Futuristics in Biology:

Some Techniques

Ronald E. Charlton

WE MUST EDUCATE FOR THE FUTURE; we will spend the rest of our lives in it. Clones, genetic engineering, extraterrestrials, population, test-tube babies—many of the issues of the future are biological issues. Forward-looking individuals will be needed to cope with the "future shock" created by these issues. Futuristics is becoming a necessity in our educational programs; yet much, if not all, of our teaching-learning is directed to the past, or, at best, the present. This article presents some techniques for helping our students to think about the future.

The Delphi Technique

The Delphi Technique, one of the most popular forecasting techniques, was developed by Olaf Helmar of the Rand Corporation in the early 1950s. Weaver (1972) describes it as an intuitive method of organizing and sharing "expert" forecasts about the future. "Experts" in a field are asked to respond to questions. Anonymity of the individual panel members and their responses eliminates personal prejudice and biases among the respondents.

A first-round questionnaire is administered that allows for "open-ended" responses. Responses are analyzed and the results are tabulated. A second-round questionnaire is administered after the respondents are informed of the tabulated results of the first round. The respondents may change, clarify, sharpen, or define their original opinions. Again, responses are analyzed, and the results are tabulated. Finally, a third-round questionnaire is administered after the respondents are informed of the

Ronald E. Charlton has taught biology at Mt. Lebanon High School, 7 Horsman Drive, Pittsburgh, Pennsylvania 15228 for the past seven years. He received his B.S. degree in education from California State College in 1967; his M.S. degree in biology, also from CSC, in 1970; and he is currently working toward a doctorate in curriculum and supervision at the University of Pittsburgh. Charlton holds memberships in NABT, NSTA, the World Future Society, and the School Science and Mathematics Association. His interests include nature photography, environmental education, computer applications for biology education, and cognitive styles and biology education.

second-round results. The respondents are given a final opportunity to revise their opinions. These final responses are analyzed, and the results are presented.

Stolovitch (1976) developed the *Delphi Game* as a variation of the Delphi Technique. The object of the game is to estimate the likelihood of particular events occurring within a given field by some future date. Each player examines a list of predictions distributed by a game facilitator and makes a percentage probability estimate of that prediction coming true by a given date. Through repeated rounds of prediction, feedback, and a final discussion, a list of consensus items is derived in terms of both high and low probability of occurrence.

A list of about 30 forecasts can be teacher-produced or class-generated. If class-generated, the forecasts must be kept anonymous to prevent biasing players. The list should be duplicated allowing writing space for three estimates beside each prediction (fig. 1).

Assemble players in groups of about five. Appoint a facilitator who is a nonplaying member of the group. The facilitator distributes the forecast lists and asks players to read each item. Players are directed to secretly estimate the probability of each item occurring by the given date and write their estimates beside the item under round one. No discussion is permitted. As soon as a page of forecasts is completed, it is given to the facilitator who lists the predictions on the chalkboard. The predictions are kept anonymous. Players use feedback from Round 1 to make Round 2 predictions. Again, no discussion is allowed.

Once the Round 2 estimates are listed, begin a third and final round, still maintaining the anonymity of predictions. During this round players may make statements related to any of the forecasts. As they go through the items, have them write a third percentage figure beside each forecast under Round 3 based on the chalkboard feedback and discussion. Impose a time limit on the discussion if necessary.

At the end of Round 3 rank order from highest to lowest and compute the median and interquartile range of the probability percentages for *each* forecast (fig. 2).

What are the chances (in %) of these future events occurring by 1995 A.D.?

Rounds			Forecasts
1	2	3	

1. Babies will be completely produced in the laboratory.

2. Every human body organ will be transplantable.

3. Clones will be used for spare body parts.

4. Life will be discovered on another planet.

5. Artificial life will be created

FIGURE 1. Sample of part of a forecast list.

Those forecasts that have an interquartile range of 10 percentage points or less are considered to have achieved consensus among the players. Items not achieving consensus are eliminated. The remaining forecasts are then analyzed to determine their degree of probability. Those with a median percentage estimate of 75% or greater have high probability. Those with 60% to 70% have moderate probability. Those with 35% or less have low probability.

Cross-Impact Matrix

The cross-impact matrix allows students to assess the impact of several factors on each other as they interact to shape the future. The simplest matrix lists the same factors along the left side and across the bottom. Each intersection is analyzed to determine the potential impact of one factor on the other.

I prefer to use a matrix in which the factors along the left side and across the bottom are related but not exactly the same (fig. 3). Students are asked to write down a few ideas about the impact of the factors in the cells of the matrix. Remember that this is a method of analysis and investigation; it is designed to suggest questions, not to provide answers.

Future Circles

Future circles can be used at any level of sophistication as an individual activity, a group project, or a class lesson. A circle is drawn in the center of a piece of paper or on a chalkboard. A topic for consideration is written within the circle. Several lines or "spokes" are drawn from the central circle. A consequence or association of the original topic is placed in a circle at the end of each line. Third- and fourth-order associations continue the process. You may also want to join various ideas that are interrelated even if they did not originate from the initial topic (fig. 4). The only limits on future circles are time, writing space, and imagination.

Decision Trees

A decision tree is a method used to call attention to or analyze the alternatives from a sequence of decisions.

FIGURE 2. Determination of median and interquartile range of probability percentages.

N = number of players $Q_1 = N/4$ $Q_3 = 3N/4$

Median = N/2   Interquartile Range = $Q_3 - Q_1$

Example: 12 players, probability percentages for forecast 4.

Percentage probabilities - rank ordered

#4) 80, 80, 80, 78, 75, 75, 75, 70, 70, 70, 65, 60
                    ↑   ↑   ↑
                   Q_3 Md Q_1

N = 12 $Q_1 = 3$ $Q_3 = 9$ Md = 6

Interquartile Range = $Q_3 - Q_1$

78% - 70% = 8% (concensus)

Median percentage = 75% (high probability)

	Lifespan	Family Life	Government Control of Science	Space Exploration	Food Production	Prejudice
Human Clones						
Growing Spare Organs to Transplant						
"Turning Off" Harmful Genes						
Complete "Test-tube" Baby						
Artificial Organs						
Drug that allows regeneration of human body parts						

FIGURE 3. Cross-impact matrix.

One begins with a single decision and traces all the possible consequences of it (fig. 5).

Scenarios

A scenario is a story, play, model or audiovisual production of some future situation based on the creator's own ideas. Often scenarios reflect existing trends and their probable consequences. Alternatives may also be considered.

One interesting use of scenarios is to give an opening statement as "In 1996 human survival in the open atmosphere was impossible because..." and then have the students complete the scenario. Another technique is to trace a trend, for example advances in organ transplants, and then have students prepare three scenarios—a probable, a possible, and a preferable.

Summary

These are only a few of the techniques used in futuristics. They were chosen because they are inexpensive and, more important, because they can be adapted and modified easily. As you use these techniques do not hesitate to experiment. Modify the techniques to fit your particular group of students. The important objective is to have students think about the future.

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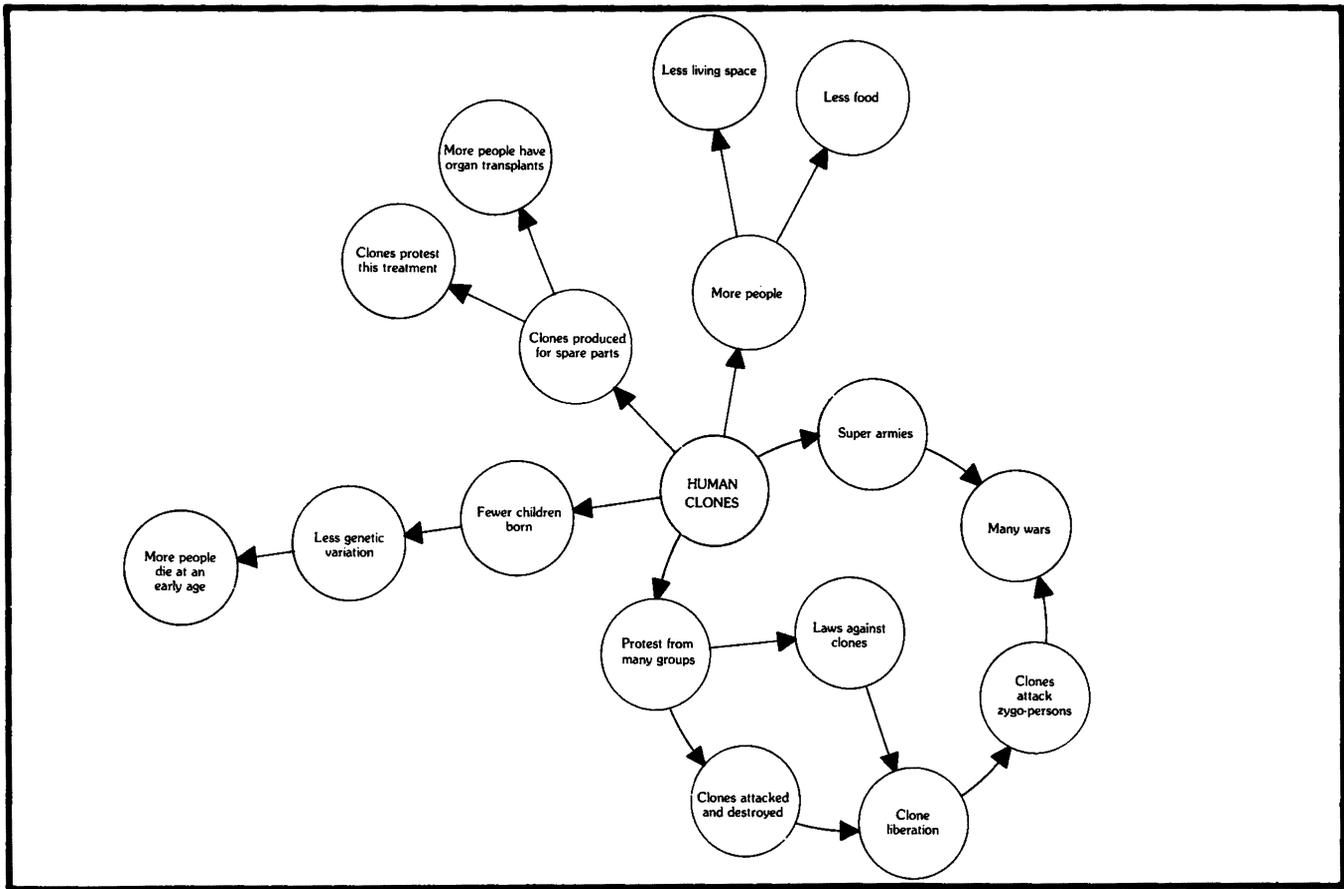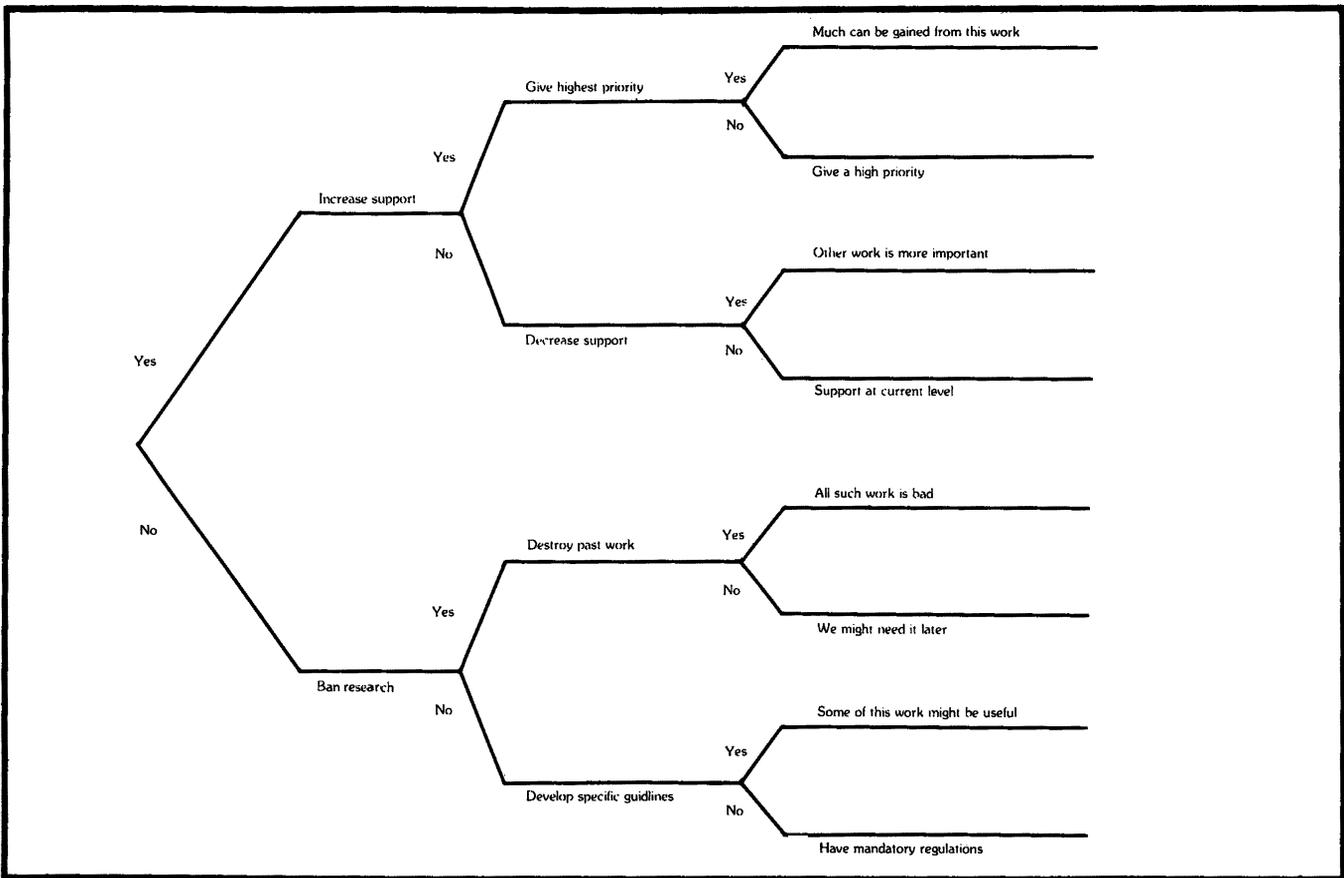
FIGURE 4. Future Circles.

FIGURE 5. A Decision Tree.