

PHOTOGRAPHY IN A NEW EXAMINATION TECHNIQUE

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The list of good examination techniques is already a long one, perhaps long enough. But, numerous and varied though such techniques are, I propose another to be added to the list: one which, so far as I know, is new, and one which I hope may be useful. My own use of it through the past several years has demonstrated a combination of advantages not duplicated by any other method I am familiar with. Frankly it has some disadvantages too, but I hasten to add that the disadvantages I have seen in it are not educational ones. Briefly, this method consists of recording typewritten questions on two-inch lantern slides, and then projecting these questions on a screen at examination time.

Questions or problems are first typed on a fairly soft paper: mimeograph paper is often used. A clear record can be made if type are kept clean and if every question is typed twice, the second typing being done directly over the first so that the lines of every letter are solid and sharp. A good record can be made also by typing on a sheet of paper that is backed by a reversed sheet of carbon paper. Such copy will photograph well. Four questions are typed on a page and then the page is photographed on a $3\frac{1}{4} \times 4\frac{1}{4}$ Process film (Fig. 1). After this, each question can be print-

Suppose that, for experimental purposes, you want to grow green plants in monochromatic light (light of one pure color).

- (a) Will you expect them to grow better in red light, or green?
(b) Why?

Since green plants have been taking carbon dioxide from the air for millions of years, why doesn't the carbon dioxide supply ever give out?

Why is it necessary that the light screen, which one attaches to a leaf in the photosynthesis experiment, allow air to reach the under side of the leaf while excluding light from it?

Some plants live wholly submerged in water. Where do such plants get carbon dioxide for photosynthesis?

Fig. 1. Four questions typed on one typewriter sheet

ed independently on a two-inch Process lantern slide, and the slide can be labeled, covered, and filed.

The money-cost of the finished slide is about thirteen cents. Labor-cost must be added to this sum; but if the work be done by departmental assistants who have a "flare" for photography, rather than by a professional whose work has to show a profit, the cost is in no sense prohibitive, even for several hundred slides. And of course the initial cost is the only cost there is: slides are permanent and they are usable from the instant they are finished.

It is not to be assumed that the successful projection of such slides is restricted to darkened rooms. Were that true a teacher would face disaster from the instant he would flash the first question. The contrast in black-and-white line figures is great enough so that the projected image is clearly legible even when lights in the room are turned on.

Obviously any essay type question that can be written on a blackboard or typed on a stencil can be used here (Fig. 1). But other questions also can be used, e. g. questions which are so long or so intricate that one refuses to write them on a board, and even prefers to omit them from his copy for the duplicating machine in order to avoid bulk. Fig. 2 shows four questions of this sort: problem questions which are designed to test a student's ability to arrive at a logical inference or conclusion from a set of data. Such a question, if used on a slide, needs to be typed but once for the original photograph, and when finished it occupies only

A growing coleus plant is sealed in a jar filled with pure oxygen, and through which a slow stream of oxygen is passed. A second coleus plant is sealed in a jar filled with air, and through which a slow stream of air is passed. The first plant dies within a week or two, whereas the second plant is still growing vigorously after two weeks have passed.

As shown in a rainbow, ordinary sunlight is composed of rays of red, orange, yellow, green, blue, indigo, and violet. Experiments have shown that light is necessary for the development of green pigment in plants. One coleus plant was growing in a box that allowed only the red rays of light to reach the plant. A second coleus plant was growing in full sunlight. Both plants became green in color.

A branch of willow grew for five years in a pot of soil. The plant was regularly supplied with pure water, but no additional soil or other materials were added to the pot. At the beginning of the experiment the willow branch weighed 5 pounds; at the end of five years it weighed 164 pounds. The loss in weight of the soil was 2 ounces.

A potato was planted in a box into which only red light rays were admitted. A second potato was planted in a box into which only the blue and violet rays were permitted to enter. At the end of four weeks the stems of the first plant were three feet high, while those of the second plant were one foot high.

Fig. 2. Problem questions.

four square inches of filing space. But it can be used time after time with no repeated preparations.

Still another type of question that can be used on slides is the recognition question, represented by a drawing which the student is to label (Fig. 3). One will seldom take the time or the pains to draw a figure accurately on a blackboard, and his efforts with a stencil are sure to be disappointing unless he omits small detail or else makes the figure so large as to be ungainly. But such a question on a slide fills but four square inches of filing space, and it can be used repeatedly without further preparation.

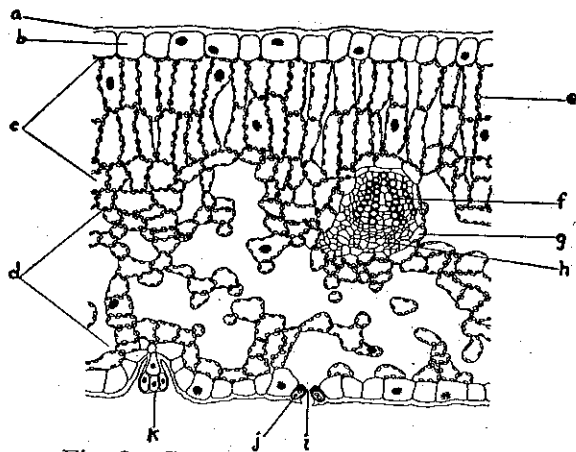


Fig. 3. Cross section of a leaf blade.

The force which makes minerals enter a root hair from the soil is:

- The inward creep of entering water
- The need for minerals inside the plant.
- The drawing power of the cell sap.
- The diffusion pressure of the minerals themselves.

Stems differ from roots in that:

- Stems are organized into nodes and internodes, while roots are not.
- Stems always grow up above ground, while roots always grow down into the ground.
- Stems are terminated by apical buds, while roots are terminated by thimble-like caps.
- Stems never store food surpluses, while roots do.
- Stems exhibit xylem and phloem tissues in radial arrangement, while roots exhibit these tissues in collateral arrangement.
- Stems branch endogenously, while roots branch exogenously.
- Stems branch at the nodes, while roots branch at any level.

The reason why water absorption is restricted to the tip regions of roots is that:

- Here is the only place where surface cells are permeable to water.
- The upper soil is too dry to yield any water.
- It is only at considerable depth in the soil that water pressure is great enough to force water into a root.

The reasons why seeds eventually lose their ability to germinate are that:

- Light cannot penetrate old seed coats.
- Seed coats become impermeable to water and oxygen.
- Part of the stored food is oxidized in continuous respiration.
- Enzyme activity declines.
- Coagulation of protoplasm kills many cells.
- The testa becomes too hard for the embryo to break.
- Toxic waste products accumulate.

Fig. 4. Multiple choice questions.

Even the objective type of question is not ruled out by this examination technique. Multiple-choice questions like those in Fig. 4 have been used, and no doubt matching exercises and classification of items could be used equally well.

Answers to multiple choice questions can be recorded on mimeographed blanks like the following:

Question
number

_____ c f h b d a g e
 _____ c f h b d a g e
 _____ c f h b d a g e

The student needs only to cross out with an X all letters on the answer sheet which correspond to correct completions in the questions. Two types of answer sheet can be used, the two differing only in the order of arrangement of letters. Then if students sitting side by side are given different types, the chances of dependence upon one another are reduced.

One who continues to use this examination technique will add a few new questions each time he repeats a course until, after a few years, the questions in his classified file will be numerous enough and varied enough so that he can construct a whole examination to his liking in a matter of minutes. And since a slide bears but one question, different combinations can be used at different times over the same subject matter.

Since in this method there is no stencil-cutting nor mimeographing in which student help may participate, and no typing except for the first copy, chances for the pre-examination leakage of questions to students is reduced to almost zero. Nor is there likely to be an accumulation of any instructor's "favorite" questions in a club house or dormitory. While it is possible for speed artists to copy questions from the screen after having recorded their own answers, and then carry them away, it is not likely that they will. Questions change on the screen before one can get

much writing done beyond that necessary for the answers themselves. And of course if a hoodlum should break into an office and make off with a selected set of slides, those are the very questions that would not be included in the subsequent examination.

Since only one question is shown at a time the dawdling student is out of luck, and he remains so until he stops dawdling. And I should add that it is not the instructor who stimulates him to speed up: it is the dawdler's own classmates who have to wait on him. That is as it should be. Also the speed artist is held back by the class majority that is slower. Speeders are at least given a chance to think twice about their hasty answers before handing them in, and that is as it should be too. The whole class finishes an examination at about the same time, unless an instructor is willing to show some questions a second time to the few who ask for them.

It may be repeated that there is only one expense connected with the preparation of examination slides: that is the initial expense. There are no repeated expenditures year after year for paper, typing, and mimeographing, unless one uses mimeographed answer sheets for objective questions. And not least among the advantages inherent in this method is the fact that questions projected on the screen are always legible. That is in contrast with some blackboard questions, and also mimeographed ones, whose legibility has puzzled me.