

PRNG 66 OFFICIAL USE ONLY PUERTO RICO NUCLEAR CENTER EVALUATION STUDY OF SUMMER INSTITUTES IN RADIATION BIOLOGY RE, RUSHFORD 1965 'OPERATED BY UNIVERSITY OF PUERTO RICO UNDER CONTRACT NO. AT (40-11-1199 FOR U.S. ATOMIC ENERGY COMMISSION ---Page Break--- PRC 66 EVALUATION STUDY OF SUMMER INSTITUTES IN RADIATION BIOLOGY F. B. Rushford 1965 ---Page Break--- Abstract From 1959 through 1964 six Summer Institutes in Radiation Biology were offered in Puerto Rico. A total of 115 teachers were enrolled. Since the number of applications for admissions dropped in 1964, no Institute was offered in 1965, and instead a study was made to determine the value of the Institutes to participants. Sixty participants were interviewed, and this report is a detailed account of the information obtained. The results indicate limited utilization of the training in most cases, due to the absence of radiation biology courses from the curriculum being taught, lack of basic teaching materials including textbooks, inadequate laboratory facilities, and lack of safe storage areas for equipment. The conclusion is that continuation of the Institutes under these conditions is not justified. It is recommended that the Department of Education be urged to recognize the importance of radiation biology in the science curriculum. ---Page Break--- SECTION The first Summer Institute in Radiation Biology conducted in Puerto Rico was offered at the College of Agriculture & Mechanical Arts of the University of Puerto Rico during the Summer of 1959. Table 1 lists pertinent data about the six Institutes offered from 1959 through 1964. The objectives of the Summer Institute program in general are (a) to improve the subject matter competence of the participating teachers, (b) to strengthen their capacity to motivate able students toward careers in science, (c) to bring the teachers into personal contact with prominent scientists participating in the Institutes, and (d) to bring about greater mutual understanding and appreciation of their problems among people teaching.

science at various academic levels. The specific objectives of the Radiation Biology Institute program are (a) to make teachers aware of the importance of radiation in the modern world, (b) to provide them with an adequate fundamental knowledge of radiation biology, and (c) to train them in the use of radiation detection equipment so that they are prepared to teach radiation biology within the framework of the present school curriculum. In 1962, the Director of PRIC requested the cooperation of the Department of Education of the Commonwealth of Puerto Rico in offering the Institute. The Department of Education agreed (a) to help select teachers to attend the Institute, and (b) to provide funds for the participants' traveling expenses and lunches. At the request of the Science Curriculum Department of the Department of Education, the ---Page Break --- a Table 1

Year	Institute	Location	Participants	Interviewed
1959	CAMA	UPR Dr. J. Ramos, Dr. H. Ingo Mayaguez	38	23
1960	PRN	UPR Dr. J. Ferrer Monge Mayaguez	40	22
1961	PRNC	UPR Dr. J. Ferrer Monge Mayaguez	19	2
1962	PRN	UPR Mr. P. Z. Rushford Rio Piedras	3	2
1963	PRUC	UPR Mr. F.B. Rushford Rio Piedras	6	3
1964	FRG	UPR Mr. F. E. Rushford Rio Piedras	4	5
			8	0
			5	1
			1	6
			60	100

Number of Institutes in Radiation Biology Offered in Puerto Rico, 1959-1964 (operating funds were provided by the US ABC, participant support was provided by NSP, except in 1962, when it was provided by the P.R. Dept. of Education.) Enrollment Year Sponsor Director Location (total, 125) 1959 CAMA, UPR Dr. J. Ramos, Dr. H. Ingo Mayaguez 1960 PRN, UPR Dr. J. Ferrer Monge Mayaguez 1961 PRNC, UPR Dr. J. Ferrer Monge Mayaguez 1962 PRN, UPR Mr. P. Z. Rushford Rio Piedras 1963 PRUC, UPR Mr. F.B. Rushford Rio Piedras 1964 FRG, UPR Mr. F. E. Rushford Rio Piedras with the cooperation of the P.R. Dept. of Education. Table 2 Participation in Other Institutes by Radiobiology Institute Participants Interviewed Number of other institutes attended by persons interviewed 1 38 23 40.0 2 22 19.2 3 6 6.0 4 5 8.0 5 1 1.6 Total 60 100.0 ---Page Break --- American Institute of Biological Sciences BSCS* high school biology course materials were purchased for the participants, and a contemporary biology course was offered in addition to the radiation biology course as part of the Institute. Each course was assigned three semester hours.

of credit through the UPR Department of Biology in Río Piedras. The contemporary biology course was taught by Mea, Graciela Candelas, Assistant Professor of Biology at UPR. The radiation

biology course was taught by FRG staff members. The Department of Education wanted the BSCS high school biology course taught because the decision had been made to offer this course in the public schools, and trained teachers were needed. The PRIC staff thought that this course would upgrade the background of the teachers and help them understand the more complex radiation biology course. The cooperation of the Department of Education in selecting candidates for the Institute was continued in order to ensure that the maximum number of teachers participating would return to classroom teaching. In 1963, 8 applications were received and were reviewed by an ad hoc admissions committee composed of Mrs. María Antonia Ruiz, Director of Science Curriculum, P.R. Department of Education; Mrs. Graciela Candelas, Assistant Professor of Biology, UPR; and Mr. Frederick B. Rushford, Director, Summer Institute in Radiation Biology, PRIC. The Institute curriculum was similar to that in 1962, with Dr. Gustavo Candelas, Professor and Chairman of the UPR Department of Biology, teaching the contemporary biology course with emphasis on the Green Biological Sciences Curriculum Study ---Page Break--- version of the BSCS high school biology course. Mrs. Ruiz had indicated that the teachers trained in this Institute would be provided with the BSCS materials needed for their students and would be assigned to teach this course during the next academic year. In 1964, 100 application forms and brochures were distributed, but only 18 applications were received. The Institute was held as in 1963. The sharp decline in the number of applications indicated that an evaluation of the impact of the Institutes should be made. The JS ASC Division of Nuclear Education and Training granted permission to PRIC to utilize funds for making an evaluation study during the

spring of 1965. [EVAI/IATSON PROCEDURE. A personal interview with each former participant still teaching was considered to be the best way of obtaining pertinent information. A letter (see Appendix 1) was sent to each of the 114 former participants requesting a personal interview and asking whether they were still teaching. In many cases, a second letter had to be sent before an answer was received; in other cases, information about former participants was obtained from Institute classmates or fellow teachers while visiting the school. If the participant was no longer teaching, a personal interview was considered unnecessary. Sixty participants were visited. Each interview lasted about 30 minutes and was based on the AEC-NSF Institute Evaluation Guide (see Appendix II) used in a national survey of the ABC-NSF sponsored Summer Institutes in Radiation Biology covering the period from 1956 through 1961. (In this national survey, 795 questionnaires were returned out of approximately 1700 sent, a 46.5% response). Of the 795, only 5 were from Puerto Rico. Since 63 persons had attended the three Institutes in Puerto Rico from 1959 to 1961, the 5 responses represented only an 8% response. During the personal interview, the questions were asked by the interviewer and the answers written down, with any additional comments or qualifications added. The interviews were conducted in Spanish. ANALYSIS OF DATA The enrollment recorded for the six Institutes was that since one teacher attended twice, the total enrollment was considered to be 114. The number of persons interviewed was 60 (52.6% of the total). Of the 114 participants, 69 (60.9%) are still teachers, 29 (25.4%) are no longer teaching, and 16 (14%) did not respond. Since the interviews were based on the Institute Evaluation Guide, the data are presented according to its sections. 1. Identification Information. After giving his current home and school address, each person was asked to list all other institutes, besides Radiobiology, in which he had

participated, (See Table 2.) of those interviewed, 47 (78.46%) had attended one or more other Institutes. Table 3 lists these by institution and type. Many of the Institutes attended were unrelated to actual teaching assignments. The data on educational backgrounds are given in Table 4. Of those interviewed, 33.06% had either graduate training or two undergraduate degrees. Of the

undergraduate majors, 42.5% were in biology and 28.5% in education. Table 5 lists subjects taught before attendance at the Institute and at present. Biology only was taught by 29 prior to attendance and ---Page Break--- Table 3 Institutions and Types of Institutes Attended by Persons Interviewed To, of Times Institution Type of institute Date interviewed attending Catholic U. of P.R., PSEC Physics summer 1962 4 Cornell U. Chemistry summer 1961 8 Silverside Education AY 1962-63 1 Darwin Centennial Chemistry, Geology, Mtg. Astronomy summer 1961 8 Florida U. Aerospace summer 1953 Fordham U. PBSC Physics summer 1962 2 Indiana U. Biology summer 1957 8 Inter-American U. Mathematics summer 1957 1 Biology summer 1958 3 Mathematics summer 1958 1 General Science summer 1959 8 Biology summer 1960 2 Modern Biology summer 1962 2 Modern Biology summer 1964 5 Modern Biology summer 1965 2 Missouri State Teachers College Biology summer 1963 8 Montana U. Science Teaching summer 1962 1 Science Teaching summer 1963 8 Science Teaching summer 1964 8 Ohio State U. Biology AY 1958-59 8 U. of Pennsylvania Biochemistry AY 1960-61 8 Physical Sciences Study Committee. ---Page Break--- Of These Institutions Type of Institute attended: interviewed: attend nig PR (Río Piedras) Mathematics summer 1958 Mathematics In-service 1959-60 summer 1960 summer 1960 Teaching of Modern Astronomy and New Mathematics, Chemistry = Below — Interviewing 1966 Ecology Mathematics Astronomy and Meteorology PEC Physics and Geology, summer (caua) Biology Biology Mathematics Biology Biology Chemistry Marine Biology Mathematics Physics, Chemistry, Biology Field Biology Biology In-service 1964-65 rise 1959-60 To be continued ---Page

Break--- tbls University or College Training of Participants Interviewed Undergraduate degrees Undergraduate majors Undergraduate minors a re wo. Tyne wo. \$ one 1 16 2 26 Baa, ak 40.0 39 cg Bs, 8 16.5 Betence: 6 9 BAL & Mathematics au 7 7 18 Howe Economics 1 Mathematics 5 Pharmacy 2 Biology 3 60 100.0 Chemistry i Physics 3 Social Sciences 1 Social Sciences 3 Nutrition a Agriculture a Agronomy a Psychology L French a Spanish 1 not. 66 6 Professional Diploma Graduate Majors Tyre mw. Tee % Supervision 4 66 Professions Diploma supervision h 30.7 Mab, Degree Graduate Degrees 1 UT 2 agile ype wo. i TT ! 2 UT WA. & 66 1 TT "5, B66 Biology. a TH MPH. 1 6 Mathematics i Tm Degree 'Total, 9 1k8 9 Health 2 1 grand Total@ 130 21. Total, 13 100.0 'Walther Professional Diplomas or Masters Degree ---Page Break--- Se Table 5 — Teaching assignment before Radiation Biology Institute participation Present SS ee Biology only 19 Biology only ab Biology & Chemistry 4 Biology Demonstration Class: 1 Biology & General Science a Biology & Chemistry 4 Biology & Mathematics 2 Biology & General Science 3 Biology & Physical Sciences 2 Biology & Physical Science i Biology, Chemistry, te Biology, Chemistry, General Mathematics 3 Sciences, & Physics 2 Biology, Chemistry, & Physical Chemistry only 2 Sciences 6 General Science only 8 Biology, General Science, & Mathematics only 3 Mathematics 3 Mathematics & Science i Chemistry only L Physics & Material Science 2 General Science only 7 Chemistry, Physics, & Mathematics only 2 Mathematics a Mathematics & Science 5 'General Science, Sciences 2 2 Chemistry, Physics, & Science Teaching Methodology i Physical Science a Science Coordinator, Physics Mathematics, Physics, English, 2 4& Religion 1 Pathology Teaching Assistant 2 Science Coordinator i Curriculum 'Tenure 2 Principal 3 Total 60 'Total, 60 Se +9 ---Page Break--- Numbers of Sections, Students, and Textbooks for Each of 16 Teachers Subject No. of sections No. of students No. of textbooks Bas Biology 3 a oy Biology B ay 30 Biology 4 158 no texts Biology & bi

no texts Biology 2 65 no texts BSCS Biology 3 225 60 OCS Biology 3 40 no texts Eiology 3 ioe 60. BSS Biology 3 320 & Biology 5 io 2 Biology i 160 160 BSUS Biology i 36 2 General Science 8 320 160 BES Biology 3 430 no texts 90S Biology 3 iat 29 Biology i py no texts total cord 65 ---Page Break--- being taught by 24 now, For biology either alone or with other subjects, the corresponding

numbers are 40 (66.74) and 34 (56.76). Three persons were promoted to principal and two were named curriculum technicians after participation. The numbers of sections taught, pupils, and textbooks for each of 16 teachers are listed in Table 6, note that only about one textbook was available for every three students on the average. Of the 7 teachers teaching BSCS biology, only one had enough texts. 412 the teachers interviewed indicated a shortage of texts, laboratory manuals, laboratory equipment, or a combination of these. 2, Institute Carry-Over, A numerical tabulation of the answers to the questions in this section appears in Table 7. Note that 63.0% of the people interviewed stated that their participation in the Radiation Biology Institute was highly useful, yet only 16.7% stated that they could use the training received a great deal in their teaching. This is a reflection of the fact that radiation biology has not been incorporated into the school curriculum and that any teaching of this material comes from the individual teacher's effort alone without official support. Of those interviewed, 54 (90%) stated that the school administration was generally apathetic toward their efforts to incorporate radiation biology into their regular courses. It appears that the local school administrations are in favor of introducing radiation biology into the curriculum, but that this is not supported by the Department of Education. Of those interviewed, 51 (85%) indicated they had maintained contact with their Radiation Biology Institute Director; 36 (60%) of the 60 persons interviewed indicated they had not used their training in nonteaching.

Activation; 45 (75%) indicated that their training had been helpful in " ---Page Break --- L consider your participation in the Radiation Biology Institute to why several 20, highly used 36, not answered 0. Total? Is. Has your school administration been generally sympathetic toward incorporating radiation biology into your coursework? yes 50, no 3, "if not answered 2. Total 60, 2. To what extent have you been able to incorporate the training received into your teaching? "le 9, some 39, a great deal 10. Total 3. Have you continued liaison with your Institute director? yes 51, no 8, not answered 1. Total 60. 3a, How? correspondence 1, repair equipment 2, arrange student visits 13, business fair consultation 3, not specified 2 Total 51. 4, To what extent have you used your training in teaching activities, i.e., lectures to community groups? won 36, civic defense 8, elective to civic groups 12, not specified 1, Total 60. Has your training been of use with respect to clubs, etc.? yes 15, no 15, not answered 2. Total 60. 6, Would you enroll in a Summer Institute in Advanced Radiation Biology? yes 57, no 1, not answered 2. Total 60. 6a, Why? teacher supervision 1, improve teaching 24, personal interest 17, no reason given 15. Total 97. 7. Do you receive the Auditing Biology Newsletter regularly? yes 27, & of moderate use 27 a. Total 54 ---Page Break --- guiding students for science fairs and science clubs. Fifty-seven (95%) of those interviewed indicated they would enroll in an Advanced Institute in Radiation Biology if it were offered, in order srest (308). Again it should be stressed that the participants appear to recognize the value 'to improve teaching (42.18) and for personal, of radiation biology and indicate a desire to learn more, but there is no official provision within the existing science curricula of the Public schools of Puerto Rico for them to use the training properly. The Radiation Biology Newsletter is received regularly by Mb (73.34) of those interviewed, and I find it useful. Suggestions

for improving the newsletter, include describing experiences in more detail, adding a Spanish section or translation, publishing more information on new equipment, adding topics related to a tropical environment, adding a section from Puerto Rico (possibly contributed through FRIC), and publishing descriptions of student projects. Note that language was mentioned here as a prime factor in the communication of ideas. Teachers requesting a Spanish edition feel that their students' knowledge of English is too poor for them to use the present English version. It should be emphasized that more than 90% of the teachers interviewed indicated that their students have difficulty reading English, so that the teachers spend much of their classroom time translating into

Spanish. This is an additional obstacle to the introduction of radiation biology into the curriculum, since most of the reference materials originate in the United States and are in English.

Each participant in a Radiation Biology Institute is provided with an equipment kit, which he learns to use during the Institute and which is then signed to his school. The kit remains the property of the U.S. Government, but the teacher uses it as desired and takes it with him when transferred to another school. The return of scaler radiometers was requested because of a manufacturing defect, and some participants did not take a kit because of uncertainty regarding their next teaching assignment. A typical kit contains the following:

- 1 Scaler radiometer
- 1 Beta-gamma detector, side window
- 2 Beta detectors, mica end window
- 1 Probe and cable
- 1 10-in. cable
- 1 Tube mount and sample holder with clamp
- 2 Absorber packs, 8 aluminum, 4 lead
- 2 Radium D and F sources
- 1 cobalt-60 source
- 100 Planchets and rings
- 1 Here and ground adapter
- 1 Electroscope
- 1 Spintariscope
- 2 Cloud chamber kits
- 2 Stop watches
- 4 Film holders for autoradiography experiments
- 1 Package X-ray film
- 1 Package developer
- 2 Package fixer
- 2 less syringes
- 2 three syringes

See airings 22 Wypodammic needs 1 Package assorted mi: -opipe! 2 River-bulb pipetric 1 Pair rubber gloves 1 Pair plastic gloves 2 Radioactivity warning placards 1 Roll radioactivity warning tape Each equipment kit costs about \$700, and about 100 kits were issued to participants in Puerto Rico, so that about \$70,000 worth of science equipment was given to the schools. Note that part of this equipment is useful for conventional science experiments. Table 8 summarizes the information obtained on equipment kits from the persons interviewed. The average dimensions of 39 classroom laboratories indicated adequate size and ventilation. The utilities were inadequate in many cases (e.g., no installations, no water, no gas). The result is that many teachers conduct a very limited laboratory program as part of courses such as biology, which require laboratory exercises. With utilities defective or missing, it is impossible to do experiments in radiation biology. Autoradiography experiments require dark room facilities, and the fact that 76% of the teachers had none indicates that they were not able to do autoradiography experiments even though all the equipment was provided. The equipment kit was used, on average, 23 days or 12.84% of the academic year. This does not mean that all the equipment was being used. ---Page Break--- Laboratory Past Kit, and Information Radiation Biology. Estimated size of average science laboratory (based on approximate floor area derived from one of 39 2-ageroom laboratories visited) approximately 40 ft. x 25 ft., approximately 1075 sq. ft. — 3. available in school or nearby: yes 9, no 32. Estimated a kit lasting

an approximately 180-day school year ej: 23 days. Ten (16.7%) of the persons using the equipment kit for the following reasons: returned to Director 2, cannot account for storage 2, they did not have an outlet at another school 5, used L, equipment in Utilization of equipment in complies: physics 20, chemistry science lb, mathematics other than biology (based on M6 2 13, physical 7. Utilization of

egutzment for Type of research; student project for avien! Be total ah, arch: yes ih, no 36, total 50 not ape' 8, Does scaler ratemeter function properly at this time? yes 30, ro 18 total us 9. Has maintenance and repair of equipment been a minor problem? 33, a serious problem? i. Total La 10. Evaluation of five 4 value to the participant nested from the equipment kit in order of their (based on 13 replies): Ba et Mh sth Sealer ratemeter 3 2 t 3 3 Histroscope 3 6 B 1 2 Autoradiography Kit 3 % 3 a 9 Cloud chaser 2 3 6 n 3 Spintheroscope c 2 7 10 a 11. Would you prefer the scaler ratemeter available as a separate unit? yes jr, 20 8. Total us. ratemeter were portable, as a separate unit, would it be preferred the present combined unit? yes 36, no 7." Total 3s wz, 13. Estimate how much use you could make of the catemeter: none 1, Little "2, some TZ, considerable 32. Total lo, ---Page Break--- at the same time, but only that some part of the equipment, in most scaler ratemeter, was used in demonstration or an experiment. The equipment had been used for research in less than one-third of the cases, mostly in projects being done by students for a science fair. Almost two-thirds of the scaler meters were not functioning properly. Since the scaler ratemeter is a basic radiation detection unit needed for the majority of radiation biology experiments, it may be assumed that teachers with defective ones were doing little or no radiation biology laboratory work. One-fourth of the teachers stated that maintenance and repair of equipment had been a serious problem. The main difficulty is that the equipment must be brought to the Nuclear Center for repair, and, since it does not belong to the school, the teachers have difficulty obtaining transportation and in some cases have made little or no effort. 4. Radioisotopes, Radioisotopes are needed for most experiments in radiation biology. Each participant is entitled to order a free package of Radioisotopes once during each of the three years following an Institute. Subsequently he

must either purchase thea or find another source of supply. The utilization of radioisotopes is a direct reflection of the extent that a participant has been able to incorporate the training received into their teaching. Table 9 summarizes the information obtained. Only 20 (33.34%) of the 60 persons interviewed indicated that they had ordered radioisotopes. Not one of the 16 participants from the 1964 Institute had ordered any. Some of the reasons for failure to order free radioisotopes were as follows. After the 1959 and 1960 Institutes, the free packages were sent without being ordered. Some teachers had no equipment and therefore could not use the radioisotopes. Three teachers had no safe place to store the radioisotopes.

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Information on Radioisotope Procurement and on Availability of a Source of Ionizing Radiation

Table 9

	1959	1960	1961	1962	1963	1964	Total
1. Did you order radioisotopes? yes							
2. If NO, why not? (a) free package sent without ordering (b) no equipment (c) not teaching (d) inadequate facilities (e) no specific reason							
3. If YES, how many times did you order the free packages? (a) one time (b) two times (c) three times							
4. Did you ever purchase radioisotopes? yes							

5. If NO, did you obtain additional free radioisotopes? yes
6. If YES, where did you obtain them?
7. Do you have access to a source of ionizing radiation? yes no

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radioisotopes. Three did not return to the classroom, with no specific reason, but the factors prompting them not to order radioisotopes included inadequate utilities, lack of safe storage area, no official place in the curriculum for radiation biology experiments, not teaching biology or other courses including laboratory work, schedule too full to allow time for preparation of experiments, and equipment not functioning - or a combination of these. Not one of the 60 persons

interviewed has purchased radioisotopes. All of this indicates that the application of the training received at a Radiation Biology Institute is limited largely to mention of theoretical concepts in class while the more valuable laboratory training of the students is generally not done. Almost all the teachers had access to a source of ionizing radiation where they could send seeds or other materials to be irradiated, namely, the Puerto Rico Nuclear Center: irradiation sources in Bayamón and Mayagüez. The main difficulty is transportation of samples from small towns that are not near either San Juan or Mayagüez.

Supplementary Information. To obtain additional information helpful to PRN in determining its role in training and support of teachers in Puerto Rico, a series of questions was added to the ABC-NSF Institute Evaluation Guide Questionnaire. The results are tabulated in Tables 10 and. The most frequently mentioned applications of the training received were curriculum enrichment (32.6%) and classroom demonstrations (22.2%). In general, the ideas and concepts on radiation biology are mentioned to the students when appropriate during regular science classes. Demonstrations are usually limited to showing the scaler ratemeter functioning.

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Supplementary Information or, Utilization of Training, Training Program, and Equipment
 UTILIZATION OF TRAINING 2. How has the teacher Curriculum enrichment: 3 Classroom demonstrations 2 Not specified about Science fair 8 Special 7 Selective 6 Civics defines teaching 3 Teacher supervisor 3 Total (based on 60 90 AB, really not sure 3, 20 TRAINING PROGRAM (60 interviews) a on of BR 8 tion allow you to add radiation source courses you teach? yes Total 60. Here Me No answer Is Was it adequate? a 2. Were you able to retain to feel confident in this area? 7 8 2 3. Was the laboratory enough for you to tour HB evaluations? v4 2 Did you receive enough reference material for your own use? Be 2 5 interactive enough for your students? 29a a If NO, why not? e.g.

English too difficult eS Contents too difficult 6 206 Quantity not sufficient 9 Total, 29 200.0
 EQUIPMENT KIT (60 interviews) 2. Was it adequate for teaching radiobiology? 38 7 2 Is it now adequate? 5 3 3. Is the equipment now working? 0 7 5. Do you have radioactive sources? 5. Would you like to receive additional free radioisotope packages? 2 1 30 6. Would you like FRI to service your equipment? 3030 ---Page Break--- — Table 12 Possible Future Contributions of the Puerto Rico Nuclear Center (60 interviews) Yes No No answer —__¥__— 2. Would you like a film library available? 6 2 3 2. Does your school have a projector? 45 ae 3 3. Would you like HUW to prepare detailed radiation biology laboratory exercises? 38 2 3 4. Would you like a bibliography of reference

material on radiation biology? 57 ° 3 5. Would you like PRIC to make available expert lecturers or consultants on radiation biology to visit your school and speak to the students? 0T ° 3 Do you think PRNC should keep the Department of Education informed about new developments in the teaching of radiation biology? 0T ° 3 Do you think PRIC should organize a seminar for all former Radiation Biology Institute participants? 0T ° 3 8. Would you like descriptive brochures for the Puerto Rico Nuclear Center for your students? 0n ° oe ---Page Break---

by using the radioactive sources provided with the kit. It has been clearly established that the participants have made very limited use of the free radioisotope packages (see above). Of the 60 persons interviewed, 8 (GOK) stated that the Department of Education allowed them to add radiation biology to biology or junior science courses; only one person said he was not allowed to teach radiation biology and this could be a misunderstanding. The important point here is that radiation biology is not in the curriculum, and the individual teacher is completely on his own. It has been shown above that the majority of teachers are working under far from ideal conditions (textbook shortages, inadequate laboratory).

facilities), which makes them hesitant to undertake any task without receiving official support. Almost all of the 60 teachers interviewed said that the training they had received was adequate, that they still felt confident in this area, and that the laboratory training was sufficient for them to use their equipment. About half said that they did not receive adequate reference materials for their students. The reasons given were insufficient quantity (51.91%), contents too difficult (20.6%), and English too difficult (27.58%). This is the second time the language problem was mentioned specifically. Most of the teachers agreed that the equipment provided is adequate for teaching radiation biology. Of the 47 answering the question, 33 (69.1%) stated that their equipment is still adequate. On the other hand, 17 (36.28%) said that their equipment (scaler retainer) was not functioning; in some cases it had not been functioning for several years. Five people mentioned theft as one of the reasons why their equipment was no longer adequate. The lack of storage areas in the schools seems to be a serious problem throughout Puerto Rico. Many teachers do not keep the equipment in the school. When they want to use it, they transport it from home. Obviously, this contributes to the overall lack of use, as it is a major task to move this equipment each time it is needed. In regard to possible future contributions of the Puerto Rico Nuclear Center, it is apparent that the teachers are overwhelmingly in favor of any additional help that could be provided. In regard to library services, 12 teachers (20%) stated that their school does not have a projector, which precludes the showing of movies. **IMPLICATIONS OF THE INFORMATION PRESENTED**

The training in radiation biology has been utilized only to a limited extent by most of the Institute participants. This is primarily because radiation biology has not been incorporated into the school curriculum, and therefore any effort in this direction is made by the

Individual teacher without official support. Additional factors are overcrowded schools and shortened school days, lack of basic materials such as textbooks, inadequate facilities for laboratory work, and a lack of safe storage areas for the equipment. It appears that the Summer Institutes in Radiation Biology were started in Puerto Rico prematurely. That is, the core basic problems of the Department of Education have not been resolved, and no real effort to incorporate radiation biology into the school curriculum has been made during the past 6 years. This is true in spite of the fact that the Department of Education was cooperating with the Puerto Rico Nuclear Center in offering the last three Institutes, in which 52 teachers were trained, at the request of the Department of Education the participants in the last 23. ---Page Break---

Three Institutes were also trained to teach the Green version of the BSCS high school biology course. However, most of those interviewed from this group stated that their training was not recognized by the science supervisor or that they were not provided with adequate textbooks and materials, as they had been promised.

In summary, after the training of 11% teachers during the past 6 years in the basic fundamentals of radiation biology, it is clear that the application of this training to the actual teaching of students in the classroom has been very limited. To continue the program under these conditions does not appear to be justified. RECOMMENDATIONS 1. The Department of Education should recognize officially the importance of radiation biology in the science curriculum. 2. The Department of Education should take full advantage of the training and equipment received by the participants in the Radiation Biology Institutes. 3. Closer cooperation should be established between the Puerto Rico Nuclear Center and the Department of Education to explore ways in which PRNC can continue its efforts toward training teachers and introducing radiation biology into the schools. 4. Summer Institute

Directors should make a greater effort to select participants who have not had previous opportunities and who can give reasonable assurance that they will return to classroom teaching after the Institute. Teachers who accept appointments to an Institute should recognize and accept the moral responsibility for returning to classroom teaching immediately afterward.

APPENDIX 1 LETTER SENT TO PARTICIPANTS BEFORE INTERVIEW PUERTO RICO NUCLEAR CENTER U.S. ATOMIC ENERGY COMMISSION Cable Address: 'Address reply to: Bio-Medical Building Nuclear, Bfo Piedras Caparrs Heights Station San Juan, Puerto Rico 00935. In reviewing our records, I noted that you participated in a Summer Institute in Radiation Biology. For the past three years, I have directed these Institutes offered by the Puerto Rico Nuclear Center. During the current academic year, I am interested in visiting former participants at the school where they are teaching in order to evaluate the effectiveness of this program. I would sincerely appreciate your filling in the attached paper and returning it to me in the addressed envelope by 2002 as soon as possible.

Sincerely yours,
Frederick E. Rushford
Director, Summer Institute in Radiation Biology

Enclosures: As stated above

Name:
Home address:
Name of school where you are now teaching:
School address:
Telephone hours during which you would be available for a personal interview at your school:

NOTE: If you are not teaching, please let us know as I am interested in determining if the equipment you received is being utilized in the school. I would like to know the type of work you are now doing if you are no longer teaching.

APPENDIX II QUESTIONS ASKED DURING INTERVIEW

USABC ~ RBI ABC-NGP INSTITUTE EVALUATION GUIDE IDENTIFICATION INFORMATION

Name (No initials, please):
Home address:

High School or University address:
Radiation Biology Institute attended:
Date, other institutes attended, dates:
University or college training: Major:

minor, degrees, dates What did you teach before participating in the Radiation Biology Institutes? What do you teach now? TL. INSTITUTE CARRY-OVER L Do you consider your participation in a Radiation Biology Institute useful (consider factors such as new subject matter, new teaching techniques, career benefit)? Has your school administration been generally sympathetic toward incorporating radiation biology into your coursework? ---Page Break--- 2, 4 5 To what extent have you been able to incorporate the training received in a Radiation Biology Institute into your teaching? One very little, some, a great deal. Have you continued liaison with your institute director? To what extent? To what extent have you used your training in radiation biology in non-teaching activities, i.e., lectures to community groups, etc.? Has your training been of use with respect to science fairs, science clubs, etc.? Would you enroll in a summer institute in advanced radiation biology? With respect to the Radiation Biology Newsletter, do you receive it regularly? Do you find it of little use, moderate use, or much use? How might it be improved? Estimate how much space (in square feet) you have and describe briefly present facilities for using your kit. Is it adequate? ---Page Break--- 2 a o 1 How frequently is the kit used? How many times per week? How many times per year has the kit been used in courses other than biology, i.e., physics, chemistry, others (be specific, please). Has the kit been used in research? Moreover, is your scaler rate meter functioning at present? Has the maintenance and repair of the equipment been a minor problem or a serious problem? Please rate those five instruments from the equipment kit in the order of their value to you (Use a scale of 1 to 5 with 5 as the highest rating). Scaler rate meter, electroscope, cloud chamber, spintharoscope, autoradiography kit. Do you recommend additional items? Would you prefer the scaler rate meter available as separate units? If the rate meter were...

Portable, as separate units, would it be preferred over the presently combined unit? Estimate how much use you make of the rate meter (none-little-some-considerable). See IV. RADIOISOTOPES 1. Did you order radioisotopes? If no, why not? ---Page Break--- 2. If yes, how many times did you order the free packages? 3. Did you ever purchase radioisotopes? 4. If no, did you obtain any free radioisotopes? 5. If yes, where did you obtain them? 6. Do you have access to a source of ionizing radiation? SUPPLEMENTARY INFORMATION A. Utilization of Training 1. Has the teacher been able to use the training received? 2. Does the Department of Education allow you to add Radiation Biology to Biology or other science courses you teach? B. Training Program 1. Was it adequate? 2. Were you able to retain enough to feel confident in this area? 3. Was the laboratory training enough for you to learn how to use the equipment? 4. Did you receive enough reference material for your own use? Did you receive enough reference material for your students' use? 5. If no, why not? Equipment Kit 1. Was it adequate for teaching Radiobiology? 2. Is it now adequate? Is the equipment now working? 3. Do you have radioactive sources? 4. Would you like to receive additional free radioisotope packages? 5. Would you like PRNC to service your equipment? ---Page Break--- IV. POSSIBLE FUTURE CONTRIBUTIONS OF THE PUERTO RICO NUCLEAR CENTER 1. Would you like a film library available? Does your school have a projector? 2. Would you like PRNC to prepare detailed Radiation Biology laboratory exercises? 3. Would you like a bibliography of reference material on Radiation Biology? 4. Would you like PRNC to make available expert lecturers or consultants for Radiation Biology to visit your school and speak to the students? 5. Do you think PRC should keep the Department of Education informed about new developments in the teaching of Radiation Biology? 6. Do you think PRNC should organize a seminar for all former

Radiobiology Institute participants? Would you...

Like descriptive brochures of the Puerto Rico Nuclear Center for your students? a3ee ---Page
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