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Developing Creativity, Talents, and Interests across the Lifespan: Centers for Creativity and Innovation

Yaratıcılık, Yetenek ve İlgi Alanlarının Yaşam Boyu Geliştirilmesi: Yaratıcılık ve Yenilikçilik Merkezleri

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Abstract

Based on a strong belief that all people have the potential to be innovative and creative in at least one talent area, and that their potential can be developed and enhanced through access to a rich and stimulating environment, the authors have developed an innovative idea for community centers. We have designed centers that have a rich supply of materials, spaces for individual exploration and group problem solving, suggested experiences for exploration, and people to guide when needed; these centers can be established in local communities or in schools, and need to be available to all ages and all members of the community. The Prism of Learning, a framework developed by Maker and Anuruthwong, and tested in several countries, is recommended as the overall theory guiding the development of creativity and talent. Human abilities include Linguistic, Mathematical, Auditory, Emotional, Social, Scientific, Mechanical-Technical, Visual/Spatial, Bodily/Somatic, and Spiritual. We present this plan and invite the global educational and psychological community to think about it, discuss it, tell us what you think, and most importantly of all, try it!

Keywords: talent development, innovation, giftedness, creativity development, theories of intelligence, exploration, independent learning, group problem solving

Öz

Bütün insanların en az bir yetenek alanında yenilikçi ve yaratıcı potansiyeli olduğuna ve bu potansiyelin zengin ve uyarıcı bir ortamla beraber geliştirilerek arttırılabileceğine dair güçlü inanışı temel alan araştırmacılar toplum merkezleri için yenilikçi bir fikir geliştirmişlerdir. Bireysel araştırmalar veya grup problem çözme alanlarının yer aldığı ve ihtiyaç duyulduğunda rehberlik yapacak bireylerin bulunduğu ve zengin materyallerle hizmet sunacak şekilde tasarlamış olduğumuz merkezler her yaş grubundan toplumun tüm bireylerine hizmet verecek şekilde yerel topluluklar veya okullarda faaliyete geçirilebilir. Öğrenme Prizması yaratıcılık ve yetenek gelişimi teorileri temel alınarak Maker ve Anuruthwong tarafından geliştirilmiş ve çeşitli ülkelerde test edilmiştir. İnsan yetenekleri dilsel, matematiksel, işitsel, duygusal, sosyal, bilimsel, mekanik-teknik, görsel/uzamsal, kinestetik ve manevi yetenek alanlarını kapsar. Bu planı sunarak küresel eğitim ve psikoloji camiasını üzerine düşünmeye, tartışmaya, fikirlerinizi söylemeye ve en önemlisi de denemeye davet ediyoruz.

Anahtar Sözcükler: yaratıcılık, yetenek gelişimi, yenilik, üstün zeka, zeka teorileri, keşif, bağımsız öğrenme, grup problem çözme

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Introduction

We believe that *all* people have the potential to be innovative and creative in at least one area of a wide range of human abilities; their potential can be developed and enhanced through access to a rich and stimulating environment. This is a bold statement of a belief resulting from years of research and practice: observing what happens to people when they are provided opportunities in areas in which they have interest, which usually results in motivation or desire, and some basic capacities; in other words, heredity and environmental influences merge in the development and expression of talent. Indeed, Howard Gardner (1983), in his synthesis of research to form the Theory of Multiple Intelligences, concluded that for high-level talent to develop, the individual needs "hard wiring" or innate inherited capacities, opportunities to develop those capacities, and the desire to pursue them. Vygotsky (1962) concluded that motivation consists of both interest and challenge. If a task is too easy, it is boring; if it is too difficult, it is frustrating. In either case, the individual or the learner is not motivated to accomplish the task. If, however, the task is in the learner's "zone of proximal development" in which the task is challenging and the support and "scaffolding" the learner needs are present, the person will perform at the highest level of which he or she is capable. Similarly, research on creativity across domains of ability and knowledge has shown that the development of creative products requires three components: creativity-relevant skills, domain-relevant skills, and task motivation (Amabile, 1983). If the task motivation is not present, the individual may not attempt the task, and certainly will not demonstrate high levels of creativity.

Usually the development of creativity, innovativeness, talents, and interests is considered to be the sole responsibility of parents and teachers in individual classrooms. We suggest that the responsibility to develop creativity, innovativeness, talents, and interests belongs to all of us: school communities, local communities (towns, cities, neighborhoods), states, nations, and the larger global community. How is this possible?

The purpose of this article is to present an idea and a challenge: Develop innovative school and community-based *Centers for Creativity and Innovation*. Most centers for innovation and creativity have been designed for business and related professionals, not for a community; and all or most community centers are designed for entertainment only or for sports and other similar activities. We envision centers that are like the Exploratorium that was designed in conjunction with the Discovering Intellectual Strengths while Observing Varied Ethnic Responses (DISCOVER) projects (Maker & Pease, 2008). In these centers, both children and their parents explored various areas of human abilities and solved problems in a creative way. The corners or areas of the centers were designed around Gardner's Theory of Multiple Intelligences, and each center included materials that were considered the "tools" of the intelligences. Children could explore by themselves, parents and children could explore together, and parents could explore alone. Watching what happened to both children and their parents was truly exciting! Another similar project is the Exploring Centers

developed by Dr. Usanee Anuruthwong (2002) from Srinakharinwirot University in Thailand. These centers have been built as sections of existing schools and have been built as separate buildings in rural communities. In one small town, an Exploring Park was built by the city as a place where everyone could come to solve problems in an open-air environment. Similar to the Exploratorium, the exploring centers included different corners that corresponded to different human abilities, but they were designed only for children.

An important aspect of the Exploring Centers in Thailand is that students keep records about their activities in the centers, teachers and experts may observe the children at certain times, and experts are available if parents want their children to be assessed. Recommendations based on the records kept by the students, observation by teachers and experts, and assessment by teachers, psychologists, and experts are given to parents in interview and counseling sessions. Our plan for these Centers for Creativity and Innovation is a merging and expansion of these two examples (the Exploratorium and the Exploring Centers) to fit the overall goal of developing the gifts, talents, creativity, and innovativeness of all our citizens. We present this plan and invite the global educational and psychological community to think about it, discuss it, tell us what you think, and most importantly of all, try it!

The Theory and Models on Which the Centers Are Designed: The Prism of Learning, TASC, and DISCOVER

The overall theory guiding the development of the centers is the Prism of Learning developed by Maker and Anuruthwong (2003) based on Maker's research in the USA and Anuruthwong's research in Thailand. The theory has elements that are similar to the Theory of Successful Intelligence of Robert Sternberg (1985; 1997) and Multiple Intelligences Theory by Howard Gardner (1983; 1999), but is different from both of them. In the Prism theory, problem solving, especially when the problems are challenging and interesting, is seen as the spark that ignites and activates the abilities. Abilities include both general capacities (i.e., Memory, Creativity, Logic, Intuition, and Metacognition) and specific human abilities (i.e., Linguistic, Mathematical, Auditory, Emotional, Social, Scientific, Mechanical-Technical, Visual/Spatial, Bodily/Somatic, and Spiritual). All the general capacities are necessary for and important in the successful functioning of all of the specific human abilities; they are expressed through one or more of the specific abilities.

Research on the Theory and Its Components

After the development of the theory, June Maker collaborated with Belle Wallace, teachers, and administrators at two schools in the UK in an action research project (Wallace, Maker, Cave, & Chandler, 2004) to apply the theory in educational settings and to combine it with the DISCOVER problem continuum and the Thinking Actively in a Social Context (TASC) creative problem solving process. Anuruthwong and colleagues (personal communication,

Usanee Anuruthwong, July, 2014) have studied the implementation of the theory in the Exploring Centers in Thailand, and have found that teachers, parents, and counselors believe the centers are engaging, fun, challenging, and motivating. Wallace and colleagues (2004) found that the combined model was very effective, and that both learners and teachers were challenged and excited during their learning and problem solving. Anuruthwong is now implementing the combined model in the Exploring Centers in Thailand, and Maker and colleagues are implementing it in a variety of programs (c.f., Gomez-Arizaga, Bahar, Maker, Zimmerman, & Pease, 2016; Maker, Zimmerman, Gomez-Arizaga, Pease, & Burke, 2015; Maker & Pease, 2008; Maker & Zimmerman, 2004; Reinoso, 2011; Wu, Pease, & Maker, in press; Zimmerman, Maker, Gomez-Arizaga, & Pease, 2011).

Problem Solving: The Key Construct in Intelligence and Creativity

At the heart of all theories of intelligence and creativity is problem solving, which includes resolving everyday problems as well as creating new knowledge. A **problem** is "a question or situation that presents doubt, perplexity, or difficulty; a question offered for consideration, discussion, or solution" (Webster's II: New Riverside University Dictionary, p. 937). *Problem solving* is the process of answering questions, resolving difficulties, creating solutions, and investigating perplexing situations.

Designing Challenging Questions and Problems: The DISCOVER Problem Continuum

All people of all ages can benefit both personally and professionally from developing and improving their ability to solve problems. Too often, educators focus on teaching one way to solve a problem or the right way to perform a task. In our current world of constant change, these programs are not adequate for the development of skills needed to cope with, embrace, enjoy, and meet challenges successfully. Programs and settings for the development of skills in meeting challenges in original and different ways are essential. Knowledge and skills are important, but must be applied in new and personal ways.

To facilitate the learning of a wide range of skills, individuals need to develop the ability to solve problems with differing degrees of structure. The DISCOVER model, modified from research on creative artists and development of creativity, has been used effectively in many countries, situations, and schools to guide in the development of problem solving exercises and challenges with varying degrees of structure (Maker, 2005; 2001; Maker & Schiever, 2010; Sak & Maker, 2005). The model is conceptualized as a continuum of six related types (Figure 1), beginning with the most closed and continuing to the most open-ended, and can be used easily to categorize all the types of challenges individuals face across all academic and career areas. In the model, problem-solving situations are categorized according to whether the problem, method, or solution is known by the presenter, the solver, or both.

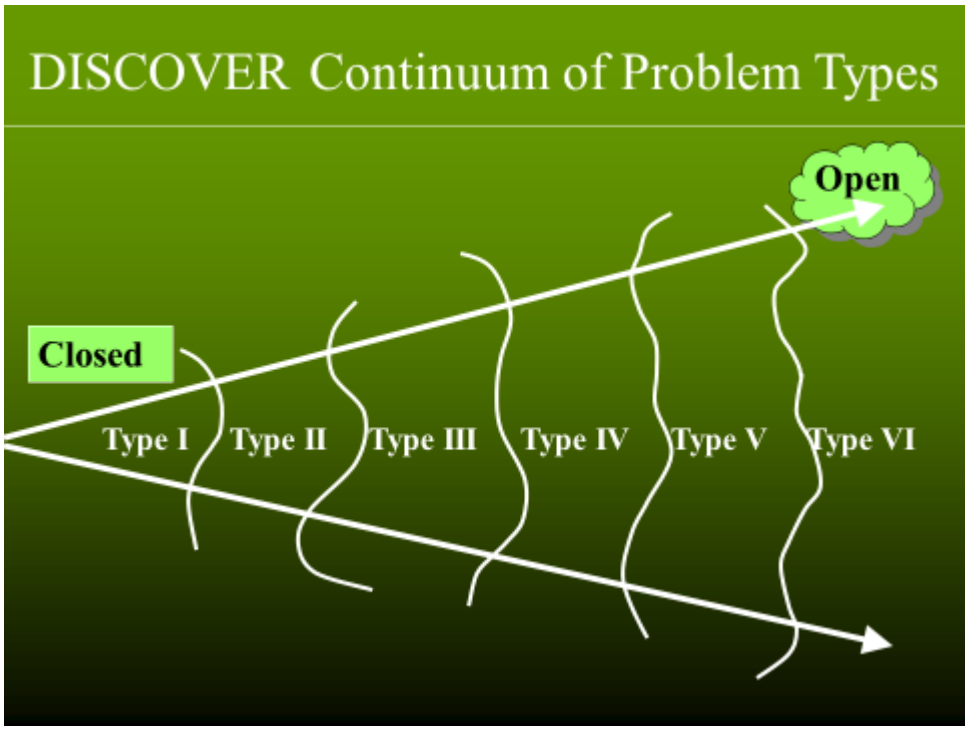


Figure 1. The DISCOVER continuum of Problem Types

The Closed Problems. The first type is one in which the problem and method are "known" by the presenter and solver, and the solution is known only by the presenter. The solver's task in a **Type I** problem is to apply the known method to reach the solution already known by the presenter (i.e., the expert, the teacher, or the author of the test). Common problems of this type are tests of knowledge or specific processes, such as when an employee is asked to learn the management policies of an agency and pass a test of knowledge about these policies or a student is asked to solve a math problem using a particular method. The second type is close to the first in structure, with a problem known to the presenter and solver, and both method and solution known to the presenter but unknown to the solver. The solver's tasks in a **Type II** problem are to select and apply the correct method to reach the correct solution. Common problems of this type are those in which employees are expected to remember the appropriate procedures or policies of the agency or organization and to apply them in the way that a supervisor believes they should be implemented or a student is asked to solve a math problem using the correct method and reach the correct solution, but is not told what method to use.

The Semi-Open Problems. The third problem type is well-defined and has multiple methods, but only one correct answer. A typical **Type III** problem, one encountered by many speakers and researchers, is to find the best way to present a set of data to an audience or in a scientific report. In another example, a governmental agency may be interested in an equal distribution of land for a particular use across two regions of different sizes. In region one, the percentage of land use needs to be the same as the percentage of land use in region two. Farms in region two occupy 10,000 acres. How many acres should be allocated for farm-

ing in region one? These problems can be solved using many strategies, but it has only one correct answer. In the fourth problem type, more than one method and more than one solution are acceptable. However, the methods and solutions in a **Type IV** problem are known to the person presenting the problem. In the example of a person implementing a policy, the fourth type of problem would be one in which the employee has a number of options available, the supervisor knows the parameters or limits of options, and the employee has the freedom to choose what he or she believes is the most appropriate option and the best way to apply it. When using technology, this is a common problem type. The software usually sets the limits for certain functions or operations, but the user can select the best or most efficient method and apply it in a way that works in a particular situation.

The Open-Ended Problems. The majority of problems encountered by policymakers, administrators, professors, and most people in personal situations can be categorized as open-ended. The fifth problem type has a clearly defined problem, but an unlimited number of methods and an unlimited number of solutions can be identified or developed. The person presenting a **Type V** problem does not have acceptable methods or solutions in mind. For example, if a person has decided that he or she will become an architect because funding is available from parents or a governmental scholarship, a problem area has been identified, but a wide range of methods and solutions are available. Depending on the level of skill desired, the individual might decide on methods such as an undergraduate degree in architecture, a graduate degree, or practical training in drafting. Then, decisions must be made about the place, the program, and other important aspects of implementing of the method to reach the goal of being the kind of architect he or she wants to become. The sixth problem type, the most open-ended, the problem, method, and solution are "unknown" by both presenter and solver. In **Type VI** problem solving situations, the problem solver must define the problem to solve before attempting to solve it. This type permits the most individual creativity, and requires the ability to "find" or "define" a problem contained in a situation. Using the above example, if an individual is making a decision about a future career, but is free of constraints, the problem situation is a **Type VI** because the career area must be identified before a plan can be developed and implemented. Global warming is another example of a Type VI problem. Many definitions, methods, and solutions are being proposed and implemented; the problem remains unsolved.

Developing and Exercising Creative Problem Solving: The TASC Model

Research on the development of effective problem solving skills in both students and professionals has shown that most people need to develop skills in the **processes** of problem solving (Parnes, Noller, & Biondi, 1967; Wallace, 2011). In the centers, a process that can be applied in any career area by individuals of all ages is needed. The model recommended for this aspect of the program is the Thinking Actively in a Social Context (TASC) model developed by Belle Wallace and Harvey Adams (Wallace & Adams, 1993; Wallace, 2011). The

model has been tested and used in many different countries (c.f., Ball & Henderson, 2008; Cartwright, 2008; Davies, 2008; Faulkner, 2008; Holyoake, 2008; Whitehead, 2008).

Beginning in the 1980s, Belle Wallace and Harvey Adams surveyed programs and instructional packages used all over the world to develop thinking skills and problem solving abilities (Wallace & Adams, 1993; Wallace, 2008), and worked with researchers and practitioners who were implementing these programs. As a result of these investigations, they developed an approach to teaching problem solving and thinking skills that included the core principles and essential elements of the programs that had demonstrated success. They then applied this approach in an action research project with teachers and students in several schools in South Africa (Wallace, 2011). Use of this model has now been extended to many countries and used in a variety of settings, including with community groups involved in developing solutions to difficult challenges they faced (Evans, 2008).

The problem solving process in TASC is depicted as a wheel, signifying that it is not linear and not restrictive. Although the parts of the wheel can be completed in a particular order, that order is not essential, nor is it always desirable. Much of the process of problem solving is recursive, one in which the problem solvers return to an earlier stage to re-think a plan, gain new information, come up with new ideas, and re-evaluate their plans. The model consists of eight sections: *Gather and Organize, Identify the Task, Generate, Decide, Implement, Evaluate, Communicate, and Learn from Experience* (Figure 2). The flexibility of the model is symbolized by the arrows that go into each section from all other sections.

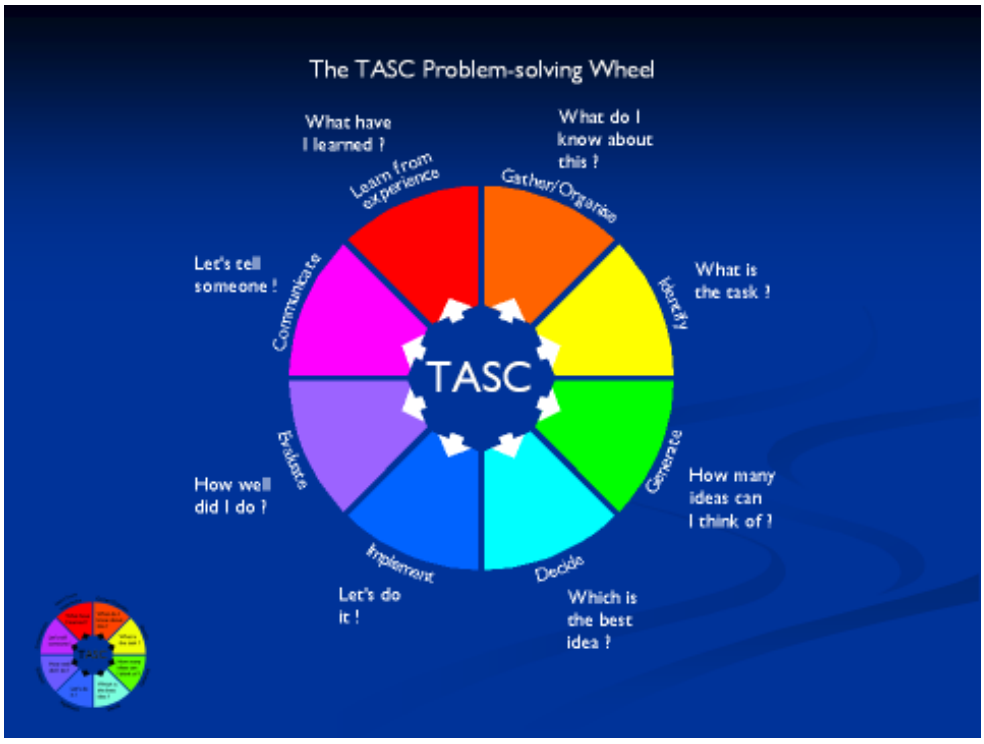


Figure 2. The Thinking Actively in a Social Context (TASC) model

The TASC model is similar to the Creative Problem Solving (CPS) model developed by Sydney Parnes and his associates (Parnes, Noller, & Biondi, 1967) as a way to help individuals and groups in business and industry to solve problems in more creative ways. However, the TASC model is more versatile and can be used more easily by all ages and developmental levels; it also contains all the steps and guiding principles included in CPS. An important difference between TASC and CPS is the inclusion of two important components in the TASC model: communicating results to an audience and reflecting on learning (metacognition). Visually, the model is appealing to children and adults, and it can be used flexibly and effectively in solving all types of problems as well as developing all types of products. For the centers, it provides a better fit with the Prism of Learning, the theory guiding the Centers for Innovation and Creativity, and with the DISCOVER problem continuum. The TASC model was integrated with the Prism of Learning Theory of Maker and Anuruthwong in an action research project in three schools in the UK (Wallace, et al., 2004), and in a program for teachers of the gifted in Korea led by Maker and Zimmerman (2008).

The Prism of Learning

A prism (Figure 3) is used as a metaphor to show how problem solving and the aspects of learning situations are related to the development and expression of gifts, talents, and creativity through different human abilities (Maker & Anuruthwong, 2002). Problem solving is the white light that enters the prism. It stimulates or activates the desire to meet a challenge. The Prism of Learning has three sides. On one side is the environment, another the competencies or outcomes we wish to help learners acquire, and on the third side are the learning processes. In the middle, or the axis, are human abilities. Guides and teachers must provide the kind of environment that will enable each person to be illuminated from within.

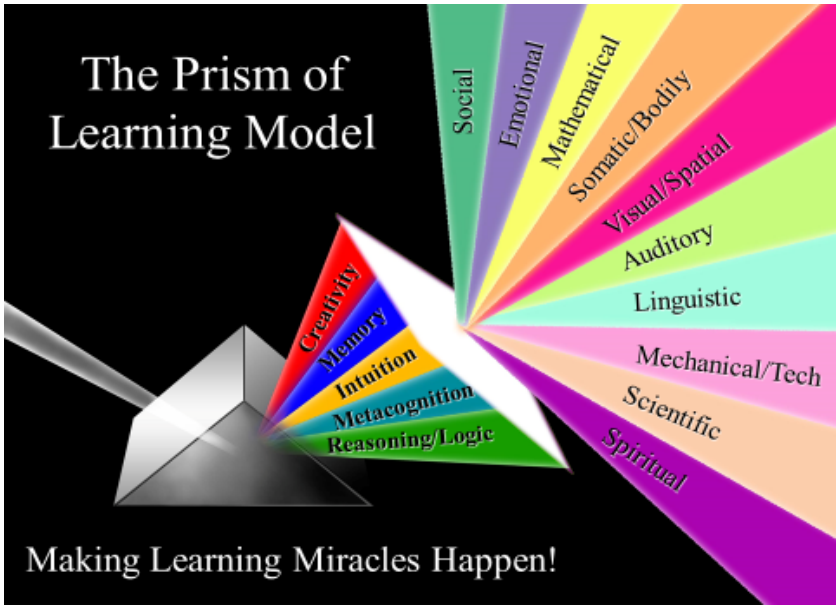


Figure 3. The Prism of Learning Theory

General Capacities

To solve problems, people must use five general capacities—Memory, Creativity, Logic, Intuition, and Metacognition—and ten types of human abilities: Social, Emotional, Somatic/Bodily, Visual/Spatial, Auditory/Sound, Mathematical, Linguistic, Mechanical/Technical, Scientific, and Spiritual.

Memory. Remembering information and experiences is the most basic of the general intellectual capacities. A person must be able to both encode and access information and use it in a meaningful way.

Creativity. Creativity is a general capacity necessary to the functioning of all the dimensions of human abilities; it is the ability to think of, develop, or implement unique and appropriate ideas or solutions. Creativity can result from the association or connection of previously unconnected ideas or things; the resulting ideas can be new to the world or new to the individual.

Reasoning/Logic. Reasoning or logic is the general capacity to think in systematic ways, and is a necessary element in all-human abilities. The logic necessary to solve a problem in one area may be very different from the logic necessary to solve a problem in a different area. For instance, a humanitarian problem cannot be resolved simply by using numbers and symbols, nor can it be solved through application of formal principles of physics. However, logic has a clearly defined set of principles that can be explained or demonstrated in some way so that others see a chain or connection in the reasoning process. Logical reasoning is a necessary part of evaluating ideas before selecting one as the solution to a problem, and is the key element in "critical" thinking.

Metacognition. Metacognition is self-awareness and the ability to monitor one's own thinking. It is the general capacity to reflect on one's own problem solving processes, identify one's own logic (or lack of it!), see one's own flaws, recognize one's intuitive insights, and analyze one's thinking. Metacognitive ability also includes the ability to decide which of one's own abilities to use at a particular time—when to be creative or when to be critical, for instance.

Intuition. Intuition often is thought of as the opposite of logic or reasoning, and can be described as the act of knowing without the use of identifiable processes. However, intuitive insights are not illogical! In fact, they may be highly logical. However, the individual may not immediately know the steps necessary to demonstrate the logic of her ideas. Intuition is the ability to know something immediately—without going through steps or sequences of thought. Intuition is the language of understanding, and can be considered people's real **first language** while the words, symbols, and sounds people learn are part of their **second language**.

Using TASC to Develop General Capacities

TASC is a way to develop all of the general capacities that are in the Prism Model, and then these general capabilities are extended and applied in any or all of the specific human abilities. For example, at the first step in the TASC model, problem solvers *Gather and Organize* the information they have, which activates their **memory** related to a particular topic and if done in a group, gives a structure within which all members of the group can share what they know and remember. When they *Identify* the task, they are using their **reasoning/logic** to focus on the essential aspects of the problem they are solving or the task they are completing. At the next step, *Generate*, **creativity** is activated and developed, and various strategies are taught to assist individuals in thinking in new and innovative ways. At the *Decide and Evaluate* steps, participants apply their **creativity** to generate possible criteria that can be used to make their decisions (*Decide* step) or evaluate their implementation (*Evaluate* step), and then they apply their **reasoning/logic** to choose the most important criteria to evaluate their ideas (*Generate* step) or to evaluate their implementation of the ideas (*Evaluate* step). The final step, *Reflect*, mainly involves **metacognition**, which is necessary for individuals to consolidate and transfer their learning and problem solving skills from the current situation to others in the future. At all steps, **intuition** is valued and encouraged.

Human Abilities

At the most specific level, humans have ten different types of abilities: Social, Emotional, Somatic (touch, movement, and taste), Visual, Auditory, Mathematical, Linguistic, Mechanical/Technical, Scientific, and Spiritual. People have a spectrum of abilities—a broad range of related qualities that are combined in many different ways to solve problems, meet challenges, and create new products. In all activities and careers several of these basic types of abilities are needed. However, most activities and careers have two or three that are dominant, and therefore essential to success.

- **Auditory/Sound** abilities are skills in hearing, producing, and manipulating sounds.
- **Bodily/Somatic** abilities include large muscle movement as well as small muscle movements, and also include touch, taste, and smell.
- **Emotional/ Intrapersonal** abilities are the skills we need to understand ourselves and manage our emotions.
- **Linguistic** abilities are skills in using words.
- **Mathematical** abilities consist of the use of abstract models, numbers, mathematical figures, and objects that symbolize abstract ideas.
- **Mechanical/Technical** abilities are the skills needed to understand, create, and repair machines or other devices that perform or help perform human tasks.
- **Scientific/Naturalistic** abilities include observing, identifying, describing, classifying, studying, and explaining natural phenomena.

- **Social/Interpersonal** abilities are skills we need to understand, value, and get along with other people.
- **Spiritual** abilities include knowledge, ability, and willingness to see beyond bodies and objects to develop awareness and understanding of phenomena related to the human soul or spirit.
- **Visual/Spatial** abilities include seeing things accurately and clearly through one's physical eyes as well as seeing images clearly in one's mind; then producing, describing, or modifying them in a visual or other form.

Learning Processes

Learning processes can be explained by using the metaphor of a tree. Some learning processes are conscious and some are subconscious. In the tree metaphor, this is explained by comparing the root system of a tree to the system of branches. Some processes are above the surface while others are below the surface. The trunk, when cut, is the place where one can see evidence of growth over time. In the Centers for Creativity and Innovation, we recommend using the TASC model to develop and exercise the processes needed for creative problem solving. All the other learning processes can be integrated into this model or integrated with the development of each ability.

Understandings

Understandings are important to people's success, and are learned as a result of school or life experiences. However, they may not have been developed in sufficient depth to enable even adults to become successful as creative problem solvers. Often, teachers/guides attempt to categorize or compartmentalize these understandings, separating the academic subjects and career areas in artificial ways. Knowledge is connected and interdependent just as our bodies and all natural systems are connected and interdependent. For these reasons, activities and experiences should be designed to develop key ideas that are important within and across traditional and non-traditional content areas: individuality, change, patterns, relationships, cycles, environment, conflict, communication, cooperation, interaction, structures, culture, extinction, exploration, diversity, systems, ethics, beauty, harmony, invention, and interdependence. Others can be identified.

Understandings and the DISCOVER Problem Types. The DISCOVER problem types can and should be used to develop all understandings. In general, the closed problems (Types I and II) tend to develop discipline- and career-specific understandings and skills, while the open problems (Types V and VI) are best implemented by encouraging cross-disciplinary knowledge and application of skills. For example, a closed problem (Types I and II) to develop an understanding of systems might be one in which participants learn important information about one system (ecosystem, political system, the circulatory system), while an open-ended problem (Types V and VI) about systems might be one in which partic-

ipants use what they know about a system in nature to suggest improvements in a man-made system or create a model showing how several systems interact. A real-life problem (Types V and VI), making decisions about if or where development should occur offshore in the Gulf Region, would require understanding of the ecosystems in the ocean and the interaction of man-made political systems. The semi-open problems (Types III and IV) provide a transition between the discipline-based and cross-disciplinary understandings. For instance, if asked to demonstrate how the systems in the body interact, even though only the human body is involved, participants are going beyond one system. However, the understandings are still discipline-based. Another example of a semi-open problem (Types III and IV) is to examine several systems and determine which elements are common to all the systems studied. This would be a cross-disciplinary problem solving experience. In all examples of activities in the center, we believe the understandings (stated as themes) developed through the problem solving experiences need to be identified for participants. In each of the examples we provide, these themes are stated.

Understandings, Problem Types, and the TASC Creative Problem Solving Process. All understandings can be developed through use of the TASC model. Similar to the DISCOVER problem continuum's use, TASC can be used to develop discipline- and career-based understandings when participants are solving closed problems (Types I and II) and cross-disciplinary understandings when participants are solving open-ended problems (Types V and VI). The semi-open problems (Types III and IV) are ways to help participants make a transition from discipline- and career-based understandings to cross-disciplinary ones. Although the TASC process is useful for solving all types of problems, it is most helpful in solving semi-open (Types III and IV) and open-ended problems (Types V and VI). Movement through the phases of problem solving usually is simple and quick when participants are solving closed problems (Types I and II), but they need to think and plan more carefully, as well as generate more ideas, when solving open-ended problems (Types V and VI). When groups of people are working together, TASC can be helpful in solving all types of problems by providing a structure for encouraging group interaction and the pooling of ideas and strategies.

Learning Environment

The environment influences growth, but does not dictate how the growth will occur. The learning environment has two major components: **physical** and **dynamic**. The **physical** environment includes color, shape, temperature, light, sound, textures, and materials. The physical environment includes buildings, outdoor areas, trees, and other natural things as well as the way the environment is arranged and the materials placed on the walls. The **dynamic** environment includes the methods for teaching new skills and processes as well as the ways the leaders and guides interact with the participants. The activities that are organized, the questions asked, the type and frequency of feedback given, and management techniques are part of the dynamic environment.

Learning Environments for the DISCOVER Problem Types and the TASC Creative Problem Solving Process. The **physical** environments that facilitate problem solving across all the problem types and all steps of TASC are those including a variety of resources and a variety of places where participants can be alone and with a group. They include equipment, supplies, and other tools of the different abilities that are age-appropriate and complex enough for those who are more advanced than those of their age. Participants need comfortable working spaces as well as quiet spaces in which they can concentrate on their tasks. Especially with open-ended problems (Types V and VI), they need to be encouraged and given the freedom to go beyond the boundaries of the physical space in which they are learning to include outside resources and people from the local, regional, national, and international community. The most important elements of **dynamic** environments that facilitate the solving of all types of problems are questions asked by leaders, guides, and facilitators, which will be different across the problem types. However, in all problem types, questions need to be asked in an open-ended way to facilitate group interaction and individual thinking. The general rule is to ask questions that cannot be answered by "yes" or "no" by beginning the question with nouns such as who, where, what, which, when, how, or why rather than verbs such as are, can, or is. For instance, ask "What do you think is the correct solution?" rather than "Is this the correct solution?" Then, follow the "What do you think" question by asking "Why do you think that is the correct solution?" In this way, the problem solver's thinking is the emphasis, not simply an opinion.

Combining the Theory and Models to form an Innovative Community Center

Our idea is to create a big learning/problem-solving center that would include 10 sections, which we will call "pods", for each human ability. Eight of the pods correspond to the human abilities: Linguistic, Mathematical, Visual/Spatial, Auditory/Sound, Spiritual, Scientific/Naturalistic, Mechanical/Technical, and Personal. The Emotional and Social abilities in the theoretical model are combined into one area and named Personal because these abilities interact in a significant way. We have not included a separate Bodily/Somatic pod even though it is one of the human abilities because many communities have sports centers that can accommodate and develop these abilities. However, Bodily/Somatic abilities are integrated into all the other ability areas. The 9th pod is a greenhouse/solarium located between the Scientific/Naturalistic and Visual/Spatial pods. The 10th pod is the administrative office and the entrance.

The most important aspect of the Centers for Creativity and Innovation is that most of the people's time in the center needs to be spent on self-selected activities. They need to be free to explore and discover in all the pods, and to spend an extended time in the problem solving activities that are of most interest to them. Another valuable type of program offered at the centers is special programs. Some are on-going classes and group problem solving experiences while others are presentations, workshops, and other educational programs provided periodically or only once.

Framework

The DISCOVER problem continuum is recommended as a framework for designing both Individual Exploratory activities and Structured Group activities in the center, and the TASC problem solving process is recommended as a way for all people of all ages and from all career areas to develop the problem solving abilities needed to be creative and innovative. These models have been tested in a variety of settings, and are appropriate in both educational and community settings.

Ability Pods and Central Problem Solving Area

In each ability pod are materials, equipment, a variety of learning and meeting spaces, and suggested problem solving challenges that participants can choose to do independently and collaboratively, depending on their level of development, interests, and abilities. In the center, connected to all the pods is a space where people can gather to have group activities (such as classes and programs to learn the TASC problem solving model), listen to talks by experts, and share their products, learning, and insights.

Physical Environment. The best physical space is constructed as a decagon (a 10-sided building) with a central area connected to all the pods. In the central area is a gathering place for activities involving groups of people. In each ability pod is an area enclosed in glass as a work space for a counselor/teacher or other expert in that area of human ability. The learning spaces for each "pod" are large enough to accommodate groups of 10 to 15 people without being crowded. In these pods, people have places to work and talk with others as well as places to work alone. In the central area, a round space is preferred because it will facilitate interaction. A very interesting detail to add would be to include the TASC wheel on the floor in the middle of the area, preferably in mosaic tile, corresponding to the colors on the wheel. Young children could stand on the sections to show the steps of the model and how they progressed through them, and others could refer to the wheel as they work in groups or alone. It would serve as a constant reminder to follow a process that can result in achieving creative and innovative solutions.

In all areas, the learning environment needs to be a comfortable and inviting learning space (Figure 4) with a variety of areas that can accommodate individual and group work in comfortable, interesting, inviting environments that have variety in color, texture, size, and function. The furniture is movable and flexible for creating different working spaces.

Materials. In each ability pod, materials are available that people of all ages can use independently, materials that are flexible and have much potential to excite curious minds—materials that can be used to challenge individuals at many different levels of ability. The materials need to be varied, useful for developing the human abilities, useful for developing creativity and innovation, carefully-chosen, and durable. Each pod also contains general

tools such as computers, video equipment, audio recorders/players, and printers. Other specialized equipment and materials may be needed in each pod.

Cards with Suggested Problem Solving Experiences. In each pod also are individual cards with problem solving activities that have a wide range of structure, based on the DISCOVER problem continuum, and are related to important understandings and skills in the 8 areas of human ability. These cards are re-usable and color-coded, and they contain suggestions for problem solving activities to be done alone, with a partner, or with a group. The problem solving activities are related to both the understandings and the human abilities. Individuals are given opportunities to choose to solve problems that are well-defined as well as problems that are "fuzzy and undefined." They are encouraged and assisted in using the TASC creative problem solving processes. Use of the TASC process combined with the challenges included in the cards develop the general capacities of creativity, intuition, reasoning, and metacognition as well as understandings (e.g., individuality, change, relationships, conflict, structures, exploration, systems, ethics, harmony) and learning processes such as observing, feeling, connecting, composing, transposing, remembering, sensing, inventing and the creative problem solving processes in the TASC model: *gathering and organizing, identifying, generating, deciding, implementing, evaluating, communicating, learning from experience*. In other words, these activity cards are designed to integrate the outer surface elements of the Prism of Learning with the inner axis of the prism—the general capacities and the wide spectrum of human abilities.



Figure 2. Examples of Learning Environments

Management

The administrative offices are located in the 10th pod. The 10th pod is the entrance, with administrative offices on either side of a hallway that leads to the central area from which all pods can be accessed. Visitors check in and sign a log indicating the time they entered, the pod(s) they intend to visit, the pod(s) they actually visited, and the time they left.

The center offers performance-based assessments on a periodic basis for different ages and levels of proficiency, and information about participation in self-choice activities is maintained by participants and is recorded in a central location. All of this information can be combined to form a profile of strengths and interests across multiple abilities, creativity, and problem solving skills for each individual. Then, guides and mentors can be available to work with individuals and groups to further develop their abilities. Mentors are matched with the interests and needs of individuals, and can be both professionals and members of the community who like to help others develop their gifts, talents, creativity, and interests.

Underlying Principles for the Exploratory and Structured Programs

Within the Centers for Creativity and Innovation, several principles are important in the development and implementation of both Exploratory and Structured programs. These principles should be kept in mind by those who design the programs and those who deliver them to the community.

1. Within a rich environment of learning experiences, people use vital general learning capacities: intuition, memory, creativity, logical thinking, and metacognition.
2. These capacities interact dynamically in the process of problem-solving and creating innovative products.
3. Problem-solving should take place with the option of using any or all of the human abilities.
4. Through a developing network of learning processes, participants need to acquire a range of competencies and understandings.
5. People need to understand their problem-solving processes and should use these processes across a wide range of problem-solving experiences.
6. People need to be offered a wide range of choices of topics, activities, and experiences that can assist in developing their gifts, talents, interests, and creativity.

Independent Exploration

The most important function of the Centers for Creativity and Innovation is to be a place where individuals of all ages can choose from a wide variety of ability areas, difficulty levels, materials, and problem types; and can explore freely. When groups from schools, classrooms, or other programs visit the center, a group activity is planned at the beginning for a variety of purposes: to help people learn some concept; to exercise a particular learning process; to introduce materials; or to serve another important purpose identified by the teacher, guide, mentor, or facilitator. However, these group activities preceding exploration need to be limited to 10 or 15 minutes except in special instances.

After the group activity, participants may choose a pod. If young students are coming with a class and their teacher, they go to a central place and take a marker or a card with the name of the pod where they will spend their time. The number of cards available for each pod are

determined by the size of the pod and the approximate number of individuals who can be accommodated comfortably in that pod. When a large group is present, this process facilitates a smooth flow of children and ensures that enough resources and spaces are available. If no card is available for a pod, the children choose another pod until their first choice is available. They return their cards when they leave a particular pod so that the guides and teachers can ensure that all participants have opportunities to explore the areas of most interest to them.

Near the end of the time that people from a school, classroom, or other group are in the center, all participants are brought together. Participants then record what they did during their time at the center. All who come to the center should be encouraged to return, and to create a portfolio of their development and a record of what they have done when they participated in the Center. If they have pictures of products they made, they put these in an on-line or hard copy portfolio, and they write or draw about their experiences in the pods and when creating products. The teacher or guide also may ask them to reflect on certain aspects of their participation or performance.

When parents bring their preschool children to the centers for exploration, they accompany their children. Guides are available to assist parents and children in finding and using the materials. When adults and older children come to the center for exploration, they work independently on self-selected activities unless they request assistance. The sign-in sheet at the entrance ensures that staff members know who is there and the pod(s) they intend to visit.

Structured Programs for Development of Creativity and Innovation

To provide maximum benefit for a community or school, the resources in a Center for Creativity and Innovation need to be available for small and large groups. These structured programs vary according to the needs and interests of the community or school. In addition, the topics for these special programs are determined by both the staff and the participants. Facilitators, teachers, and guides who work with participants will see common needs and interests, and then develop workshops or find speakers who can provide needed information or teach needed skills. Participants also can request speakers or workshops on certain topics. Regular programs are available for students of various levels from all the schools in the region, and can include students in various types of special programs, but are designed for the entire community. The types of structured programs offered will vary depending on whether the center serves one school or an entire community.

Examples of Structured Programs

1. During the school day, special programs are offered for students from surrounding schools. In addition to the exploration programs described in this report, structured programs could consist of workshops of varying lengths in which students learn the

steps of the TASC wheel as they participate in independent exploratory experiences provided in each pod.

2. Also during school hours, the Centers can offer programs for parents, both those with preschool children and school-age children, to help them understand how they can develop their children's problem solving, creativity, and interests in a variety of areas. This would include, but not be limited to, teaching the TASC process and the ways children can develop their general capabilities across the wide range of human abilities.
3. During school hours, the Centers can be open for exploration for children and adults, so to avoid conflict with the exploration function for preschool children and adults, certain days could be designated for exploration only and certain days designated for group experiences for classes and students coming with their teachers.
4. After school hours, in the afternoon, structured programs could be offered periodically for students from local schools, for teachers, and for community members. This would include, but not be limited to, teaching the TASC process and the ways participants can develop their general capabilities across a wide range of human abilities.
5. In the evening, special workshops and talks can be arranged to meet the needs and interests of people in the community. For instance, experts in the development of creativity and innovation can be asked to share their experience and knowledge, individuals from the government offices can explain the process of applying for a patent for an invention, experts in a particular area of human ability can give tips and instruction for development of that ability, and participants can be invited to present their products to a local audience. These workshops and talks also can include teaching the TASC process and the ways participants can develop their general capabilities across the wide range of human abilities.
6. In the evening, community members can share the products they are developing and receive assistance and feedback from others.
7. Evening meetings also can be scheduled in the centers for mentors and their mentees.

Assessment and Evaluation in Exploration and Collaborative Experiences

Learning about the strengths, creativity, interests, and abilities of the individuals who participate in the Centers is an important part of the plan. The assessment serves several purposes: to find out how to guide or assist individuals while they are in the center, to help children and their parents choose and organize learning experiences that will develop their children's natural abilities, to help everyone teach and guide each person more effectively, and to help adults develop, find new ways to extend, and apply their gifts, talents, and creativity in innovative ways.

When classroom teachers bring their students to the center, the classroom teachers, teaching assistants, and the teachers and guides in the center use specially-designed checklists to observe each individual as he or she participates in the activities in the center. At other times,

teachers, guides, and experts in the centers may use checklists when an assessment of abilities is requested by a parent or the individual him/herself.

These checklists include problem solving behaviors and characteristics of the things people produce. Observation must happen over a long period of time, be done with reliable and valid instruments, with a wide "lens," and with multiple procedures and observers. Teachers, guides, and experts use a system of rotation in which they make a special effort to observe everyone who comes to the center, and when a classroom of students is at the center, they keep records of which students were observed, making certain to complete an approximately equal number of observations of each student. Teachers, guides, and experts also note special performances or products made by anyone, regardless of whether the individual was one of the people to be observed that day.

A second aspect of assessment is a special assessment day. For one or two weeks each year, all individuals who are interested can be offered the opportunity to participate in specially-designed assessment activities. Individuals are invited to sessions for those of different developmental levels. For instance, preschool, elementary, middle school, and high school/adult. One interesting, engaging activity can be set up in each pod. An adult who is interested in that pod or has high abilities in it—and who has practiced observing the activity—is in the pod to observe the participants as they engage in the activity. Observers watch the participants solve problems, take notes about their observations, interview participants, and take photographs. They collect and photograph products such as artwork, written and oral stories, and other creations. Participants rotate through the centers. After all participants of a particular group or grade level have been assessed, the observers complete checklists of abilities and assign ratings to show each individual's pattern of abilities.

A third aspect of assessment is examination of portfolios. This includes drawings, records of which pods each individual visited and the activities they did while there, and their reflections on their performance. Also included is a self-assessment in each of the areas of human ability. Periodically, individuals are asked to complete this self-evaluation.

Finally, teachers and guides in the center compile the assessment information from all sources and have a conference to decide what they believe to be the most important abilities of each individual. They also identify areas of challenge that may interfere with development or expression of the individual's abilities. If additional assistance or another perspective is needed, they may invite an expert in the particular human abilities being examined or another person familiar with the individual to join the conference. The teachers and guides compile all information using the checklists and report forms, and schedule a conference with parents, teachers, mentors, and family members to discuss what they have learned about each individual.

Examples of Individual Exploratory and Collaborative Problem Solving Experiences

Using our experience and research and the research of others, we have developed specific examples of exploratory and structured learning experiences that can be provided in the Centers for Creativity and Innovation. In all these examples, the Prism of Learning Theory is combined with the DISCOVER problem types and the TASC problem solving process. We have created many examples of problem solving experiences: for each level (preschool, elementary, middle school, and high school/adult); for each ability pod; and experiences designed for one individual to do alone (individual exploratory) or a group of individuals (collaborative). Space does not permit us to include all of those examples, so we have chosen a sample to demonstrate how this aspect of the Centers is designed.

Auditory/Sound Pod

Independent Exploratory Experiences for Preschool Children. These activities can be recorded so that children listen to the instructions or they can do them with a parent or the adult in the pod.

Type I/II

Theme: Environment

Focus Question: What sound does this animal, person, or thing make?

Activity: Children choose cards and reproduce the sound they think is made by the animal, person, or object on the card.

Materials:

- Cards with various animals, both in the child's environment and those not in it
- Cards showing various environmental phenomena such as the ocean or a palm tree
- Cards showing people demonstrating a variety of expressions, such as crying and laughing
- Cards showing cars, airplanes, refrigerators, and other objects that might be familiar to children in the area

Type III/IV

Theme: Environment

Focus Question: What other sounds might be found in the same place as this animal, person, or thing?

Activity: Children choose one card at a time, and make other sounds they think might be found in the same environment.

Materials:

- Cards with various animals, both in the child's environment and those not in it
- Cards showing various environmental phenomena such as the ocean or a palm tree
- Cards showing people demonstrating a variety of expressions, such as crying and laughing
- Cards showing cars, airplanes, refrigerators, and other objects that might be familiar to children in the area

Type V/VI

Theme: Environment

Focus Question: How can you make a song about this place?

Activity: Children choose one of the cards. They make their own songs about one of the places. Encourage the children to include at least three of the animals, people, or objects from that place. When they have made it, ask them to sing it for someone or record it.

Materials:

- Cards with various animals, both in the child's environment and those not in it
- Cards showing various environmental phenomena such as the ocean or a palm tree
- Cards showing people demonstrating a variety of expressions, such as crying and laughing
- Cards showing cars, airplanes, refrigerators, and other objects that might be familiar to children in the area

Scientific/Naturalistic Pod

Examples of Independent Exploratory Experiences for Preschool Children, Middle School Age Participants, and High School/Adult Participants. The experiences for preschool children can be recorded, as can other levels if needed for participants with disabilities; most participants of school age will simply choose a card of interest and experience the activity!

Preschool, Type III/IV

Theme: Cycles

Focus Question: How do you see weather change in your world?

Activity: Create a drawing of what happens when it rains.

Materials:

- Drawing paper
- Colored crayons
- Pens and pencils

Middle School Type V/VI

Theme: Interdependence

Focus Question: What can be done to protect endangered species?

Activity: Identify a problem facing endangered species. Present a possible solution to this problem by making a drawing, writing in your science journal, or making a 3D model.

Materials:

- Local and regional science articles and books on the natural world
- Information sheets on endangered species
- Science journals
- Writing paper
- Drawing paper
- Drawing pencils
- Colored pencils and pens
- Clay of various colors
- Pipe cleaners
- Colored construction paper
- Scissors
- Tape
- Glue
- Rocks
- Internet availability and computers

High School/Adult V/VI

Theme: Interactions

Focus Question: What is my relationship with my environment?

Activity: Select a specific environment or habitat that you are passionate about, then write, draw or make a 3D model of your own plan for the way you would work to protect that environment. Explain any interrelationships, interactions, or conflicts that occur in your environment. Reflect on your plan, and then explain it to others.

Materials:

- Local and regional science articles and books on the natural world
- Information sheets on local and regional environments
- Internet availability and computers
- Science journals
- Writing paper
- Drawing paper
- Drawing pencils
- Colored pencils and pens
- Clay of various colors
- Pipe cleaners
- Colored construction paper
- Scissors
- Tape
- Glue
- Rocks

Mechanical/Technical Pod

Examples of Collaborative Problem Solving Experiences for Middle School Age and High School/Adult Participants. These activities are designed for both large and small groups. If the group is large, put the participants in several small groups to work together. At the end, each small presents to the large group.

Middle School Type I/II

Theme: Interdependence/Communication

Focus Question: How can you identify and understand the following concepts: motion and forces and transfer of energy?

Activity: Use simple objects, such as rolling balls and mechanical toys to describe your understandings of moving objects and the forces acting on the objects (motions and forces). The understanding of energy will include light, heat, sound, electricity, magnetism, and motion of objects (transfer of energy). Explore these two concepts and develop definitions and examples. Present your findings on paper and/or in oral presentations.

Materials:

- Rolling balls
- Mechanical toys, such as robots, mechanical arms, and vehicles
- Pencils, colored pencils, markers
- Paper

High School/Adult Type V/VI

Theme: Ethics

Focus Question: What kinds of impacts do robots, machines, or technology have on your community?

Activity: Brainstorm possible impacts on your community. Use available resources and the Internet to research the focus question. Interview at least one expert from your community about what impacts robots, machines, or technology have on the community. After investigating a number of sources and an expert in the field, present your findings in any way.

Materials:

- Computers, Internet, websites
- Community expert or mentor
- Paper, pencil, science notebooks
- Any materials found in the Mechanical/Technical pod

Visual/Spatial Pod

Examples of Collaborative Creative Problem Solving Experiences for Elementary, Middle School, and High School/Adult. As in the other pods, these can be recorded so that participants can listen rather than read the instructions. If the group is large, divide the participants into several small groups of 5 or 6 and at the end of the activity, each small group can present to the large group.

Elementary Type V/VI

Theme: Environment and Change

Focus Question: How do you think your environment will change in the next 10 years?

Activity: In small groups, create a model showing what you think your environment will be like in 10 years. Think about the changes that are occurring now, and focus on an environment that is familiar, such as the local area.

Materials:

- Markers, black and colored pencils, and crayons
- Various textures and colors of paper
- Fabric, yarn, and craft supplies, and materials for decorating and attaching fabric (sewing, gluing, and weaving)
- Scissors and other tools for cutting paper and fabric
- Modeling clay or plasticene
- Materials in the Mechanical/Technical pod also may be useful for certain groups

Middle School Type I/II

Theme: Systems

Focus Question: What are the qualities of systems?

Activity: In small groups, choose a system such as the solar system, an ecosystem, the sound system at the Center or at your home, one of the systems in your body or your body as a system, the body of a fish, a local or national governmental system, the public school system, the ocean, an oil refinery, or other system of interest, and create a visual product of some type that shows what you believe are the essential elements in the system you chose. Be sure to show how all the parts interact and depend on each other. Present your product to the group or place it on display in the Center.

Materials:

- Photographs, CDs, books, videos, and movies about various systems
- Software for modifying images
- Software for editing videos
- Varied art supplies as needed
- Cameras and other equipment for recording still and moving images

High School/Adult Type III/IV

Theme: Communication

Focus Question: How are visual images used in similar and different ways across different career areas to enhance communication? Why do these differences occur and how are they important?

Activity: Compare the results of the investigations made by different groups. Analyze the similarities and differences in the ways images are used in different career areas. Discuss the possible reasons for the differences and speculate about why they are important. If possible, compile a list of general principles for using visual images. Present these principles in a visual form.

Materials:

- Results of presentations by various groups
- Software for modifying images
- Software for editing videos
- Varied art supplies as needed
- Cameras and other equipment for recording still and moving images

Final Thoughts

The plan we have proposed is a scaled-up version of a smaller idea that has been implemented successfully in three countries. We have proposed a community center in which the general capabilities and varied human abilities in the Prism of Learning are developed and explored, both independently and in groups. In this center, people of all ages and from all segments of the society can find an environment, human and material resources, and activities that motivates and inspires them to become creative innovators and producers of knowledge rather than consumers of the products and ideas of others.

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