOLD FILM	What hypothesis is tested by this design?	The results here indicate that: • the toad is hungry • the toad will eat dead insects • the experimental design does not discourage feeding

Fig. 3. Some members of the Committee which has guided the development of the BSCS Film Program. From left to right: Walter Auffenberg, Manert Kennedy, Roy Gromme, and Clarence Flaten.

2) The animals being more closely related than was believed.
3) Hybridization. The similarity results from interbreeding among closely related species.
4) Habitat selection. Factors in the habitat have influenced the color patterns of animals in the area.
5) Climate. Temperature, moisture or other weather factors have affected or selected for a particular color pattern.

A sample page from the Teacher's Guide accompanies this article and illustrates possible interactions that follow the first sequence discussed above. The left-hand column gives visual information on the titles and motion picture scenes from the film while the center column presents typical teacher commentary to the students. The right-hand column contains notes to the teacher giving background information, suggestions for strategy or teaching methodology, and typical student reactions to key questions and problems.

Additional experiments follow those shown in the illustration from the Teacher's Guide and allow students to reject other hypotheses concerning the experienced toad's refusal to eat robberflies. Based on this experimental evidence the students may develop the idea of model and mimic as one possible explanation for the similarities in appearance in the animals observed in the opening scenes. The following questions in the Teacher's Guide suggest further discussion:

1) Under what conditions could mimicry arise?
2) What are the possible advantages of mimicry?
3) Can you now account for the fact that both of these insects appear to be adapted successfully to the same environment?
4) How might you account for the *origin* of this similarity?
5) How would you determine whether the similarities between the other pairs of animals shown early in the film are the result of mimicry of this type?
6) In nature, what do you expect would be the relative proportion of mimics to models in a population? Why?
7) How might the disappearance of bumblebees from the population affect the numbers and appearance of robberflies?

The Teacher's Guide accompanying each of the BSCS Single Topic Films contains additional subject matter information the teacher may need for background and to direct the student discussion. A list of references for students who wish to pursue a topic forms another part of each Guide.

Evaluating the Experimental Films

Before general release each film will have been revised at least once and in some cases several times. Revisions have been based on feedback reports provided by over 100 teachers who have tested the films in geographically distributed secondary schools in the United States. Feedback not only has been valuable in revising the films but also has guided the development of both the format and content of the Teacher's Guides. Student responses found in the Guides were formulated during classroom use of the films.

Fig. 4. Test versions of the Teachers Guide and films for the topic, "Social Behavior in Chickens."

BSCS Staff Consultants or members of the Film Committee visited many of the test schools. These personal visits were important in evaluating both individual films and the impact of the over-all program. Discussions with teachers and students led to several important decisions concerning film design and Teacher's Guides.

Classroom trials have shown that the general approach taken in the films is successful. Each topic presented takes only four minutes of film, but many teachers use full class periods to involve students in spirited interaction and discussion.

Release Plans

Twenty films are in final edition and plans for commercial release are underway. The BSCS Single Topic Films are meant to play an integral role in the classroom presentation of biology. For this reason and because the films are significantly different from those distributed through usual audio-visual channels, they will be distributed by the publishers of the three BSCS Versions. This will assure that the films are promoted and distributed as a part of the total BSCS program and not as ancillary materials alone.

BSCS Single Topic Films will be released on Super 8 mm rather than on standard 8 mm film and will be cartridged. The Super 8 mm format offers a brighter and larger image for classroom showing and will not require the use of special screen devices.

The first commercial release will include these titles:

Social Behavior in Chickens
Prairies and Deciduous Forests
The Peppered Moth: A Population Study
Mimicry
Water and Desert Plants
Water and Desert Animals
Temperature and Activity in Reptiles
Mountain Trees—An Ecological Study
The Kidney and Homeostasis
Phototropism
Convergence
Australian Marsupials
The Intertidal Region
Life in the Intertidal Region
Predation and Protection in the Ocean
Mating Behavior in the Cockroach
An Inquiry—The Importance of the Nucleus
Mitosis
Grouse—A Species Problem
An Example of the Biological Significance of Color

Twenty additional Single Topic Films are presently in various stages of production. Many of these topics will be in the areas of physiological, molecular, and microbial biology. Announcements concerning the development of this series will be made in the BSCS NEWSLETTER at a later date.

Health Careers

Free single copies of health career leaflets and pamphlets are available from the Public Inquiries Branch, Public Health Series, U.S. Department of Health, Education, and Welfare, Washington, D.C., 20201: *Careers—USPHS Health Programs, Health Professions Student Loan Program* (PHSP-1347), *Health Professions Scholarship Program* (PHSP-1460), *Nursing Student Loan Program* (PHSP-1348), *Something New in White* (dental assistant; PHSP-1300), *Your Career in Sanitary Engineering* (PHSP-579), *Doorways to Health Careers through Biology,* and *Nursing Careers in Mental Health* (PHSP-1051).

Hope Through Research

Free single copies of the *Hope Through Research* series of leaflets and pamphlets are available from the Public Inquiries Branch, Public Health Service, U.S. Department of Health, Education, and Welfare, Washington, D.C., 20201: *Cataract and Glaucoma* (HIS-99), *Cerebral Palsy* (HIS-95), *Epilepsy* (HIS-105), *Headache* (HIS-104), *Hearing Loss* (HIS-53), *Mental Retardation* (HIS-114), *Mongolism* (HIS-94), *Multiple Sclerosis* (HIS-92), *Muscular Dystrophy* (HIS-106), *Parkinson's Disease* (HIS-100), *Shingles (Herpes Zoster)* (HIS-125), *Spinal Birth Defects (Spina Bifida)* (HIS-103), and *Little Strokes* (PHSP-689).