

Expanded Rationale and Research Background Support with Citations

"In Quest of the Quark" is a series of three, four hour workshops, each to different level of learner. The target will be English as a second language learners (middle school and adult workshops) and subject matter will be Physical Science

The intent is to reinforce and structure the periodicity which underlies and flows from atomic theory covered in middle and high school textbooks, and then link it with particle physics whose language occurs *constantly* in current publications and electronic media. Because a person's advancement as a scholar should be unimpeded by language constraints, 2nd language learners will be provided full access to the program through materials and teachers in English *and* Spanish. Costs for the program include writing support, translation, books, workshop, coordinator, teachers, facility and all materials for the program. The advancement of **world understanding and peace** begins with self-respect and opportunities to **lift oneself out of poverty**. **Education** is a pathway which can accomplish both.

Project Description Regarding Needs:

A primary need in our community mirrors the general condition of the world communities: for peace and understanding among the diverse people, and access to avenues out of poverty for all learners, and illiteracy. 1. **One avenue to understanding and peace** is established through having the common language of, and interest in, science as a starting point for dialogue; 2. alleviation of **poverty** is addressed through additional supportive structured instruction in the **difficult subject of science which offers a huge field of good jobs**; 3. stakeholders who are 2nd language learners will find **illiteracy addressed** by providing **1st language support to better access concepts**.

There is a developing need for elementary particle physics concepts and their interrelationships to be taught to middle school and high school students antecedent to the presentation of atomic theory in the classroom. At one time atomic theory was actually presented at the *back* of Chemistry textbooks because it was considered "too hard" to be presented right away to students. New material is always considered "hard" however. Today it is the *first* thing covered in a Chemistry course because atoms are what make up all the rest of what the course talks about. Furthermore, it is now taught in elementary and middle schools to young learners. Small children are familiar with the term and the days of atomic theory seeming "too hard to understand" are gone.

Now however, "Particle Physics", which studies the smaller particles which make up the sub-atomic particles of the atom (called quarks), while "new" to our generation, is published in journals, at the back of college texts, mentioned in science fiction on TV and in movies, and investigated and reported on during science documentaries. Now it is time for particle physics and quarks to "come to the front of the bus."

Moreover, familiarity with the names, concepts and interrelationships of these fundamental particles establishes a framework which allows the student whether child or adult, to fit new information coming at them from electronic sources, into an *understandable context*. Information which has a pre-existing framework is more understood and less ephemeral.¹ The effects of such an introduction, so that prerequisite learning is in place, aids retention, appreciation for the material, and understanding.²

Another consideration is for the education of, and supplementary support for, second-language learners who have difficulty accessing concepts in rapid technical lectures as well as adults who have no framework for understanding particle physics. Concepts do not exist in isolation, they derive meaning from, and are enriched by, a web of relationships to other concepts.² Assimilation of material is aided by precedent learning in the case of 2nd language students; in addition however, **the presentation of concepts and testing in first language provides both greater understanding and more reliable learning assessments.**³ Finally, framework establishment aids adults who have no idea where these new concepts they hear about through the media fit. This is concept framework is essential for learners of any age to fully access the curriculum in an educational setting.

Project Description regarding how the project will meet those needs:

The goal of the proposed workshop: “*In Quest of the Quark*” (also the title of the short book used, written specifically for this endeavor) is to take research, organize it, and present it to the learner in a restructured framework of concepts so the student can see where the new information fits in.

This will be done through updating materials the author has previously presented at ACS meetings, Academy of Science convocations, and LAUSD workshops, into a format appropriate to learners; further, the treatise will be translated into Spanish. The material will be presented in a series of three four hour workshops composed of twenty students each at the levels of the middle school, the high school and adult education.

Many of our best students in Chemistry are Spanish speakers who have only recently bridged into academic classes like college-preparatory Chemistry. Theirs is a mighty struggle with difficult highly technical concepts presented in lecture material. Prior to their taking Chemistry, or even at the end, **their access to material is heightened when they are presented the concepts in English but also in their first language as well.**³ This does not circumvent their mastery of English but rather reinforces their learning in science.

The workshops at each level will provide a highly structured concept presentation, overhead graphics, a package of all classroom materials including the text, two teachers (one English, one Spanish), and a classroom facilitator who organizes the workshop. The class will begin with an overview of the history of the development of atomic theory, then the structure of an atom, and move then into what makes of the particles of an atom, fermions versus bosons and quarks versus leptons. Graphics are prevalent throughout the book, the periodic table organization based on leptons will be stressed, and **the goal is that students leave with a solid foundation for learning Chemistry, reinforced with the lessons in Spanish for those learners, or a new perception of matter and energy for those who are in Chemistry at the time.** There will also be one adult workshop for both English and Spanish speakers to become current in the new purview of chemistry. **The material is limited, highly structured, and will be covered completely by competent professional instructors with realistic goals who are well aware of time constraints.**

Results will be assessed at the end of each workshop with a short measure as well as an affective survey. In addition, the timeliness of the material is viewed as a plus and perhaps particularly so **for Spanish learners, who due to language constraints may have impediments to full acquisition of information.** Through this workshop, actually enlarging their fund of information and providing a framework for it, it is hope that their access to a career in science and technology is advanced. *The ability to resolve problems begins with respect and common goals; the sciences reach across the world, chemists in any country*

use the same words in the same context, and with the same measurements; the sciences bridge differences! This is the beginning of true understanding on Earth. And for these learners, in conclusion, the opportunity for a leg up to success in science is a leg up toward students envisioning themselves as successful working partners in our local and world community. Moreover, in much needed and financially solid technological fields. *From understanding comes enjoyment, and from enjoyment comes career commitment.*

This workshop series is viewed as the **first set in ongoing workshops held annually, and not as an isolated event.** The quest is for more than the quark; the quest is really for the future, and for the affirmation and strengthening of the young minds who will occupy it. As stated earlier: **The advancement of world understanding begins with self-respect and access to lift oneself out of poverty. Education is one pathway which can accomplish both.**

Citations

1. Ausubel, D.P. (2000). The Acquisition and Retention of Knowledge: A Cognitive View. *Springer, online.* (Original- *Ausubelian Psychology, 1977*)
2. Hamrick (Bartrom-Olsen), Harty, Ault, (2010 published online). Concept Structure Interrelatedness Competency (ConSic): A Tool for Examining and Promoting Cognitive Structure. *School Science and Mathematics.* (Original- 1985)
3. Hagan, Elsa Cardenas. (2011). Response to Intervention: Implications for Spanish-Speaking English Language Learners. *University of Houston, RTI Action Network.*