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ABSTRACT

Students' beliefs about science and their perceptions of its purpose and usage in everyday life affect their science world view which forms the framework they use to interpret their experiences and may influence their learning of science and their choice of science related careers. The purpose of the study reported in this paper was to investigate the following questions: (1) How do Lebanese middle school students (N=80) define science? (2) What is the purpose of science according to Lebanese middle school students? (3) Where and how do middle school students see themselves using science? (4) Where do middle school students see others using science? and (5) What are the perceptions of middle school students of how others use science in everyday situations? Students participated in semi-structured interviews and filled out a questionnaire while teachers were interviewed. Results show that most students defined science as an academic subject and perceived its purpose as preparation for higher grades, higher studies, and careers; and saw themselves and others using science in academic settings. Moreover, most of the teachers of the students participating in the study defined science as an academic subject whose purpose was to give students information about the world and perceived themselves and others using science in school related settings. Contains 38 references. (JRH)

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Introduction

There is growing awareness in the international science education community that the focus of science education has to change. Rather than focusing exclusively on what students need to know to become scientists and engineers, curricula should be designed to prepare scientifically literate citizens who can function in an increasingly technological society. The emphasis needs to shift from merely helping students to solve textbook problems to emphasizing textbook and everyday problems (Anderson, 1987; National Science Teachers Association, 1993; American Association for the Advancement of Science, 1989; Yager, 1989, 1991).

Most existing science curricula focus on academic preparation. These curricula rarely incorporate students' everyday experiences or help them to apply their science knowledge to deal with everyday issues. This is still the case though recent research has shown that emphasis on everyday applications improves students' knowledge, skills, and attitudes (Ramsden, 1994), and learning in both school and out-of-school contexts can offer important opportunities for cognitive growth (Saxe, 1990).

Students' beliefs about science and their perceptions of its purpose and usage in everyday life affect their science world view. This world view forms the framework they use to interpret their experiences and may influence their learning of science (Edmondson, 1989; Songer & Linn, 1991) and their choice of science related careers. Consequently, to help students connect school and out-of-school science, it is essential to understand how they think about science and its relationships to their lives and to determine how they define science and its purposes.

Moreover, it is beneficial to understand if and how students use science, and if and how they perceive others using science in everyday situations. This understanding may provide teachers with information useful in improving their teaching and making science more relevant to students' lives and may provide rich, empirically derived examples of everyday uses of science that can be incorporated in new textbooks or curricula.

Presently, there is some research on students' definitions of science in the United States and Canada. However, there is very little research on students' perceptions of the purpose of science and the use of science in everyday life. Moreover, there is no research on Lebanese middle school students' definitions and perceptions of science and its uses in everyday situations. Consequently, the purpose of this study is to answer the following questions:

a. How do Lebanese middle school students define science?
b. What is the purpose of science according to Lebanese middle school students?
c. Where and how do middle school students see themselves using science?
d. Where do middle school students see others using science?
e. What are the perceptions of middle school students of how others use science in everyday situations?

Review of Relevant Literature

The past three decades have seen a shift in the goals of science education in response to social pressures to prepare citizens who are decision makers. The general trend was from emphasis on the structure to emphasis on the structure and the function of science (Anderson, 1987); from science that prepares scientists and engineers to science that helps people deal with practical or day-to-day problems (Ebenezer & Zoller, 1993). This approach is meant to make science more attractive and more relevant to students' lives outside the classroom.

Before 1975 the emphasis in science curricula was on the conceptual structure of the scientific disciplines and the processes of inquiry. This was followed in the late seventies and early eighties by the "back to basics" movement that resulted in teaching very specific knowledge objectives to the neglect of general, more process oriented ones. However, starting with the early eighties, there was a shift toward science-technology society (STS) objectives and in some cases to science-technology-environment-society (STES) objectives (Zoller, Ebenezer, Morely, Paras, Sandberg, West, Wolthers, & Tan, 1990). In this framework science is presented in the "context of science-technology related issues" and scientific inquiry is "presented as inquiry into personal, environmental, and societal problems to acquire information for decision making" (Trowbridge & Bybee, 1990, pp. 426). The science-technology-society movement and its functional goals have been supported by teachers and leaders in science education alike (Mcintosh & Zeidler, 1988; Waks & Barchi, 1992; Ramsey, 1993).

While science-technology-society goals have been accepted theoretically in the science education community, in practice, science teachers emphasize preparation of students for higher grades (Beisenherz & Yager, 1991), neglect the social dimensions of science, and describe science in terms of exploring the unknown and discovering new things (Rubba & Harkness, 1993). Teachers do not attempt to link science to students' everyday life. Science teaching it seems has transformed science into a "set of inert ideas that are not generative, not interactive with the explanations children have constructed themselves for natural phenomena" (Hawkins & Pea, 1987, pp. 298-299).

Students' perceptions about science and the goals of science are analogous to those of teachers. Research on students' definitions of science conducted in the United States has shown that students hold a restricted view of science. Students perceive science as a school subject with no relevance to real life (Charron, 1991; Reif & Larkin, 1991; Song & Black, 1991; Urevbu, 1991). Ryan and Aikenhead (1992) and Griffiths and Barry

(1993), assert that many students perceive science as a body of knowledge or the study of science fields such as biology and physics. Ledbetter (1993) has shown that science as "discovery," "school centered activities," and "phenomena and their actions" were the top three views presented by Grade 7-12 students. Junior high students, however, were more inclined to identify science with school activities than with discovery.

In a study of classroom and community effects on children's perceptions of science, Charron (1991) found that elementary students associated science with active doing while high school students associated it with passive learning. Moreover, she found that most students and their parents thought that science had almost no bearing on their everyday lives. Songer and Linn (1991), on the other hand, found that middle school students hold three types of views about science: static, dynamic, and mixed. In the static view students affirm that science is a collection of facts that are best learned by memorization. In the dynamic view of science students understand that science is tentative and that understanding science is the best approach to learn it. Finally, students with the mixed view of science hold elements of the static and dynamic nature simultaneously. Espousing a restricted definition of science is not limited to teachers and students. For example, members of community organizations realize the necessity of teaching science for daily living but their priority is for academic preparation (Yager & Penick, 1988).

Additionally, research has shown that elementary science textbooks focus on academic preparation (Staver & Bay, 1987). Recently, however, there has been a movement toward incorporating science-technology-society themes in textbook series (For example: *SCIENCEPLUS* Technology and Society, published by Holt, Reinhart and Winstc 93).

Science-techr '(-society is not the only approach to make science more relev to students' lives. O'brien (1993) advocates using toys in science teaching. According to him, using toys in science teaching extends learning beyond the classroom and provides students with opportunities to see science in action. Roth (1992) and Sanders (1994) envision a role for technology in bridging the gap between classroom and real life situations. Sanders (1992) suggests using science activities to give middle school students a chance to see real-world applications for science and mathematics and technology. Roth, (1992), on the other hand, suggests providing students with opportunities to use the computer in solving ill-defined problems that are similar to real life problems; this is because students rarely experience these types of problems in the science classroom. Finally, according to Martin and Brouwer (1991), one way to make science relevant to students' lives is through using stories, narratives, and anecdotes. They suggest that:

> "[S]tories and anecdotes open up the possibility of involving the imagination of students and in many instances evoke a response and demand participation from students. Often, the students themselves are involved in giving meaning to the stories, and such stories resonate with the lives of individual students in personal ways" (pp. 719).

Method

<u>Subjects</u>:

Eighty middle school students from four schools in Beirut, Lebanon (50% males, 50% females, age range 11-13 years) participated in this study. Two private and two public schools were randomly selected from a list of private and public schools available in the Lebanese Ministry of Education. One Grade 7 and one Grade 8 classroom (called first and second intermediate in the Lebanese Educational System) were randomly selected from each school and ten students from each of the resulting eight classrooms were asked to participate in the study. The selected students represented different socioeconomic status and achievement levels. Also, the six science teachers (all females, four private school teachers and two public school teachers), who taught the students participating in the study took part in the study.

Interviews and Questionnaires:

Students participated in semi-structured interviews and filled out a questionnaire while teachers were interviewed.

An initial set of interview questions were piloted with 10 students from schools similar to those participating in the study. Students' comments were incorporated in the final[1] set of questions that included the following:

a. What is your definition of science? What comes to your mind when I say the word science?

b. What is the purpose of science? Why do you study science?

c. Did you use science in the past few days? Where? How did you use science?

d. Did you see others using science in the past few days? Where? How did they use science?

Students' interviews took between 10 and 20 minutes each and teachers' interviews took between 30 and 40 minutes. Two weeks later all students filled out questionnaires containing the same questions used in the interviews. These questionnaires were used to check consistency of response by individual students. Interviews were tape recorded and transcribed for subsequent analysis. Information about students' gender, grade level (Grade 7, Grade 8), and achievement (high, middle, low) and about parents' occupation (professional, semiskilled, unskilled, unemployed) and school type (public, private) was collected during the interviews and from school records.

Since the medium of science instruction in Lebanon is either French or English[2], the interview questions and the questionnaires were conducted in English or French to match the

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[1]The questions were not used verbatim. Different versions of the same question were used to encourage students to respond.

[2]In a number of cases the interviewees used their mother tongue, Arabic, because they felt more comfortable expressing themselves in that language.

language of science instruction of each school. Care was taken to insure the consistency between the two versions of the interview questions and the questionnaire. This was accomplished by translating the questions from English to French by one expert and from French to English by a second expert. Then, the initial set of questions in English was compared to the final translated set to insure the consistency between the two sets.

Data Analysis

There were two phases of data analysis. The first phase was conducted using the process of analytic induction (Bogdan & Biklen, 1982; Goetz & LeCompte, 1984). This process involves scanning the students' and teachers' interviews and students' questionnaire responses for categories and relationships among categories, and "developing working typologies and hypotheses upon examination of initial cases, then modifying and refining them on the basis of subsequent cases" (Goetz & LeCompte, 1984, p. 180). The two investigators conducted the initial stages of data analysis independently. Following each stage they met to discuss the results and to resolve any differences in the categorization. They collaborated, however, on the last stage of analysis and the final set of categories and frequency counts were a result of this process. Frequency counts of the categories were computed using the statistical package SPSS for Windows, Version 6.0.

The second phase of analysis was needed to study the relationship between students' perceptions and background variables. It involved coding the data to classify each subject in one category. This required combining categories into more inclusive ones. This reduced the number of categories and allowed coding each student in one category. This process presented the problem of coding 15 responses that appeared to belong to more than one category. This problem was solved by coding these responses based on the first category appearing in the response. The assumption was that the first response was more spontaneous and thus more representative of a student's views. Then, the data were analyzed by each background variable (school type, grade level, sex, achievement, and father's occupation) using Crosstabs and Chisquare of the statistical package SPSS for Windows, Version 6.0.

Results

Comparison of the results from the analysis of the students' interviews and questionnaire responses produced the same categories. However, higher frequencies of each category appeared in the interviews but the percentages were similar for both the interviews and questionnaires. The results presented in this paper are those from analysis of the interviews since they were open-ended and offered a richer and more detailed data source than the questionnaires.

The first part of the results section presents the analysis of students' responses. Data analysis showed that some students' responses contained more than one type of category. Consequently, the percentages presented in the first part of this section do not add up to 100% and a higher percentage suggests that a certain category appeared more often in the responses. Results of the analysis of teachers' interviews are presented at the end of this section. The second part of the paper presents the results of the analysis by each background variable.

Students' definitions of science: Six definitions of science were found in the students' interviews. Most of these definitions stressed the view of science as a school related activity. However, there were different nuances of this definition as indicated in the analysis that follows.

Most students suggested that science was a "subject that gave information about humans, animals, plants, earth, the sky, and the stars." This definition appeared in the responses of 63.8 % of the students. The second most common definition suggested that science was "a subject matter divided into other subjects such as physics, chemistry, and biology." This definition appeared in the responses of 35% of the students. "Science as a method for doing things" and "science as a subject to teach new things" tied for third rank; these two definitions appeared in the responses of 18% of the students. The definition proposing that science was "a subject that enlightens and gives the truth about nature" appeared in the responses of 16.3% of the students. Finally, "science is a subject we studied in class" appeared in the responses of 10% of the students.

Students' perceptions of the purpose of science: Students perceived six main purposes of science. These were: Academic preparation, preparation for future careers, achieving higher social status, helping people in solving everyday problems, discovering new things, and helping people to appreciate and understand nature (Figure 1). The most commonly mentioned purpose of science was academic preparation. This was followed by preparation for future careers. The third most common response was related to the relationship between science and social status. This category included two components. The first one involved "responding to questions in out-of-school settings" while the second emphasized "achieving higher social status." Both components may be related to the importance Lebanese parents confer on achieving high grades in science and the high social status accorded to people with science related professional careers. It seems that students have been socialized to think that science-related professional careers (engineering and medicine specifically) are very high status occupations in Lebanon. Consequently, for them, the purpose of science is to achieve high grades in science, which prepares them to attain high status science-related professional careers: 55% of those students who said the purpose of science is to prepare for future careers also included academic preparation in their definition. Moreover, 45% of those students who said the purpose of science was either to prepare for future careers or to teach about things and prepare for higher grades said that the purpose of science was to improve the social status. Besides the above categories, many students' responses included a realization of the importance of science in everyday living. Finally, a few students suggested that "the purpose of science was to discover new things" and "to help people appreciate and understand nature."

Insert Figure 1 About Here

Students' perceptions of their use of science. There were five categories of students' perceptions of their use of science. These were: using science in academic settings, using science to solve everyday problems, using science in hobbies, during play, or during sports activities, using science when performing activities related to their bodies or during sickness, and not using science. The most common use of science reported by students was "using science in academic settings." Sixty-six percent of the students said they used science in academic settings such as "doing science homework, preparing for examinations, answering science questions in class, and working in the laboratory." Approximately 13% of the students said that they used science to solve everyday problems such as "changing ligh. bulbs, checking for gas leaks, fixing radios, taking care of plants, and farming activities." Eight percent of the students said that they used science in "hobbies, during play, or during sports activities." Under this category students mentioned "playing with magnets, building small engines, sweating and increased heart beats when playing basketball or soccer, and building model boats and airplanes." Another 8% of students said that they used science when they "performed activities related to their bodies or during sickness." Examples provided under this category included "eating, drinking, falling ill, or breaking a leg." Finally, 19% of the students said that they did not use science regularly. When these students were asked to elaborate, they were unable to think of any use of science except an occasional mention of studying science.

Students' perceptions of the use of science by others. There were nine categories of perceived science usage by others generated in the data analysis. The most prevalent responses were perceptions of science usage in academic settings and in career related activities. Thirty-six percent of the students said that they saw others "using science in academic settings such as teachers teaching science, classmates studying science, or teachers and students performing laboratory experiments." Additionally, 17.5 % of the students said that they had seen others "using science in science related academic activities outside school." Examples of these activities included "seeing friends studying science, siblings performing required experiments at home, and relatives preparing to teach science lessons." Thirty-one percent of the students mentioned "seeing science being used by career professionals such as doctors, engineers, electricians, nurses, pharmacists, and mechanics." Eight percent of the students said that they "saw science being used by others in the media such as in TV programs or in the movies." Another 8% said that they "saw science being used when their parents were reading science related books, magazines, and other reading materials at home." Only 4% of the students said that they "saw others using science in solving everyday problems." Examples of activities given under this category included "fixing radios and other electrical appliances and farming." Another 4% of the students mentioned others "using science in hobbies and in sports." Finally, 5% of the students said that "everybody uses science" and 18% said that they "do not remember seeing or encountering others using science."

Teachers' definitions of science and perceptions of its usage: Analysis of teachers' interviews showed that they defined science as an academic subject whose purpose was to give information about the world. According to one teacher "science gives students information about their environment. Science, -- all sciences: physics, chemistry, biology -- gives students true knowledge and frees their minds from myths and superstitions" (Teacher-2/public). A second teacher suggested that "science is the subject that gives the necessary information about everything around us, the living world and the physical world, it gives students necessary information about their bodies, animals, plants, and nature in general (Teacher-2/private). A third teacher said "science is studying and discovering everything in nature. It is studying plants, animals, humans, rocks, air, water and many other things" (Teacher-2/public).

When asked where and how they used science, all teachers mentioned the classroom and the laboratory during teaching or planning. One teacher, however, added using science in gardening and taking care of a pet (Teacher-3/private).

When teachers were asked where they saw others using science, five of them mentioned students using science in the classroom or in the laboratory and their colleagues teaching science in other classes. One teacher mentioned farmers and other people using science in everyday life. This teacher (Teacher-1/public) said "the peasant makes use of science in his land. If he sees the way clouds are forming in the sky, he can tell from the type of cloud if it is going to rain. Or he may tell from the type of clouds if a storm is coming so that he may try some fertilizers." Two of the teachers who mentioned students and colleagues using science (teacher-3-private and teacher-2-private) said that they thought students used science at home. However, when asked to elaborate, they explained that they thought students used science while doing science-related school projects at home.

One difference that emerged between public and private school teachers was the differing expectations that they had of their students. While private school teachers emphasized the need for students to "achieve high grades because they need to go to universities" (Teacher-2/private), public school teachers thought their students "will never use science in their careers. Very few of them probably can go to college because of their weakness in science. They are not able to cope with everything they have to study" (Teacher-1/public).

Relationship between students' perceptions and background

variables: Frequencies of each category resulting from the data reduction procedures described in the analysis section above were examined using the background variables of school type, grade level, sex, achievement, and father's occupation[3]. The following paragraphs present the results of this analysis.

Definition of science: Three categories of the definition of science were used in this analysis: "Science as a school subject," "science as doing," and "science as the truth." There were statistically significant differences between the type of school and students' definitions of science (c2=20.9, a=.0018). Students of the two public schools were different from the private schools and different from each other. Eighty-five percent of the students of one public school defined science as a school subject as compared to 65% in both private schools and 40% in the second public school. Also, 50% of the students in the second public school defined science as the truth as compared 5% in the second public school and 10% in the two private schools.

Purpose of science. Three categories of purpose of science were used in the analysis: "Academic preparation for careers," "Solving everyday problems," and "Inventing and discovering." There were no statistically significant differences on any of the possible relationships in this analysis. However, there were some differences in the percentages that were intriguing. For example, the lowest percentage of students who said the purpose of science was to solve everyday problems came from the public school in which the highest percentage defined science as a school subject. Moreover, more of the students in the private schools than in public schools said that the purpose of science was to solve everyday problems. Finally, more females than males said that the purpose of science was to invent and discover new things.

[3]The background variable "mother's occupation" was not used in the analysis because very few students' reported working mothers.

Students' use of science. The same categories reported in the first part of the results section were used in this analysis. These were: using science in academic settings, using science to solve everyday problems, using science in hobbies, during play, or during sports activities, using science in body-related activities (eating, drinking, and sickness) and not using science. There were statistically significant differences in two relationships: use of science by type of school (c2=25.8, a=.01) and by father's occupation (c2=24.9, a=.01). More students in the public schools than in the private schools said that they did not use science and more students whose parents were professional said they used science in hobbies and body-related activities and more students whose fathers were unskilled or semiskilled said that they used science in academic settings. The relationship between use of science and sex was not statistically different but is worth reporting. More females than males said that they did not use science while more males than females said that they used science in hobbies.

Students' perceptions of science usage by others. There were five categories of students' perceptions of science usage by others used in this analysis: Use of science by others in "academic settings," "careers," and "daily life." The two other categories were "everybody uses science everywhere," and "nobody uses science." There was a statistically significant difference in the analysis of the relationship between fathers' occupation and students' perception of science usage by others (c2=21.5, a=.04). More students' whose parents were professional or semiskilled than unskilled said they saw science used by others in careers and more students whose parents were unskilled than professional or semiskilled said they did not see science being used by others. While there were no statistically significant differences in the relationship between science use by others and other background variables, several patterns were interesting. For example, a higher percentage of students in public schools than in private schools said they saw science being used by others in academic settings.

Discussion and Conclusion

Lebanese middle school students, like middle school students in the USA, seem to have a restricted view of science. Most of them defined science as an academic subject and perceived its purpose as preparation for higher grades, higher studies, and careers, and saw themselves and others using science in academic settings. Moreover, most of the teachers of the students participating in the study defined science as an academic subject whose purpose was to give students information about the world and perceived themselves and others using science in school related settings and activities.

The relationships between students' background variables and the different categories showed that more public school students than private school students defined science as an academic subject, said that they did not use science, or that they used science in academic settings. Additionally, more students whose parents were professionals than nonprofessionals said that they used science in hobbies and that they saw others using science in career settings. However, the effect of type of school and fathers' occupation may be confounded by teacher effect and students' socio-economic status: most Lebanese public schools serve students' of low socio-economic status and most parents with professional degrees send their children to private schools.

School and out-of-school factors may influence students' definitions of science and perceptions of its purpose and usage. School factors include curriculum, school administration, teachers and teaching, and external examinations. Out-of-school factors include parental expectations, social status associated with science, and career expectations.

The official Lebanese science curriculum emphasizes science as an academic subject. At the intermediate level (equivalent to Grades 7-10 in the USA), the curriculum provides a list of science topics with a statement regarding the use of science process skills. At the secondary level (equivalent to Grades 11

& 12 in the USA plus Grade 13) the curriculum provides a list of science topics with no mention of science process skills. In Grade 10 and Grade 13 students sit for official examinations in all areas of the curriculum. The Grade 10 examination determines whether students are promoted to Grade 11 and whether they can choose to continue their education in the sciences. The Grade 13 examination is a requirement for admission to colleges and universities. Kraidy & Fares (1984) found that Grade 12 and Grade 13 official chemistry and physics examinations emphasize knowledge level objectives.

Obtaining a professional science-related degree seems a priority for Lebanese parents. With these type of degrees come high status careers and high income. Consequently, parents have very high educational expectations of their children, especially in the sciences. Achievement in science and success in official examinations for achieving professional degrees and high social status is a high priority for these parents.

School administrators, teachers, and students are aware of the extraordinary importance that parents place on success in official examinations and on high achievement in science. Consequently, school administrators and teachers strive to complete the specific requirements of the curriculum and to prepare students to succeed in official examinations that emphasize knowledge level objectives and to achieve high grades in the sciences.

The interaction between school and out-of-school factors has created a culture of "science as an academic subject" that permeates all levels of education in Lebanon. This type of science prepares students to pass examinations, enroll in college, and secure professional science-related careers. Thus, while there are no official examinations at the Grade 7 or Grade 8 level, the major concern of parents, teachers, and school administrators is how to provide students at this level with the prerequisite knowledge and skills necessary to achieve high grades in science and pass examinations in preparation for the future. The major concern of students, on the other hand, is how to adapt to the requirements imposed on them.

The results of the study, then, are not unexpected. Perceiving science as a school subject or seeing the purpose of science as preparation for higher grades and careers and observing science being used in school related activities to the neglect of its importance in everyday life and in technology is a manifestation of the effects of school and out-of-school factors.

While expected, the overemphasis on the structure of science, rather than on the structure and function of science, may be problematic. In a developing country in which confronting environmental and other science-related issues is a major concern of citizens and decision makers, there is a need to prepare scientifically literate individuals besides preparing medical doctors and engineers. An educational system that emphasizes science as an academic subject may produce citizens who know much science but are unable to address science-related everyday and societal problems (Abou Assli, 1995). Consequently, there is a need to contemplate the possibility of incorporating ways of solving everyday science-related problems in the science curriculum and in teacher preparation programs.

However, two questions need to be answered relevant to the issue of changing the curriculum and changing students' views about science. First, is it possible to transform the prevailing culture by changing the curriculum? Second, should the culture be changed if it meets students', parents', and teachers' needs?

A prevailing culture is hard to change especially when socio-cultural expectations, students' specific agendas and views, and curriculum requirements are compatible (Wildy & Wallace, 1995). Moreover, why should a prevailing culture be changed if it meets the needs of all stakeholders? Answers to these questions are needed in light of the different agendas of all those concerned with science education.

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Figure 1. Purposes of Science Perceived by Students

Category	Percent
Academic preparation	
The purpose of science is to teach us about animals, plants, the world, and life	52.2%
The purpose of science is to prepare us for higher studies and higher classes	11.3%
Future Careers	
The purpose of science is to prepare us for future careers	46.5%
The purpose of science is to help us achieve our goals and succeed in life	11.3%
Social Status	
The purpose of science is to answer questions and take part in conversations in out of school setting	21.5%
The purpose of science is to give higher social status	8.8%
Help people solve everyday problems	
The purpose of science is to help people in their daily lives such as in deciding what to eat, how to take care of oneself, and how to fix things	17.5
Invent and discover new things	
The purpose of science is to help people to discover new things that improve their standard of living	8.3%
Understand nature	
The purpose of science is to help people become closer to nature and to understand their surroundings	5.0%