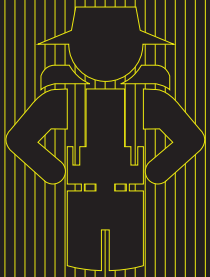

GUIDE

TO CITIZEN SCIENCE PROGRAMS

Citizen Science Program
Conservation Trust of Puerto Rico

CONTENTS

No incluido en correcciones

FREQUENTLY USED TERMS

With the purpose of easing the reading experience, and after their first appearance in the main text, the following frequently used terms have been substituted with either the corresponding acronym or the words shown below:

The Conservation Trust of Puerto Rico - CTPR, the Trust
Hacienda La Esperanza Natural Reserve - HLENR, the Reserve
Citizen Science Program - CiSci Program
Citizen Science - CiSci
Organizing Entity - OE
Informal Science Education - ISE
National Science Foundation – NSF

HOW TO USE THIS GUIDE

This Guide is directed to those individuals, organizations or institutions interested in using the Citizen Science (CS) Program's first cycle of research projects as a model for establishing its own citizen science program. The reader will find basic suggestions and descriptions regarding the steps that an Organizing Entity (OE) may follow to develop, plan, implement, and administer a similar program.

This Guide is not intended as the only source for developing a citizen science program, nor is it meant to serve as a primary reference for technical or conclusive assessment of education, informal science or scientific research. The information presented is based on the experiences of the Conservation Trust of Puerto Rico's (CTPR) personnel, as well as those of the investigators, assistant scientists, and volunteers who participated throughout the various stages of the CS Program.

This Guide should be used together with the General Summary in this kit, since the latter publication includes specific examples and experiences relating directly to many of the subjects discussed in the Guide. We strongly suggest reading both documents in order to better absorb the overall information.

If you wish to receive technical guidance about this information or would like an assessment regarding your specific needs and questions, you should consult an expert in the corresponding field, or directly contact the Conservation Trust or other sources included at the end of this Guide.

BEFORE YOU BEGIN

Developing and implementing a citizen science program should only be limited by your own imagination or the resources readily available to you. The CS Program was designed and implemented within the framework of the CTPR's guiding principles. Therefore, understanding the Trust's mission is essential for grasping its role as the OE for this program. As you go through this Guide, you should also keep in mind the principles and goals of the community or organization interested in creating a citizen science program.

After concluding a cycle of research projects, a program's success will greatly depend on the relationship established between the Organizing Entity, its needs, and the program implemented. Creating a conceptual link between informal science and volunteer work within the institution's guiding principles, the learning environment, and the program's scope is also of great importance.

This Guide explains basic components that are needed to carry out scientific research programs with volunteers. It also includes general aspects that must be considered from the outset, as well as some suggestions for planning and conducting research activities.

When consulting this Guide, the reader should try to relate the points discussed in each section to his or her own institution. The procedures and methods presented are meant to be taken as suggestions, and not as the only way to establish a program of this type. In fact, even within the Trust's CS Program, there have been exceptions to the proposed order.

This Guide should also be adapted to your institution's own particular needs and capacities so that you can effectively put into practice what you have learned. The primary purpose of this educational tool is to present the possible impacts of citizen science programs, so that you, as a representative of an OE, may establish your own parameters and objectives.

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1. WHAT IS YOUR ROLE AS ORGANIZING ENTITY (OE)?

Every citizen science program begins with at least one fundamental question about its aims and objectives. The OE will attempt to address such questions through one or more research projects that will be conducted as part of the program. To succeed, the citizen science program must be linked to the OE's mission, vision, and institutional values.

The OE is one of the basic components of the program. In the subsequent section about the OE, you will learn about some of its duties and the key personnel members that will be needed to carry out the program, depending on its complexity.

2. IS A CITIZEN SCIENCE PROGRAM RIGHT FOR YOU?

Citizen science allows the public to have direct participation in scientific research through valuable volunteer work experiences. Volunteer participation, in turn, allows scientists to answer some of the questions posed by the program, which would otherwise be a difficult task due to time and personnel limitations, as well as to the amount and complexity of the observations needed to carry out the research.

To find out whether an OE's needs and questions can be met and answered through a citizen science program, we must first examine some general aspects related to establishing a program of this type. More information on this matter is discussed in a subsequent section.

Prior knowledge of some of the functions and characteristics of a research program is also useful, and can be found in the third section of this Guide. To determine if a citizen science program can meet some of the needs of your institution or community, you should familiarize with the content of this Guide and seek additional information or assistance from the Trust.

3. WHAT IS THE EXTENT OF YOUR PUBLIC PROGRAMMING?

Determining what programming will be available for the public is another basic aspect to creating a citizen science program. This will depend largely on the location and learning environment of each research project, its duration, and, above all, the quality and variety of opportunities available for volunteers to engage in.

Because the work of volunteers is fundamental to any citizen science program, great attention and care must be dedicated to increase programming quality. As explained in the fourth section of this Guide,

designing and implementing evaluation methods to ensure the quality of programming throughout the research's different stages is also of great importance.

4. WHAT IS THE DESIRED IMPACT FOR THE PROGRAM?

The main impact will depend on the experiences of all participants, what they learn, and the way in which results are communicated. Achieving or failing to obtain answers to the proposed research questions will be another determining factor.

It is necessary to know beforehand the type of public that the citizen science programming will target. Knowing the target public is important for determining recruitment strategies, creating a volunteers' training process, and planning activity sessions.

Even though the collection of research data depends on the participation of volunteers, the most significant impact of a citizen science program is derived from instilling among participants a shared interest in research and science. In that sense, recurring volunteer participation offers the most reliable indicator of success.

The objectives of citizen science programs can vary greatly, and their emphasis will depend on the mission and vision of the organizing entity. In some cases, the quality and precision of volunteer work will be emphasized, while in others, it may be the knowledge acquired by volunteers about the area where the research is carried out, or about the scientific processes used.

Through their experiences, volunteers may also participate in the OE's mission. This serves to consolidate collaborations between scientists and volunteers and willhelp to disseminate knowledge acquired to the participants' communities, and to future volunteers.

Methods used to evaluate a citizen science program's impact will be discussed below. This factor is of utmost importance if the program depends on institutional grants or other subsidies.

5. WHAT ARE THE EDUCATIONAL AND/OR STEM OBJECTIVES?

Even when achieving effective participation in a research project is understood as an informal science education experience, many citizen science programs that are subsidized by other institutions must propose specific educational objectives. These objectives may or may not be tied to an integrated knowledge curriculum on Science, Technology, Engineering, and Math, known as STEM. The educational objectives will depend on the program's scope and the nature of its research.

A technical and professional commitment to fulfilling these goals must be undertaken by personnel and volunteers in each research project. In order to propose and implement the educational role of each project, the OE should have the support and advice of experienced institutions with the structural capacity to carry out educational or environmental interpretation activities. Therefore, the OE must evaluate its capacity and consider bringing in external resources if needed.

If the program's goals include providing learning experiences to volunteers on specific subjects, then the OE must establish methods to evaluate whether the activities are meeting those goals effectively. This is also of vital importance to obtain grants or subsidies from other institutions.

THE BIRTH OF A CITIZEN SCIENCE PROGRAM

The following sections describe some general guidelines for creating a citizen science program. These guidelines will be relevant throughout all stages of the process, so it is recommended that they be kept in mind at all times.

Even if the OE is the most qualified entity to determine its own criteria regarding these general guidelines, the direct involvement of investigators and volunteers in these early stages will enrich the overall quality of the program and further validate the importance of public participation in scientific research processes.

1. UNDERSTAND THE LEARNING ENVIRONMENT FOR EACH RESEARCH PROJECT

The questions generated by each research project should be derived from a specific area in the learning environment. The physical nature of this area, as related to the OE's needs, will determine the type of questions that must be answered.

Posing the necessary questions, in turn, will determine the scope of each research, with regard to its duration, frequency of activities, and number of volunteers required to carry them out.

Many research activities, particularly those that require data analysis and processing, will not necessarily be performed in the field or specific area of study. Therefore, the OE must consider areas where all stages of the research may be carried out, including where it will be planned, where it will begin, where each task will be carried out, where data will be collected and analyzed, and, finally, where it will conclude.

It is also important to take into consideration when and how citizen participation will be incorporated, since, in theory, volunteers may be included in all stages of each research, as defined. These aspects may be determined during the planning stages and while drafting the proposal, although some changes and adjustments may have to be implemented during subsequent stages, as explained further on.

In order to define these aspects within each research, the lead investigator must establish an appropiate scientific methodology. This step, however, must take place after the learning environment has been selected, the OE's needs have been identified, and the initial research questions have been posed.

2. DETERMINE YOUR NEEDS AS ORGANIZING ENTITY

Even though a citizen science program may not necessarily be linked to specific lands, the OE may have certain needs regarding land use and the management of particular lands, within the framework established by a management plan.. As further explained in the General Summary, this is the case of the Citizen Science Program (CC).

The needs of a management plan may be derived from specific problems in a particular area, the need to learn more about the

area and its characteristics, or to efficiently direct resources to certain management practices, including restoration, reforestation, cleaning, planting, conservation, and research, etc. If a management plan does not exist, the research results may be useful in drafting a plan or to support future management decisions.

In the case of communities acting as organizing entities, the results of a single research may provide the necessary information for justifying the importance of preserving an area, or to support a pre-existing scientific database, such as Ebird. Only the OE can define its needs, and it is better to do so before planning the citizen science program, since the success of any research will depend on how it can provide data to fulfill those needs.

3. IDENTIFY INITIAL QUESTIONS

Once the OE's specific needs have been established, any research questions to be answered must be determined in relationshipto these needs. These questions will be needed for planning and designing the program, which may include one or more research projects, each with its respective calendar and activities.

As discussed in the introduction to this section, it is recommended that the participation and feedback of investigators and volunteers be integrated from the outset.

4. DEFINE THE PROGRAM'S OBJECTIVES

A program must aim, primarily, to answer the questions that were posed, as related to the learning environment and the OE's needs. The scientific methodology established by each lead scientist will seek, above all, to answer these questions. The OE must establish

the general goals and objectives of the entire program, taking into account the individual objectives of each research. These general goals may not always agree with individual objectives, and they usually incorporate public programming based on other aspects related to volunteerism as an experience.

Great care must be applied to designing and implementing educational experiences, as part of the public programming's desired impact. Incorporating informal science education will be an important tool to achieve this purpose. Defining the desired impact of the experience for participants is a key element in this process, and will help determine the type of educational experience that is desired.

The areas or physical locations for informal science learning may include daily learning environments, pre-designed environments and science programs, as defined in Surrounded by Science, published by the National Research Council. Daily learning environments are those that offer a wide array of valuable lifelong experiences, such as family conversations, hikes through the forest, hobbies, watching television, reading, surfing the Internet, etc. Pre-designed environments, on the other hand, include museums, scientific and environmental centers, botanical gardens, zoos, planetariums, aquariums, visitors' centers, historical centers and libraries, etc. Communications media, signs, and interpretation personnel or volunteers serve mainly to guide the participant's experience within these spaces. Choosing to visit these learning environments must be freely decided by each volunteer and, in the case of young participants, must include parent or guardian consent.

Citizen science programs usually include extracurricular activities that can be linked to the school curriculum, whether to fill leisure time during the summer, or for clubs, museums, junior science cafés, public conferences or learning vacations, etc. As in pre-designed

environments, choosing to visit these places is entirely up to each volunteer and, in the case of young participants, must include parent or guardian consent.

These types of environments must be kept in mind to help citizens relate the content of research activities to some aspects of their daily lives. In doing so, the participants will feel more comfortable in the areas where activities will take place, which in turn facilitates learning and integrating informal science into each research. This type of programming, along with training opportunities and exposure to specific knowledge (see next section), complement the main objectives of a program and increase the significance of its impact on participants.

5. BE AWARE OF YOUR INSTITUTIONAL CAPACITY AND IDENTIFY POTENTIAL SUBSIDIES

The OE must adequately design the complexity of the citizen science program, not only with regard to general aspects and basic components (as further explained in a subsequent section), but also in terms of other aspects that will become evident after completing each research. Keep in mind that these general aspects are not necessarily limited by the capacities or means available—you may in fact exceed those limitations by obtaining external support or subsidies.

The reference section contains contact information for private and government institutions and entities that may help an OE in aspects related to support, logistics, and program funding.

6. ESTABLISH THE PROGRAM'S COMPLEXITY

An OE's needs and available means may offer insight into the possible complexity of a program, especially in terms of the amount of research that will be carried out. Achieving the proposed objectives for the program and for each research project will determine how the available resources will be allocated.

Every task must aim to satisfy the needs of the OE and answer the questions it has identified, regardless of the program's scope. This criterion goes above the limitations of an organizing entity, since it could potentially serve to identify funding sources.

It is important to define the program's ideal scope before considering the actual scope that may ultimately be reached, as related to the available resources (and those that may be obtained through external sources) and the resources required to achieve the desired scope. The sum of these two scenarios (the ideal scope and the attainable one) will define the final scope of your citizen science program.

7. CREATE ALLIANCES WITH OTHER INSTITUTIONS

Another way to surpass limitations is to identify other institutions and entities that may contribute towards meeting the program's objectives. The type of assistance that another institution may offer is as varied as the many needs that a program may present, from donating necessary materials and equipment, to providing personnel or professional services. Creating alliances with other institutions will depend on the quality of the proposed program, and the nature and purpose of the organizing entity.

PROGRAM PLANNING AND GENERAL DESIGN

Once the general aspects of a citizen science program have been considered and defined, the organizing entity may begin planning and designing its specific components. The results of this process must be drafted into a general proposal, as explained in this section. Beside the basic components of a program, there are other important factors that must be considered in the proposal with regard to planning research.

This section should be taken into account before planning and implementing any research activities.

GENERAL PROGRAM PROPOSAL AND INDIVIDUAL RESEARCH PROPOSALS

Many citizen science programs are based on a single research or monitoring study. Others, like the CS Program, are based on cycles of various research projects. The number of research projects will depend on the complexity of the program and its objectives.

If only one research is to be carried out, then a single proposal is needed. If several research projects are to be conducted, then individual proposals for each research will have to be drafted into a single general proposal for the program.

Each research must be preceded by its own planning and design stages, which will be reflected in the individual proposal. The lead investigator will be in charge of drafting the individual proposal, as part of the terms of his/her contract. Each proposal should include detailed descriptions on several aspects, as explained in the Lead Investigator section.

In all cases, the OE will be the final authority in charge of approving each proposal, so it must carefully oversee the entire drafting process.

BASIC COMPONENTS OF A RESEARCH PROGRAM

The basic components of a citizen science program are the following: The organizing entity (OE), the investigators, and the volunteers. As explained in the General Summary, and as recommended in previous sections, the investigators and volunteers should become involved in the research throughout its different stages. Planning and designing individual research projects may not begin without the lead investigators, since they will be the authors of the proposals.

The following sections include details about each basic component through a summary of its duties, as well as practical advice.

ORGANIZING ENTITY (OE)

SUMMARY OF DUTIES

The OE is the entity responsible for creating, planning, implementing, and managing a citizen science program from its beginning to its conclusion. It is essentially dedicated to bringing together all other basic components (the investigators and volunteers) within the learning environment, and to guiding them so as to ensure that they work together properly and that each research is carried out effectively.

Any club, association, community, company, corporation, school, university or agency—in other words, any group with the minimum personnel needed to develop at least one research in an organized and effective manner—may potentially serve as an OE for a citizen science program. There is also a great variety of administrative and personnel structures, as well as different resources and budgets, which may be taken into account when creating a program.

Therefore, defining the complexity of a program in these terms, and according to the OE's particularities, is of great importance. Nearly all tasks, duties, and responsibilities within the program, as described by this Guide—except for those of the investigators and volunteers—will be undertaken by the organizing entity's personnel, and it is essential that they perform them thoroughly.

PROGRAM COORDINATOR

Regardless of the organizing entity's size or personnel structure, a Program Coordinator should be assigned to lead practically all tasks related to planning and implementing research activities (see related section). This key personnel member must ensure that there is an adequate flow of information among all components. The Program Coordinator is also responsible for the program's success from the institution's standpoint.

The Program Coordinator should take into account the OE's goals, and the objectives of each research, along with all other general aspects. He or she will also be responsible for ensuring proper management of the funds and resources allocated to the program.

ASSISTANT COORDINATOR

Depending on the program's complexity and the amountof research, the Program Coordinator may need an Assistant Coordinator to offer support in tasks related to research activities and recruitment efforts, among other duties. These efforts must be centralized, and the information provided to the public must be supervised by the OE to ensure its validity and integrity (see section on Volunteers for more details). The Assistant Coordinator will also be responsible for keeping the schedule updated, and may also request additional assistance, if necessary. Additional assistance may be provided by other personnel members or volunteers.

EDUCATION OFFICER

This personnel member will represent the OE in the learning environment, and will serve as a liaison between the investigator, assistant scientists, and volunteers. Education Officers are indispensable, especially in research that requires a large number of volunteers, when the lead investigator does not have the support of assistant scientists, or when the area covered by the learning environment is too large.

Education Officers are responsible for ensuring the educational quality of research activities and collecting feedback that will help to improve existing activities and/or develop new ones.

LEAD INVESTIGATOR

In programs involving various research projects, the OE should enlist a Lead Investigator to oversee each one. This person should have the necessary scientific background and knowledge to ensure research quality and that strict scientific methodology is applied as

part of each activity, as well as to carry out all tasks related to the general aspects of the program, as determined by the OE.

It is recommended that all points discussed in this Guide be thoroughly evaluated and applied in keeping with both the needs of the OE and the available resources.

LEAD INVESTIGATOR

SUMMARY OF DUTIES

Each research shall be led by a Lead Investigator, who will be the scientist responsible for creating, implementing, and maintaining the integrity of the research's methodology, from its beginning to its conclusion. As scientist in charge of the research, the Lead Investigator will answer directly to the OE, which entails that a proper hiring process, or one of mutual accord if he/she is volunteering to carry out the necessary duties, will be followed.

RECRUITING AND SELECTING INVESTIGATORS

Before hiring or requesting the services of a scientist to lead a research, the OE must first identify its needs and determine general aspects needed to create the program (as discussed in previous sections). It is understood that each investigator's area of specialization should respond to these needs.

When identifying the preliminary questions and areas of interest for each research, the OE should leave some leeway so that the selected Lead Investigator may become part of the planning stages and submit a corresponding proposal. In doing so, the research will benefit from the beginning with his or her specialized knowledge.

Search and hiring process for investigators may be carried out through any means of communication available to the OE. The OE may also approach other established institutions that work in related disciplines and which may provide assistance regarding where and how to request the services of an investigator.

The OE will specify the documents that the interested scientists are to submit, as well as information regarding where, how and when to submit the requested documents. It should also include a description of the general aspects of the research, its specific needs and an overall view of the question(s) to be answered.

All scientists responding to a request for services will submit a preliminary research proposal, to be evaluated by the OE, along with his/her contact information, curriculum vitae, credentials, evidence of participation in other programs, references and recommendations, as well as any literature in which he/she based the research proposal, among other pertinent documentation.

HIRING

Contractual terms must be framed according to the OE's needs, and they should also contain general aspects of the program as it was conceived, prior to the actual planning and design of any oarticular research project, such as location, initial questions, objectives, program complexity, and institutional capacities, etc. Once the Lead Investigator has been selected, he or she should make any necessary adjustments to the general aspects of the research prior to hiring, including changes to the learning environment, as well as other adaptations to the OE's needs, objectives, scheduling, etc. Once revised by the scientist, these aspects must be taken into account when drafting the formal research proposal that will be included as part of the hiring documents (see below).

The research proposal must be evaluated, commented on and revised by the OE, keeping in mind its own needs while also maintaining open communication channels with the selected scientist. He or she will discuss, negotiate, and revise with the OE any necessary aspects of the proposal.

CHARACTERISTICS OF A RESEARCH PROPOSAL

A final research proposal should include and define the following aspects:

- Research Background- Introduction that describes how the idea behind the research originated. It should include information about the area of study, the learning environment, the specific location where the research will take place, any previous related studies, statistics, and any other relevant information that may shed further light on the research background.
- Research Description- Clear description of the scientific and educational goals and objectives, including aspects described below.
- Object of Study- Clear and concise description of the problem to be explored.
- Justification- Clear explanation of the importance and pertinence of the investigation in regards to the corresponding area of study.
- Hypothesis or Research Question- A definition of the hypothesis or question posed in relation to the area of study, the management of an area, or a particular species.
- Materials and Equipment- Detailed list or inventory that includes all tools and equipment needed to carry out data collection and analysis activities. Before requesting a final proposal, the investigator should be asked to take into account any aspects related to transportation and conditioning of the area of study (tents, measuring, recognitions, etc.).
- Work Plan- A description of the methodology, data analysis, dissemination of results, and duration of the study, as distributed among the activities to be conducted. The final scheduling for the work plan will be coordinated with the organizing entity. The investigator should provide a clear list containing all pertinent data fields. All data must be described (metadata) in order to configure the database.

• Inclusion of Volunteers- When requesting a research proposal, the program terms should be clearly stated along with any expectations that the institution subsidizing the program may have, if applicable. Each investigator must consider the active participation of volunteers in the scientific methodology, and must include elements that foster a sense of continuity and belonging among the volunteers, with the aim of ensuring recurrent participations.

• References- References that point to other studies, cases or written documents related to the subject must be included.

RECOMMENDATIONS FOR CONTRACT TERMS AND CONDITIONS

The contract should clearly stipulate duties assigned to each party—Lead Investigator and Organizing Entity—such as fees, payment installments, and any other condition deemed necessary. Expiration dates should also be clearly stipulated, in keeping with the general aspects defined by the OE after they have been commented on, adjusted and revised with the scientist in his/her final proposal. This proposal should be included as part of the formalized contract, which should also specify all duties and responsibilities to be carried out by the investigator during the research and upon its conclusion.

To receive additional information or orientation about this matter or other aspects pertaining to hiring procedures in the CC Program, you may contact the CTPR Legal Division or an authorized professional with experience in this area.

ASSISTANT SCIENTISTS

The Lead Investigator should rely on at least one Assistant Scientist, who will serve as his/her right hand throughout the research. The duties of assistant scientists will be determined by the Lead Investigator.

In the CC Program, one of the main duties performed by the assistant scientist includes ensuring that volunteers are correctly taking samples or collecting data. Among other duties related to scientific methodology, assistant scientists periodically report materials that need to be replaced or added, in order to ensure that the research process flows properly. The fees paid to assistant scientists may be included in the research project budget, or may be counted toward university internships .

RECRUITING ASSISTANT SCIENTISTS

Assistant scientists should be recommended directly by Lead Investigators. They are usually students or research assistants who have previously worked with the scientists and are already aware of their methodology. A contract should be drafted, outlining basic specifications of the Assistant Scientist's tasks.

Some research may employ committed and dedicated volunteers to fulfill duties that are typically assigned to assistant scientists. In such cases, they should be awarded some form of remuneration in exchange for their work, at least enough to cover transportation expenses.

ADDITIONAL SUGGESTIONS

The section dedicated to the Lead Investigator in the General Summary describes the tasks and challenges that lead scientists faced during the first cycle of the CC Program. Some general advice is included below:

Interaction with Education Official, Assistant Scientists and Volunteers

While conducting research activities, each investigator relied on the support of one or more assistant scientists, education officers or volunteer leaders, depending on the case. None of these team members should interfere negatively with the scientific methodology, however, they are expected to provide recommendations to the Lead Investigator.

Data Management

Each lead investigator must have access to all necessary technological tools in order to process, store, and analyze research data. This aspect should be based on the content of the final proposal submitted by the investigator. The data collected must be centrally stored and made available throughout the research.

Reports

Each investigator must periodically submit a progress report. In the CC Program, the established protocols—as related to the NSF grant—stipulated certain data that had to be included in each report, including the following:

- Reported duration
- Lead scientist's name
- Title of research project
- Date of the report
- Major results, current
- Overall Findings, current
- Training and development, both received and offered
- Participation in external activities related to the investigation
- Publications related to the research in scientific and/or educational journals
- Books and other one-time publications
- Any product or contribution obtained from the research in progress
- Contributions to the field of study
- Contributions to other disciplines
- Contributions to human resources development
- Contributions to research or educational resources

- Contributions beyond science and engineering
- Challenges faced (e.g., reasons certain activities could not be conducted, new aspects to be explored at the light of certain findings, etc.)
- Statement of needs
- Percentage of progress in the field study
- Success stories in regards to volunteers and their experiences
- Additional comments

Although reports should be submitted once every quarter, their frequency and complexity will be determined by the duration of each research project, as well as on external criteria related to the OE or the subsidizing institution, depending on the case.

VOLUNTEERS AND VOLUNTEER MANAGEMENT

SUMMARY OF DUTIES

Volunteers are the driving force behind any citizen science program. They are the wheels that keep the program turning and they serve as its very foundation. The two most important aspects to consider regarding volunteers are, the commitment and consistency they exhibit toward the scientific methodology employed in research, and the quality of the experience they will receive through their participation. To keep both aspects at an optimal level, a constant and effective communication channel must be kept open with all volunteers.

The number of volunteers required during each stage of the research will depend on the type of research, the scientific methodology employed, and the way in which volunteer participation is implemented. The number of participants per task must be adjusted gradually once the activity sessions have begun, and according to feedback from the personnel in charge.

The language and terms used to communicate with volunteers will also be gradually adjusted, as well as the pace of activities. All adjustments will greatly depend on the difference between the desired volunteer profile and the actual volunteers who participates.

DETERMINING VOLUNTEER PROFILE

The volunteer profile will be determined by the way in which the following factors are defined, which must be clearly stated once the recruiting process has begun.

Types of Tasks- These depend on the physical context and methodology of the research as it was proposed, and may include walking, writing, measuring, and monitoring, among other tasks. Prospective volunteers should decide whether or not they are capable of carrying out the necessary tasks upon receiving a preliminary orientation.

Hours- The volunteer must be aware of the established arrival and departure hours for each activity session. He or she should be willing to fully complete the established hours.

Locations- The volunteer must be given clear instructions on how to reach the location where the activities will be carried out. The area where each volunteer will be working will be described beforehand (i.e., types of soil, flora, fauna, etc.). If transportation to the area of study must be provided, specific instructions must be offered as to when and how to reach the meeting location.

Training Opportunities- If volunteers must receive training or possess prior knowledge to carry out research tasks, they must be recruited with this condition in mind. If training will be part of the activities, the volunteer must be informed in advance of of this requirement.

Time Commitment- If the research requires that a single volunteer must participate in more than one session, whether to provide continuity to the task or for any other reason the scientist deems necessary, the volunteer should be notified during the recruitment process.

Climate- The volunteer must be aware of the climate conditions that he/she may be exposed to during activity sessions, including extreme sunlight, rain, cold, winds, humidity, and heat, etc., so that he/she may take the necessary precautions.

Age- If there are any age restrictions, the volunteer must be notified when he/she confirms participation (as explained further on).

Attire - Climate conditions and physical characteristics of the area of study may determine the type of clothing that volunteers must wear. In the CS Program activities at the HLENR, all volunteers were recommended to wear long pants, shirts with sleeves, boots or closed shoes, and jackets. There are certain activities, like the CC Coastal Research Project, where volunteers can use different attire according to the conditions of the particular field work (water shoes and short pants. Participants could also bring additional clothes in case they wanted to change after the session had concluded. It was also recommended that they bring articles such as sunglasses and hats, as well as insect repellent and sunblock, depending on climate conditions.

If an activity requires special safety attire, the OE should provide it to the volunteers. This aspect must be included in the consent documents and must be planned beforehand when preparing for the activity.

Verifying Credentials (Volunteer Leaders)- In activities where recurring participation is required, the OE may request certain credentials, which may represent another aspect to be considered as part of the work materials.

IDENTIFYING PROSPECTIVE VOLUNTEERS

Once the volunteer profile has been defined, potential candidates must be identified for specific research activities or the overall program. If the OE has a database containing affiliated members or

groups, a first step would be to identify potential candidates from within the database who may fit the desired profile. If the OE does not have such a database, then the recruitment process would begin from scratch.

By way of example, the Conservation Trust relies on an extensive electronic database called Red@migos, which is continually fed from contact information cards that participants fill out during different activities carried out by the institution. Each card contains a record with key information about the person, including his/her interests. The program that manages the database allows the reports to be sorted by area of interest, or other criteria.

Other citizen-based organizations, such as the Sierra Club, use similar databases. The OE should ideally build a database consisting of interested persons, whether by doing it internally or by enlisting the help of another entity experienced in building these types of databases. The quality of the database will depend on the efforts put into the recruitment process and how effectively the program is advertised.

Ultimately, the database would serve not only to extract information about potential or existing volunteers for the citizen science program, but also as a valuable communication source to spread information about activities and other issues related to the OE's mission and objectives.

RECRUITING VOLUNTEERS

As with many other aspects discussed in this Guide, the means to recruit volunteers are only limited by the imagination and the OE's available resources. All recruitment material should contain information about the requirements to participate (general volunteer profile), dates, and a simple description about the citizen science program and related research projects. It must adequately balance the amount of information presented with its capacity to be read and understood through the promotional material. For more detailed

suggestions on this process, please refer to the flowchart on volunteer work in the Appendix Section.

The following are some recruitment tools that may be useful in the process:

Promotional Campaigns- Depending on its capacities and resourcefulness, the OE can run a publicity campaign using media that is familiar to prospective volunteers.

Emails- Using information from the database, the OE could send electronic promotional materials about the program and activities. The OE must try to do this periodically, making sure to provide a right amount of information without flooding the prospective volunteers' inboxes with annoying amounts of emails. This should also be considered when contemplating whether to create alliances with other institutions.

Regular Mail- Promotional printed materials about the program and activities can also be sent by mail by using information from the database. This should also be done periodically so as not to invade the privacy of prospective volunteers. Printed materials sent by regular mail tend to offer a wider scope of impact, since not everyone uses email.

Mass Media- The most commonly used mass media include radio, television and newspapers. The OE should become familiarized with TV channels, radio stations and newspaper publishers (both national and regional) in order to coordinate promotional efforts. Many mass media allow print space and airtime for nonprofit institutions or innovative programs, which means that the OE does not have to rely on a huge budget for advertisements, announcements, and interviews.

Internet- Ideally, a website should be created to provide information about the program to interested persons and allow them to register

for activities or as potential volunteers. If the OE cannot readily create a website, there are many existing social networking sites that provide great opportunities to reach a wide audience with a minimum resource investment. Once again, this will depend on the OE's imagination and resourcefulness.

CAPTIVE AUDIENCES AND MEDIA

Captive audiences are groups, organizations or other entities that, due to their institutional nature, maintain a fixed public continuously exposed to a specific communication medium. Through various platforms that fit into this type, the OE can find opportunities to reach different captive audiences. These forums can be ideal for offering presentations and/or informational booths with the program's promotional material.

Checklists containing these different groups can be created prior to visiting a promotional site. The OE should check with the hosts to find out what spaces and audiovisual resources might be used for presentations. Common places to find captive audiences include schools, universities, fairs, interest groups, open houses, educational workshops, community meetings, and interpretative tours, etc.

PROMOTIONAL MATERIAL

The following are some of the promotional materials that can be used to spread information about the program and recruit volunteers:

Brochures- Concise thematic leaflets that provide basic information about the OE, its mission and objectives, as well as the citizen science program. This document will support any other information presented through other media and will serve as a valuable source of reference for distribution.

Business Cards- Every representative or personnel member from the OE should have his/her own formal business card. This item will be useful to readily provide contact information in different scenarios.

Calendars- If a program or OE representative is involved in making public presentations, he/she should have a calendar readily available with all scheduled dates for activities. It should include the names of activities, dates, hours, levels of difficulty and contact information, among other relevant data.

Posters- When meeting with or presenting before groups of leaders (e.g., teachers, community leaders, etc.), they should be provided with a poster that they can later put up in a visible spot within their respective institutions or workplaces.

Videos or Digital Presentations- Audiovisual resources are currently the most effective way to present information to a captive audience. The availability and low cost of current technological media offer numerous possibilities to explore within this field.

Volunteer Information Forms- Using information forms is very useful for providing a steady feed of records for the database. The information requested in these forms may be used to identify prospective participants. The OE should try to get participants to fill out these information forms during all of its activities and presentations.

Research Material- Presenting some of the scientific tools and materials to be employed during research can be very effective for capturing an audience's attention and recruiting interested persons. These materials should be exhibited while explaining or describing the citizen science program and its research.

DIRECT CONTACT

Phone Calls- With the ideal volunteer profile in mind, program personnel can create a list of prospective volunteers to contact directly over the phone, using information from the various sources afore mentioned. As the database for the region or overall program continues to expand, this method may only be useful to reinforce recruitment for some activities.

Visiting Communities- The OE must establish relationships with nearby communities and ensure their active participation during program activities.

PARTICIPATION CONFIRMATION

The personnel members in charge of volunteer management should directly contact recruited and registered individuals over the phone. These phone calls should take place two or three business days before the activity, and should serve only for orientation and follow-up purposes. The personnel in charge should also send a reminder by email, including information about the activity and a map with directions on how to arrive at the meeting spot.

ACKNOWLEDGMENT

The OE should acknowledge the contributions of volunteers by using a range of different methods and approaches, such as thank you letters, certificates of participation, special events, luncheons, and similar activities.

FOLLOW-UP

In order to keep communication channels open, a periodical follow-up plan should be enacted, which could include phone calls, emails, or sending follow-up materials through the mail in order to share updated information about the program and upcoming activities, progress reports, etc.

IMPACT AND FEEDBACK

In addition to volunteer acknowledgment and follow-up, participants should also be allowed to provide feedback about their experiences. Creating, fostering, and maintaining open communication channels is very important, since the information provided by volunteers

will help to identify the strengths and weaknesses of any research project, thus helping to improve it along the way.

The formality in which feedback opportunities are provided will depend on the program's scope and the available resources. Some companies are dedicated exclusively to seeking public feedback, and they may be hired by the OE as an external resource.

VOLUNTEER LEADERS

During the course of the research, personnel should be able to identify volunteers who have participated frequently, and who readily absorb knowledge provided through the research and/or seem to go out of their ways to further enrich research with additional information. These volunteers may be previously identified during the initial interviewing process, so that they can be provided with the necessary training to lead data-collection activities with other volunteers (see next sub-section).

The tasks performed by Volunteer Leaders are very similar to those of the Assistant Scientists—they manage volunteers, supervise data collection and analysis, inspect materials and determine if any additional ones must be requested, and they help the Lead Investigator with any other task that he/she deems necessary.

PERSONNEL TRAINING

The types of research activities carried out by a citizen science program require certain knowledge that personnel members may not necessarily possess beforehand. This also applies to education officers, investigators and their assistants, as well as volunteers. The OE must take into account all subjects that are to be presented through training sessions and/or workshops, while also considering the skills, weaknesses, and needs of the different groups that make up the program's personnel.

For volunteers, a distinction should be made between those who participate sporadically and those who have participated in a recurrent manner. For sporadic participants, basic workshops may be offered during each activity session to cover the following aspects:

- Scientific methodology
- Branch of science associated with each area of study (hydrology, botany, etc.)
- Role of the OE or community
- Concept behind the proposal or citizen science program
- Management strategies applicable to the area of study

For recurring participants who have shown an ability to serve as Volunteer Leaders, advanced workshops may be offered to cover the following aspects:

- Branch of science associated to each area of study (hydrology, botany, etc.)
- Role of the OE or community
- Concept behind the proposal or citizen science program
- Management strategies applicable to the area of study
- Volunteers management
- Environmental interpretation
- CERT (Community, Emergency, Response, Teams) workshops and first aid
- The leader's role:
    a. Fulfilling duties
    b. Instructing
    c. Using communication strategies (interpersonal relationships and feedback)
    d. Problem-solving and conflict management
    e. Teamwork

- Sampling and data-collection techniques
- Use of basic equipment (GPS, website, etc.)
- Workshops about environmental conservation and citizen science programs, among other subjects relevant to the OE's goals.

Volunteers should receive training on the established rules of conduct. All volunteers should clearly understand how they are expected to conduct themselves during research activities and in their respective work areas, as well as in the tasks and duties they are to fulfill.

Beside their assigned tasks and duties, investigators and education officers must also be clear on how they should conduct themselves during activities, as well as the procedures established to manage volunteers and their conduct, as well as any emergencies or threats to the participants' safety. This matter is of great importance, since investigators and coordinators are responsible for the volunteers and, as such, must ensure that these procedures are followed.

The OE should consider offering training in other areas to the investigators, their assistants and education officers, regardless of their particular technical training, so as to improve their overall performance in the program. Such training should include:

- Communication techniques and interpersonal relationships, as well as training on how to provide or receive information or feedback
- Discussing difficult work situations and applying communication and feedback techniques
- Problem-solving and conflict management
- Conduct modification methods
- Procedure for termination participation
- Tools for intervening with external sources or persons, which may interfere in some way with the investigation or who may represent

an adverse interest in regards to the OE. Introduction to different scenarios and how to handle them

- Communication with other personnel members and volunteers within a respectful environment
- Teamwork
- Forms of recognition and acknowledgment
- Filling out accident reports when required according to institutional policy, even when they may seem unnecessary
- OE policies and procedures to ensure that personnel members are clear on all general institutional stipulations and volunteer conduct Guidelines (see appendixes)

To facilitate ongoing training and identify any specific needs or weaknesses, all recurrent situations should be discussed during periodical planning meetings (see next section). These meetings should discuss personnel and investigators' feedback, volunteer experiences, and how certain situations should be handled to minimize risks, etc.

ASSESSMENT METHODS

The OE must consider that each research may include in its final proposal an assessment plan. This plan should be implemented at the beginning, midway and at the conclusion of each research. The assessment plan may also include a simple component that can be implemented during each activity session.

As part of an assessment process, information about the participants' experiences and interests may be collected in order to help them interpret what they have learned. Educators who become involved in the program should also establish relationships with local communities to develop exhibitions and other experiences related to

the research. These types of activities offer insight into the success, acceptance, and grasp of different aspects within the program.

Ensuring that the program's ideas and activities are of significance to surrounding communities is also important. This may be done by using the objects of study and learning environment as a way of presenting the public with scientific problems. When using scientific terminology, the participants' shared knowledge and their cultural or social experiences should be considered, as well as other tools, to communicate the scientific concepts using everyday language.

Indeed, it is difficult to accurately measure or quantify the scientific knowledge acquired by participants within informal contexts such as this one, and the efforts to develop means or methods to do so are the subject of ongoing discussion.

ESTABLISHING A CHAIN OF COMMUNICATION

Every program, whether large or small, must establish a chain of communication in order to carry out basic tasks and to ensure that information flows efficiently. Each basic component of a program must be aware of the duties and responsibilities of each member, so that needs can be adequately met.

GENERAL SCHEDULING

Creating a general schedule or calendar is recommended when the program consists of more than one research project. If there is only one research project, a single calendar with the scheduled workplan for that research will be sufficient (see next section).

When a general calendar is used, the organizing entity, as well as the coordinators, investigators and volunteers, should all be aware of the dates for scheduled activities. Any changes should be notified

promptly. The schedule should also be readily available at any moment to advertise the activities.

The Program Coordinator should create a general schedule based on the general program proposal, and taking into account the dates for activities established by investigators, as well as dates related to administrative reports, meetings, etc. The Assistant Coordinator should update the schedule periodically, depending on the program's complexity and the progress of its research activities. Because the general calendar is directly affected by each research, it should be checked and approved by all investigators before and after it is updated.

PERFORMANCE AND PROGRESS REPORTS

Various key members of a research must submit progress reports as established and scheduled at the outset, including the following:

Program Coordinator- Responsible for ensuring that all parties submit their reports, managing the general program budget, and submitting general program reports, both to the OE and to any institution subsidizing the program.

Assistant Coordinator- Helps with the reporting on participation statistics and volunteer feedback. If the Program Coordinator is unable to fulfill his/her duties, then the Assistant will carry out the duties related to reports and coordination.

Education Officers- Responsible for drafting reports about each activity in a standardized format, including reports about tasks performed, status reports of program products, and making sure that attendance forms are filled out. This task should ideally be assigned to a representative from the OE, either the Program Coordinator or the Assistant, to properly register the general challenges and accomplishments of each activity.

Scientists- Responsible for drawing up reports as described in the Lead Investigators Section.

Assistant Scientists and Volunteer Leaders- Assist in drafting reports about tasks performed during activities, and asks Assistant Coordinator or Education Officer for any materials that may have become damaged or depleted in a timely manner, so that they will be available for the next activity.

IMPACT ASSESSMENT

Participation statistics for each research offer good insight into the program's impact. They help to determine if there are recurrent participations, and they also collect demographic data and other indicators that are considered important from the very outset. The feedback received through the assessment methods and the reports submitted by program personnel can also shed light on the program's impact on different areas.

Depending on the organizing entity's means, external resources may be contracted to evaluate impact, since they are capable of conducting an impartial study. This option is particularly important when using funds provided by other institutions that may demand some control over the use of their funds.

CONCLUDING THE RESEARCH CYCLE

The work plan for each research will include information on how and when the research is to be concluded. Two specific events may be ideal for this purpose: 1) an activity can be scheduled for volunteers to celebrate the culmination of their experience and to present findings of the research they participated in; 2) a formal publication of the research and its findings, which will then be evaluated by the scientific community. It is generally understood that a research has

formally concluded when the Lead Investigator publishes his/her findings for peer review.

When a citizen science program consists of more than one research project, the official conclusion must take place when all research projects have formally completed this cycle.

REPORTING RESULTS

The results of the studies conducted must be published using available means. As early as the proposal drafting process, scientists should already suggest appropriate media for publishing findings on their area of study. The media that may be employed to this effect are various and diverse, and may include magazines and journals (educational and scientific), websites, books, videos, newspapers, and interviews (radio and TV), etc.

PLANNING AND EXECUTING RESEARCH ACTIVITIES

Once a citizen science program has been created and designed, and after defining the organizing entity's needs and other general aspects, the OE may begin planning the activities for each research and all related logistics. Establishing periodical meetings with team members, taking into account the program's development within an informal environment, as well as the cultural background and experiences of the target groups, are essential elements for ensuring a program's success.

The following sections suggest some steps that may be taken to avoid improvising, which may ultimately work against the planning and implementation of the program.

PERIODICAL PLANNING MEETINGS

Maintaining an open and clear communication channel with team members will help to create an institutional or community culture around citizen science. Therefore, the OE should designate specific places in which to hold well-structured periodical meetings, which could incorporate the following processes:

Preparing a Meeting Agenda- Team members should have prior knowledge of matters to be discussed, so that they may be ready to participate and contribute any pertinent information.

Drafting Minutes- These should include all agreements made during the meeting and the duties assigned to each member. A specific team member must be selected to take meeting minutes so that all agenda items are recorded for future reference.

Reviewing Scheduled Activities- All team members should be aware of all scheduled activities for the week. During the meeting, the corresponding tasks should be discussed and assigned so as to ensure their completion, including the following:

- Coordinate cleaning and maintenance efforts for equipment and work areas- This includes discussing feedback from assistants and scientists regarding any needs relevant to equipment and work areas for that week;
- Coordinate transportation- Transportation means should be arranged for participants, depending on the meeting spot established for the activity and the corresponding learning environment;
- Coordinate educational resources- Appropriate means of transportation should be arranged for any educational resource deemed necessary, depending on the meeting spot established for the activity and the corresponding learning environment, and
- Coordinate purchases- If snacks or other materials or equipment must be purchased for the activities, certain team members should be designated to identify and request funds to acquire the necessary items.
- Discussing volunteer experiences- Describing particular experiences or events that took place during activities may provide good opportunities to review rules and policies regarding incident management. This will help to ensure that all situations are treated equally. These discussions also ensure that proper attention is given to certain situations.

COORDINATING RESEARCH ACTIVITY SESSIONS

A good source of reference for understanding necessary protocols to be followed during research activity sessions is the publication Surrounded by Science: Learning Science in Informal Environments, by the National Research Council.. Each protocol is described as a strand or thread in a rope. The metaphor implies that all protocols, like all threads, are equally important and ultimately contribute to the program's strength. The protocol threads for the development of an informal science program include the following:

Thread 1: Generating Interest and Enthusiasm- Experiencing enthusiasm, interest and motivation to learn about the natural phenomena of the physical world.

Thread 2: Understanding Scientific Content and Knowledge- Generating, remembering and using science-related concepts, explanations, arguments, models and facts.

Thread 3: Participating in Scientific Reasoning- Handling, reviewing, exploring, predicting, probing, observing, and understanding aspects of the natural and physical world.

Thread 4: Reflecting on Science- Viewing science as a tool for understanding processes, concepts, and institutions, and using this learning process to understand natural phenomena.

Thread 5: Using Scientific Tools and Language- Participating in scientific activities and other learning practices, using scientific tools and language.

Thread 6: Identifying with Science - Seeing yourself as a student of science, and constructing your identity as someone who knows, uses, and contributes to science.

STRATEGIES FOR RESEARCH ALREADY IN PROGRESS

Juxtaposing- Comparing participant comprehension of formal ideas related to a discipline as presented during the research. This usually involves presenting a hidden aspect of the object of study and allowing participants to reflect on its meaning based on prior knowledge.

Multiple Modes- Providing participants with multiple ways to relate to concepts, practices, and the object of study within a particular context.

Interactivity - Allowing the participant to have direct contact with the object of study. Sometimes the interaction is as simple as pressing buttons, turning knobs or interacting with an organism. It may also involve a broad process that includes collecting and analyzing scientific data.

ESTABLISHING RESEARCH ACTIVITIES

The following aspects should be considered when establishing specific research activities:

- Goal of the Activity- At the beginning of each activity session, the person in charge should clearly explain the proposed goals.
- Types of Tasks Expected- The Education Officer or OE representative, together with the lead scientist, will outline and distribute the tasks each volunteer will perform. All volunteers should be assigned a task, and all related goals and expectations should be clearly defined.
- Schedule-When determining the activity schedules, the following aspects should be considered: Preparing materials, registering volunteers, welcoming, instructions, trainings, transportation, snacks, materials, and conclusion.

- Areas of Study- Taking into account each work area's difficulty level, specific needs of the tasks, and task complexity in order to properly distribute the work among volunteers.
- Required Training- Identifying training and internal/external resources that may further enrich each activity.
- Time Commitment- Each task should have an allotted duration.
- Level of Difficulty- A level of difficulty should be determined for each activity, which should also be based on the risk factors of the area of study and the complexity of tasks. Climate conditions may also be taken into account.
- Monthly Frequency- The frequency of activity sessions will be determined by the Lead Investigator in the research proposal.
- Including Activities in the Database for Volunteer Registry- This will ensure that a proper registry of participants is kept in order to meet attendance, confirmation, and follow-up goals.

According to *Surrounded by Science: Learning Science in Informal Environments,* various aspects should be considered when designing the informal educational setting for each research project and related activities:

- Engage participants in multiple ways, including physically, emotionally, and cognitively;
- Encourage participants to interact directly by having them contribute to designing their own work environment;
- Present different perspectives and dynamic representations of science;
- Build on the foundations of common interest and prior knowledge of the participants, and
- Allow participants to choose their commitment level with the knowledge acquired, whether through the program or at an individual level.

RECOMMENDED SCHEDULING AND COORDINATING HOURS

Some programs that depend on monitoring allow volunteers to manage their own hours, while also requiring that they periodically submit data. Programs based on research may require the presence of the entire work team in the learning environment and other spaces, depending on each stage. The order established by the lead scientist in the work plan must be followed, while also remaining open to change, depending on the actual circumstances of the area of study, the OE, and team members.

The total extent of the activities scheduled for any research will also be determined by the proposal. Keep in mind that in programs with various research projects, there should be an OE personnel member in charge of the general calendar covering all scheduled activities.

FIELD AND LAB EQUIPMENT

The Education Officer and all other assigned personnel should check that all necessary materials and equipment are available and in good condition before and after each activity session. The OE will ensure that all equipment is properly and safely stored and used. Proper management of materials and equipment will be coordinated through checklists (see appendixes).

DATABASES

The OE should identify and provide all the necessary resources for managing different types of databases that will be generated, even before any research activities begin. Such databases may include the following:

Volunteers- Depending on the OE's resources, a database of participants should be created and maintained, in order to allow for easy management of each participant's records. This database is also used for the information cards filled out by individuals who receive promotional materials or orientation about the program (see Volunteers Section for more details).

Scientific Data- A database that centralizes all information obtained through the research projects should be available to everyone involved. The data fields should be properly defined from the beginning, and should include basic reports to validate data. From the moment activities begin, all data collected must be stored in the location designated by the OE. The data must remain accessible at all times, for the scientist and the OE alike.

Photographs- All activities should be photographically documented, preferably in a digital format. Photographic data should be stored with a standardized name format and within a separate file for this purpose only.

TRANSPORTATION AND FOOD

Depending on the area of study, safe means of transportation may have to be arranged for participants, or proper instructions given regarding how to arrive at the meeting spot. Snacks and beverages may also be provided, depending on available finances. Otherwise, the OE should inform participants to bring their own snacks. Whenever activities extend over a prolonged period of time, participants must be allowed to pause for a snack break to ensure their own health and safety (as further discussed below).

VOLUNTEER MANAGEMENT

Participants must feel welcome and adequately attended at all times. Each activity must begin with a welcome session and end with a closing session by the OE. All aspects previously discussed must be taken into account (see Volunteers Section), with an emphasisis placed on effective communication and acknowledgment.

INSURANCE AND EMERGENCY PLANS

The OE must be covered by all necessary insurance policies to carry out activity sessions. It should also seek orientation regarding the different emergency plans available in the areas of study, some of which are provided free of cost by municipalities or the central government, and develop a protocol for unforeseen situations.

RESEARCH ACTIVITY SESSIONS

The Education Officer or other institutional representative will support the Lead Investigator and the Assistant Scientist in preparing all the necessary equipment and materials, using an established checklist (see appendixes). The volunteers and the assistant scientist will transport the materials to be used in the field. The checklist should be reviewed once again after the activity has concluded, in order to make sure all equipment, keys, means of transportation, etc., will be properly returned and stored.

Volunteers should be welcomed in a warm and friendly manner. Afterwards, the attendance sheet should be filled out with each participant's name, phone number, and email (see appendixes). Each participant should also fill out the photo authorization form (see appendixes), the research consent form (see appendixes), and any other document required.

The formal welcome by the OE personnel should cover the following aspects: the OE's mission and vision, citizen science program and research goals, and General Guidelines (see appendixes). The scientist will also offer a brief introduction to the research and the tasks that will be performed during the activity session.

After the introduction, the Education Officer will organize and safely transport the volunteers to the areas of the study, departing from the meeting spot. This procedure shall be repeated at the end of the session.

Training and Task Assignment

- Scientific data-collection using a form designed by the investigator or a field notebook;
- Scientists will train volunteers regarding the use of instruments and tools to carry out tasks;
- The Education officer will make sure that one volunteer is photographically documenting the activity;
- A snack break should be allotted for each activity, and the Education Officer will ensure that all participants have their snacks;
- After each session, the personnel in charge will make sure that each volunteer has properly cared for the equipment he/she used (jackets, boots, flashlights, binoculars, tents, etc.). All equipment and materials must be stored in a designated area.

When required, the activity should also include a period to implement any necessary assessment tools designed for the research. Each activity should also offer a period to share with volunteers, in keeping with the feedback and communication aspects discussed earlier.

Finally, the Education Officer will thank all volunteers before dispatching them. He/she will then submit the corresponding reports on research accomplishments and challenges, to be discussed during the periodical meetings designed to attend to specific issues and to improve logistics.

The personnel in charge will leave all administrative forms completed during the activity (consent forms, attendance sheet, and photo authorization), as well as the photograph files, which will be available for the program's administrative personnel to evaluate and properly store.

CONCLUSION OF RESEARCH

When the research process is concluded, the OE will make sure it has met all goals and results initially proposed, which will also include the production of databases, publications, reference materials, evaluations, and reports, etc. The OE should also review all contracts, proposals, and budgets still in force. This will facilitate the program's official administrative conclusion.

The OE should hold a special event for volunteers, in order to present them with the findings of the research they participated in and the items that were produced thanks to their continued efforts and commitment.

APPENDIXES

no incluido en las correcciones

THE FOLLOWING FORMS AND ATTACHMENTS ARE AVAILABLE FOR DOWNLOAD IN DIGITAL FORMAT. PLEASE VISIT THE PROGRAM WEBSITE AT:

WWW.CIUDADANOCIENTIFICO.ORG

Checklists

Consent Forms

Attendance Sheet

Photo Autorization Form

General Stipulations

Rules of Conduct

Data-Collection Sheet

Inventory Management Sheet

Templates

- Requirement Letters
- Thank You Letters
- Certificate of Participation
- Red@migos Fill-Out Form
- CC Program Information
- Schedule/Calendar
- Reports
- Flowchart

REFERENCES

INSTITUTIONS:

Conservation Trust of Puerto Rico
http://www.fideicomiso.org

National Science Foundation
http://www.nsf.gov/
http://www.nsf.gov/funding/

STEM Education Coalition
http://www.stemedcoalition.org/

STEM Education blog
http://www.stemeducation.com/

Center for Advancement of Informal Science Education (CAISE)
http://caise.insci.org/

CITIZEN SCIENCE WEB PORTALS:

Cornell Lab of Ornithology
http://www.birds.cornell.edu/citsci/

Citizen Science Alliance
http://www.citizensciencealliance.org/
http://www.citizensciencealliance.org/proposals.html

Ciencia ciudadana, en el Instituto Nacional de Ecología de México
http://www2.ine.gob.mx/publicaciones/libros/507/cap1.html

Science for Citizens
http://scienceforcitizens.net/

Zooniverse
http://www.zooniverse.org/

Society for Amateur Scientists
http://www.sas.org/

Citizen Cyberscience Centre
http://www.citizencyberscience.net/

CitSci
http://www.citsci.org/cwis438/websites/citsci/home.php?WebSiteID=7

VARIOUS CITIZEN SCIENCE PROGRAMS:

Programa Ciudadano Científico
http://www.ciudadanocientifico.org

eBird
http://ebird.org/content/ebird/

Seti@home
http://setiathome.berkeley.edu/

Stardust@home
http://stardustathome.berkeley.edu/index.php

Texas Bee Watchers
http://www.beewatchers.com/

Wildlife Sightings
http://www.junponline.com/

OTHERS:

Centro para el Desarrollo de Voluntarios de Puerto Rico
www.voluntariospuertorico.com

Ciencia ciudadana en Scientific American
http://www.scientificamerican.com/citizen-science/

Programas radiales de la BBC sobre ciencia ciudadana
http://www.bbc.co.uk/radio4/science/citizenscience.shtml

The Conservation Trust of Puerto Rico is a private, nonprofit organization whose mission is to secure functional and healthy ecosystems on the islands of Puerto Rico, and to instill in their inhabitants a sense of responsibility toward the conservation of our natural resources, so that we may have ecosystem services that will help us achieve our social, economic and quality-of-life goals.

The Conservation Trust of Puerto Rico believes that we can achieve our full potential, both individually and collectively, if we can sustain the ecosystem services on the islands of Puerto Rico and respect all forms of life with which we share our natural environment.

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