Education through Exploration:
A New Theory in Teaching and Learning Science

This paper outlines the beginnings of a new theory in education. It is based on 19 years of practice and research on a middle school science program called **The JASON Project** (www.jason.org). JASON's theory is that connecting students with "great explorers and great events" through innovative pedagogy, core curriculum and interaction with scientists and other role models sparks a deeper engagement in learning – and that this engagement leads to self-motivation and higher achievement.

BY CALEB M. SCHUTZ

GREAT EXPLORERS AND GREAT EVENTS

Educators generally acknowledge that a key component of student learning is meaningfully engaging the student in the topic. Various research and literature exists to define engagement and to determine and assess teaching approaches that foster it.

The JASON theory posits an important and curiously overlooked step required for real engagement to occur: tapping into students' intrinsic interest and curiosity so they choose to become engaged in their learning. We call this the "spark."

NATIONAL GEOGRAPHIC

The JASON Project℠

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Step #1

Light the spark of inspiration in students to fuel their motivation to engage in learning.

Most assume the spark is ignited by teachers, parents or the curriculum. From interviews with thousands of kids who have taken part in JASON, it is clear these influences are important. However, with many students the effect often is not powerful enough to initiate lasting engagement. Two well-known, factual examples explain the spark and what we call "the October Sky Phenomenon":

- In October 1957, a young man named Homer Hickam looked into the night sky and saw Sputnik. The impact of this "great event" was immediate and transforming. The son of a West Virginia coal miner whose own future in the mines was preordained, Homer's sighting of Sputnik lit the spark that made him want to do whatever it took to launch rockets. He achieved that dream by overcoming daunting obstacles, including learning the requisite math and science. He also had the audacity to write to the world's premier rocket scientist, the "great explorer" Werner von Braun. To everyone's surprise, Werner took the time to write back! Instead of becoming a coal miner, Homer became a NASA engineer.

- Thirty years later, Dr. Bob Ballard's discovery of *RMS Titanic* generated some 16,000 letters from students asking to join his next expedition. Like Sputnik for Homer, Bob's discovery inspired students to dream and achieve the impossible. Some went on to earn multiple advanced degrees in order to follow in his footsteps.

Like Werner, Bob also was compelled to write back. Understanding the power of the spark, he started The JASON Project in 1989.

No one gave Homer Hickam a curriculum on rocket science. His parents often were discouraging. Other than a teacher and a few friends who were won over, almost everyone in Homer's community thought him a wild dreamer – or just irresponsible. Further, Homer's family was poor. While his circumstances may at first appear unusual, they are too common even today. We cannot forget the need to motivate students who find themselves in situations such as Homer's – or worse.

With all odds against him, how did Homer succeed? It started with the spark. Then something deeper happened.

Step #2

Students become engaged and self-motivated to overcome obstacles and do whatever it takes to achieve their dreams.

The evidence of a spark is seen clearly when students become engaged – behaviorally, emotionally and cognitively (Fredericks et. al., 2004). They spend more time on task, they talk more about the subject, they ask probing questions, they investigate, they find answers and then keep going. Students are really excited about what they are doing when their learning no longer requires external motivators. They become self-driven to find the answers that will help them achieve their goals.

Though extremely powerful and experienced by many throughout history, the October Sky Phenomenon entails a series of critical – but completely random – occurrences. First, a great event such as Sputnik's launch or Titanic's discovery occurs. A student such as Homer happens to witness, and be profoundly moved by, the event. Then, that student finds a mentor who, in some small but vitally important way, inspires the student to pursue a totally new path.

However, this sequence of events does not happen nearly often enough. So JASON has adapted and advanced this concept to systematically and repeatedly bring scientific adventure to classrooms by exposing students to great explorers and great events and facilitating their ongoing interaction with the scientists. This approach fires the spark in students to get them – and keep them – engaged deeply enough to overcome all obstacles.

CURRICULUM/PEDAGOGY

JASON's goal is to take the principles in the random occurrence of the October Sky Phenomenon and make them non-random, repeatable and available on demand to every student. Since we cannot predict what will light the spark within each student, we provide a wide range of experiences and learning activities. JASON's relationships with our steward, National Geographic Society, and such partners as NASA and NOAA give us a unique advantage to deliver a virtually endless supply of great explorers and great events.

In JASON, we have found that students approach science and scientific investigation with personal dedication when they connect with an explorer (content expert and charismatic mentor) and exciting, real-world events. For example, in our weather unit, *Operation: Monster Storms*, the excitement of science unfolds before students' eyes as they see great explorers chasing tornados and flying into hurricanes. Students get to know these explorers as real people who have had to study and work hard and, as a result, now are engaged in such fascinating and important work as saving lives and property from "monster storms." They see the explorers describe their passion for science and its use in real-world contexts to which the students can relate.

This is quite a contrast to most students' perceptions of science and the usual drudgery of carrying out "boring" calculations such as dew point. JASON completely changes the context and reasons for learning – from getting a good grade, for example, to solving a "mission challenge" with personal importance and real-life significance. JASON students see dew point through the eyes of tornado-chaser Tim Samaras, and they come to understand it as one of his most important tools for predicting a storm's formation and path. Wow! A student who learns dew point can warn people of an impending tornado!

This connection with explorers and meaningful context engages students and keeps them asking more and more sophisticated questions. They ultimately find their own motivation to uncover the answers and apply what they have learned, as Homer and so many others have done to overcome obstacles and achieve their dreams. This, however, is only part of the total experience.

Step #3

A new pedagogical approach combines rigorous curriculum with technology in ways that are appealing to students and useful to educators.

JASON starts with the premise that the curriculum needs to speak to students in their language to get and keep them engaged, and it needs to speak to educators to be relevant in classrooms.

Recognizing the importance of role models, JASON incorporates current participants and alumni of the National Argonaut Program into all elements of the curriculum. The National Argonaut Program invites students and teachers worldwide to conduct fieldwork with scientists and become featured in the curriculum as role models. Many alumni move into science education or careers, and they mentor younger Argonauts.

The language of students today is on-demand, interactive and community-based, as represented by video iPods, Wiis, MySpace and YouTube, and live and reality-based television. JASON has adapted this language, embedding new technologies and social networking opportunities in its curriculum.

Students interact with great explorers in live Internet chats and in podcasts and Web casts, asking questions and hearing them describe their lives and work. In videos, students watch thrilling footage of these role models in the field, and they learn the concepts needed to replicate that science in the classroom. They play computer games ("digital labs") with real data used by NOAA hurricane hunters and mimic efforts to accurately predict a storm's landfall.

To succeed, either in protecting lives or earning a place among the leaderboard's top scorers, they must understand and apply such principles as transfer of energy just as they see the explorers do in real life. Students upload their own digital science fair content for others to see and rate in a YouTube-type atmosphere. Designed to be fun and exciting for students, these Argonaut Challenges are aimed at motivating them to dig deeper into science.

We showcase them to inspire others. In addition, scientists featured in the curriculum lead missions with students in local communities and visit JASON classrooms to speak with students about their lives and work – and what challenged and motivated them.

If we can plainly see what excites and engages kids in their everyday lives, why not use the same tools in curriculum? This rich variety of experiences gives every student a chance to join real, inspirational science missions, get to know the explorers and student Argonauts before them, and apply rigorous science to solve the curriculum's mission challenge.

Step #4

Look over the horizon for new solutions, but work within today's educational framework.

No matter how engaging this approach is for students, the curriculum must be relevant to teachers and administrators to be used in classrooms.

It must teach what students need to learn by showing clear alignment to standards, and its effects need to be assessed.

All new JASON units such as weather and ecology are designed to fit within school districts' core science curriculum. They are built from National Science Education Standards and aligned to the standards of such states as California, Florida, Illinois, Kansas, Missouri, New York, Ohio, Texas and Virginia – and can be aligned to others quickly and easily. These standards are pre-populated in an online database and the resources themselves are searchable by national or state standard, subject, keyword and other criteria.

JASON also provides comprehensive tools to manage, assess and track student performance. Teachers can use JASON's pre-designed lesson plans (or create their own using online templates) and assign and grade student work online. To measure student performance, they can assign, administer and grade assessments online using JASON's database of pre- and post-tests, or create their own library of questions in various formats, from multiple choice to true-false or short answer.

JASON enhances its unique access to great explorers by offering this unusual combination of advanced online interactivity for students and teachers with print editions for both.

In this respect, JASON is looking ahead to the possibilities for digital education over a five- to 10-year horizon but still is grounded in the needs and preferences of many of today's teachers and parents.

STUDENT ACHIEVEMENT AND UNDERSTANDING

Student achievement often is measured with test scores. Our theory is that students who meaningfully participate in JASON will show improved scores for content covered in the curriculum – and will find science more enjoyable and engaging.

Step #5

The sum total of JASON – inspiring students to become and stay engaged in a community of science mentors and learners – can lead to greater student achievement.

Not all, or even the majority, of JASON students will become scientists or engineers. However, we think the totality of the experience will leave them richer, more self-aware, driven to set higher goals and self-motivated to achieve them. In fact, a growing number of former JASON students, now adults, attribute positive life changes to their involvement in the program, whether or not they participated in field missions or chose science or related careers:

- LaQuen Holcomb says JASON transformed him from "a young black kid from the projects of the inner city [of Milwaukee]" to "a better student, soldier and son, and now a father and provider."

- Kris Ludwig was so inspired by her experience as a 16-year-old that she went on to earn undergraduate and master's degrees in earth science and oceanography. She now collaborates with Dr. Ballard as a colleague and Ph.D. candidate.

These are examples not only of achievement, but of a greater understanding of one's self and one's place in the world.

Understanding is usually defined as factual knowledge coupled with the conceptual ability to explain, interpret and apply that knowledge to new ways of thinking. In the broadest sense, our theory holds that sustained engagement in JASON increases student understanding at multiple levels. This is consistent with studies of talent development by Bloom and others that examined three phases by which individuals reach high levels of accomplishment: early instruction emphasizing exploration, curiosity and enjoyment of the field; mastering the field's techniques, principles and vocabulary; and finally, transitioning from imitation and technical mastery to viewing problems in new ways and finding one's own voice (Bloom, 1985).

Step #6

Students' views of themselves and the world around them are changed.

As students progress through JASON in all its variety – classroom curriculum, extracurricular activities, new interpersonal relationships – they begin to see themselves and their world differently. By strenuously applying themselves to higher goals like saving lives and property in *Operation: Monster Storms* or protecting the ecological matrix in the upcoming *Operation: Resilient Planet*, they become more deeply engaged in their education.

Doing so, they also become more aware of their own potential as well as their personal and societal responsibilities, and they are better able to make informed decisions about complex issues facing themselves and society.

Finally, our theory is that research will show students' understanding of science, and their desire to engage it, will surface in other ways: their choice of elective courses, involvement in science-related extracurricular activities, the books they read and television shows they watch in their leisure time and, ultimately, their higher education and career choices.

JASON's highest goal is to deliver this experience to every student at every socioeconomic level in every setting, from rural areas to inner cities.

By systematically connecting them to great explorers and great events, to positive alternatives and rigorous academic challenges in their formative years, we hope to set them on the road to higher achievement and greater understanding of themselves and their world.

CONCLUSION

The theory proposed in this paper is supported by nearly two decades of practical application and several research studies (Goldenberg et. al., 2003; Bienkowski et. al., 2005).

One of JASON's priorities is to continue refining the program to deliver the inspirational spark across the full spectrum of learners and learning styles.

Our understanding of the full potential of great explorers and great events still is in its infancy, which is why we are working with independent researchers at The George Washington University on scientifically based evaluation.

We also are partnering with state superintendents and school districts of all types and sizes to test and refine our theory and document the results.

If our theory is valid, there is no reason that this same approach cannot be expanded to every subject, drawing on great explorers from the ranks of writers, mathematicians or social scientists. A corollary theory, not covered in this paper, is that the same factors applied to educators help to re-energize them and heighten their impact on students, and increase their understanding of science.

Our hope is that this paper contributes to a new field of research and acts as a catalyst for recruiting new JASON partners from education, business and philanthropy. We invite those who share this vision to help us explore and chart a 21st-century solution for education.

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