INTRODUCTION

The primary reason for developing this *Physical Science Activities Manual* originated about three years ago. At that time the impending change in courses that would no longer meet science graduation needs, specifically, the high school general science course, concerned us here at the Center of Excellence for Science and Mathematics Education (CESME). The heir apparent to the general science course seemed to be the physical science course. On the surface it may seem that they are basically the same course, but on closer examination there is a considerable difference in content. An exclusive emphasis is placed on chemistry and physics in the physical science course at the expense of the earth science and life science topics that were contained in the old general science course. Considerably different backgrounds are also required for teachers of the physical science course. Therefore, the main purpose of this *Physical Science Activities Manual* is to provide background along with a variety of activities to enable new and veteran teachers to teach a genuine physical science course instead of a "warmed-over" general science course. A more recent stipulation from the State Board of Education stating that three years of science will be required for graduation by all students further increases the urgency for providing this type of material for teachers who will be instructing an anticipated influx of new physical science students.

Lets determine what this manual **is not**. First, it **is not** a lab manual. The pages in it are not designed to be copied and given to students. Although many times instructions are given for carrying out an activity, they are given for the teacher's information. Almost always they will have to be adapted to the local equipment and facilities. This manual is a teacher resource and should only be used that way. Furthermore, it **is not** a series of lesson plans. By all means, there is an order of presentation represented in each lesson, but good teachers always interpret and adapt any set of material to fit their needs. In no way are the suggestions meant to be carried out in a lock-step fashion as per the manual. To encourage your changes this manual has been provided on computer diskette so that you can go in and add, delete, or rearrange the activities to fit your own purposes. And finally, it **is not** all inclusive. There are many topics that belong in a physical science course that are not addressed in the pages that follow. In developing this manual many new activities (really, many of them were old activities but new to us) were unearthed for which there was not sufficient room for inclusion in this version of the manual. It is extremely possible that many of the activities that you use in your course are better or at least different from the ones we have included. By all means, continue to use them. We would appreciate receiving copies of your favorite activities appropriate to this type of physical science course. We will pass them on to other teachers participating in current and future projects of the CESME.

The philosophy embraced in this manual is student-centered rather than teacher-centered. Although there are directions for teacher-led demonstrations, the vast majority of the activities are to be carried out by students. This philosophy encourages student observation and collection of data so that students (along with teacher direction) invent answers to questions prompted by the opening activities of a lesson. In essence, students will learn to "do" science because they are trying to answer a question or find a solution to a disturbing disequilbrating phenomenon that you provide for them. Every teacher has asked the question, "How do I get them interested in doing what I want them to do?" The heart of this manual's philosophy is to get them to "do" science because **they** want to do it. That is why we have steered away from a host of verification experiments. Once they know what the law says, why should they actively engage in following a bunch of cookbook directions to "prove" what they already know? To this end, all lessons are written in the format of the Learning Cycle. Its basic premise is that a lesson should begin with some type of challenge or discrepant event. In this way, even before the student knows what you want them to find out, he/she will have an immediate purpose for becoming a part of the instruction that you have planned. The second phase involves "inventing" the concept that accounts for the outcomes of the exploration activities. Students, along with teacher encouragement and channeling, attempt to empirically explain previous observations. Finally, these concepts are extended to similar situations in an attempt to let students try out their newly invented concepts and thereby experience a more thorough understanding than would have come by accepting somebody else's version of how a phenomenon works.

The majority of science educators today have agreed on one over-riding principle that should guide us in what we choose to teach in our science course. (By the way it is not what is contained on

the TCAP or other standardize tests.) **They have concluded that teaching less is better.** One of the factors that has contributed to declining interest in science among our students has been our encyclopedic coverage of topics in a course such as physical science. Because we feel that we have to "cover" the book or a syllabus addressing every know question that has ever been asked on the TCAP, we lightly address a host of ideas and do not provide the opportunity for our students to internalize more than a handful. Then we wonder why they are confused and don't seem to like science. What is even worse is that in doing this we have turned science into a glorified exercise in "vocabulary." Our students might be able to recognize Archimedes' principle on a multiple choice or matching test, but probably four out of five of them do not understand this principle at anything but knowledge level. They don't comprehend it and definitely can not apply it to situations other than the one presented in class. For this and other reasons the lessons in this manual go into much more detail, providing multiple situations concerning the same main idea, than your text book or lab manual traditionally addresses. Some of you may look at the *Physical Science Activities Manual* and conclude that it is too complex or detailed for your class. This may be true in some instances. But, it may simply be that you have not been accustomed to letting the students be participants in rather than recipients of science in your class. For many students spending time in a participatory way allows them to understand science for the first time. After learn to take the responsibility for doing science instead of just passively enduring another science class, the full range of these lessons will be more truly achievable by your students.

For those of you who agree to accept the challenge of participatory, activity-taught science this manual will be a valuable resource. For those students lucky enough to have been in your classes there will be an appreciation and understanding of physical phenomena to an extent that you have never before seen. Possibly the most important outcome will be for some students, who formerly hated science because they could never understand it, a realization that they actually can learn science. Some might even decide to sign up for more advanced science courses in the future. Now wouldn't that be something!!!

Untold numbers of people deserve thanks for their contribution to this manual. First and foremost are all those teachers around the state who have showed an interest in improving the level of science instruction in their schools and have asked that resources such as this *Physical Science Activities Manual* be created. Without your interest in the product of this project it would never have been completed. Second, we would like to thank all our own former teachers as well as present colleagues from who we have stolen many ideas. Some of the experiences from which we have drawn our ideas happened so long ago that we sometimes actually thought that our ideas were original. The chances of this are extremely remote. Suffice it to say that good science teachers routinely share with and steal ideas from anyone and everyone else who is concerned about providing quality science instruction. Our apologies to each of you for not giving you credit for stealing it before we did. We do want to thank Mary Thorpe for her help in designing the cover for this manual. And finally, we want to thank a variety of science educators from across the country who have stimulated us with activities, presentations, and "better" ways to teach something at the various professional meetings we have attended during the past ten or fifteen years. It is our hope that we may in some small way stimulate you to provide a richer and more exciting version of physical science instruction by utilizing the activities in this manual.

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