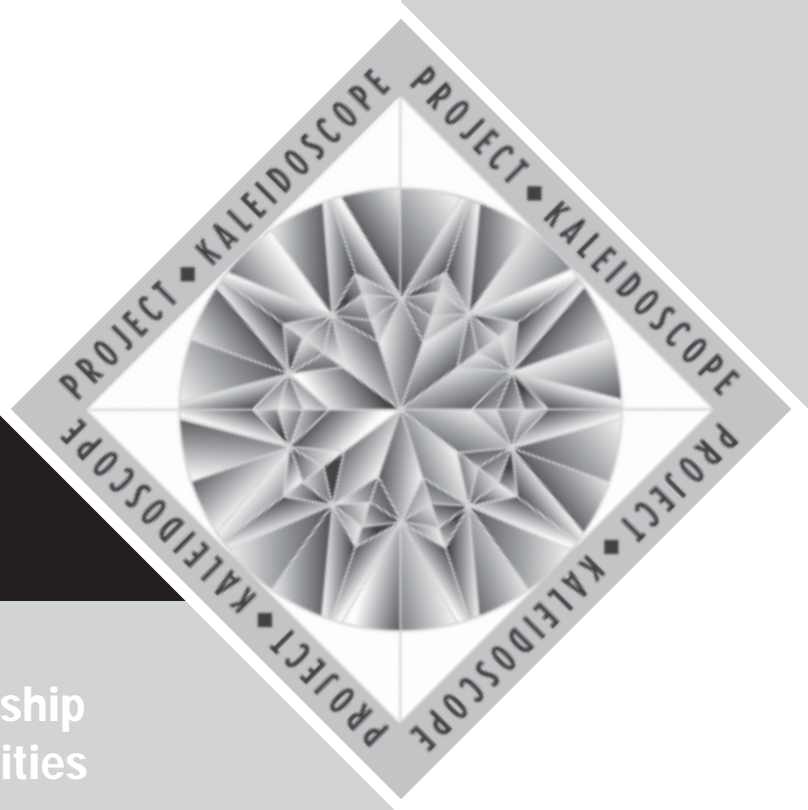


# LEADERSHIP

**INVESTING IN THE FUTURE**

Building Institutional Leadership  
for Natural Science Communities  
2004-2006



**A PKAL PORTFOLIO**

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July 2004

Greetings:

The past fifteen years have been a period of significant transformation in the undergraduate science, technology, engineering and mathematics (STEM) learning environment– how students are taught, what they are taught, where they are taught. How did this happen?

Faculty in colleges and universities across the country have explored and experimented with approaches designed to strengthen student learning in STEM classrooms and labs on their home campuses. In this they have used their capacities as research scientists, the ability: to pose, analyze and solve problems; to trust data; to collaborate and share with colleagues; to ask *what if* and *why not*, and to learn from failure. In this work they have examined:

- ◆ Reports from leading agents of change that suggest both a rationale and a means to move into uncharted territories in pedagogical realms.
- ◆ The growing body of contemporary research on how people learn that confirmed the effectiveness of specific pedagogies and technologies to achieve goals for student learning.

These lessons learned about the process of change (capitalizing on the work of peers, building a solid research base, using the scientific approach to transform the classroom) are timely. They advance the work of those now assuming leadership responsibility for taking the next step in transforming the learning environment– tackling opportunities at the institutional level.

With this publication, PKAL begins a series of occasional papers focused on building institutional leadership for natural science communities. These papers, resources for PKAL 2004 - 2006, are an opportunity for current and emerging leaders to examine and explore both the theoretical and experiential aspects of leadership. They provide one connection to the work of reflective practitioners who have thought deeply about leadership in the context of organizational change, and to those whose efforts confirm *what works*, *what matters*, and *what lasts* when a collaborating community has a vision for the future of its undergraduate STEM learning environment, and acts to realize that vision.

Cordially,



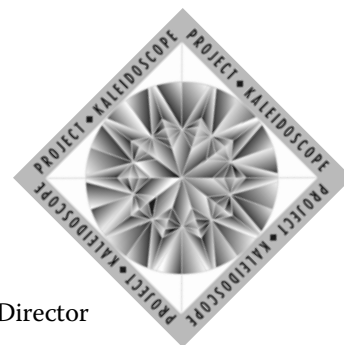
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# TABLE OF CONTENTS

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1	.....	Greetings
2	.....	Table of Contents
3	.....	Foreword
4	.....	<i>Qualities of Individual Leaders</i>
5	.....	<i>The Importance of Gifted Individuals</i>
6	.....	<i>Transformational Change</i>
7	.....	<i>Leadership Lessons Learned</i>
8	.....	<i>The Individual as a Change Agent</i>
9	.....	<i>Successful STEM Educational Innovators</i>
10	.....	<i>Informed Participation and Empowerment</i>
11	.....	Characteristics of the Ideal Leader (Tear-Out Grid)
15	.....	<i>Leadership in Undergraduate STEM</i>
16	.....	<i>A Willingness to Trust</i>
17	.....	<i>Community and Communication</i>
18	.....	<i>Open to Surprise</i>
19	.....	<i>Successful Inventors</i>
20	.....	<i>No Room for Mavericks?</i>
21	.....	<i>Understanding the Outstanding</i>
22	.....	Bibliography
23	.....	About the New PKAL Initiative
24	.....	About PKAL

There is a great body of literature addressing the theory and practice of leadership from the contextual as well as the personal perspective. Some of that wisdom— only the tip of the iceberg to be sure— is captured in these pages. Designed as a resource for those responsible for shaping the future of undergraduate science, technology, engineering and mathematics (STEM) at our nation's colleges and universities, this publication is the first of a series relating to PKAL's leadership initiative, 2004 - 2006.

A wondrous pattern begins to emerge from a review of these materials. Most speak about the ability of the leader to deal with what is not known or is unfamiliar, in the context of understanding the future and/or the current reality. Leaders are likened to inventors, in that they are comfortable working *on the margins of established knowledge* (The Lemelson-MIT Program).

Some essayists describe the importance of dealing with *mavericks* (Finzel) and the *outstanding positive deviants* within a campus community (Herschbach); others suggest the need to provide such *gifted individuals with enough rope* (Alberts) to ensure that creative solutions are found to problems not amenable to standard operating procedures.

Another dimension of focusing on the future that comes alive in these leadership materials relates to the structural changes needed to *move the system away from the status quo* (Fullan). This requires the ability to *scan the environment and identify emerging trends* (Hesselbein and Johnston) in order to bring about the *radical changes consistent with the new mindset* (Fullan).

Transforming systems calls for leaders who know how to foster collaborations that are enriched by the *multiple perspectives emerging through community discourse* (Arias et.al.), who involve *more rather than fewer people* (George), and *whose trust in colleagues is contagious* (Kouzes and Posner). Such collaborations thrive when the leader articulates a vision that *gives meaning and clarifies the organization's identity* (Northouse).

Leadership also has a personal side. Whether the analysis is from the theoretical or experiential perspective, certain characteristics are unmistakable, from being *risk takers and very hard workers* (Millar) to knowing *that there is life beyond the campus* (Denton).

The reality is that each of these dimensions of leadership must be integrated with integrity into the lives of leaders intent on ensuring the nation's undergraduate STEM programs— today and tomorrow— serve students, science and society most effectively.

We must work together *to promote cultural enrichment, creative expression, intellectual honesty, the advancement of knowledge, and personal freedom coupled with social responsibility* (Astin and Astin).

The vision is of an environment in which all American undergraduates have access to learning experiences that motivate them to persist in their studies and consider careers in these fields; it is of an environment that brings undergraduates to an understanding of the role of science and technology in their world. It is a vision that calls for attention to practices and policies that affect shaping the curriculum and building the human and physical infrastructure that calls for collective action.

— Project Kaleidoscope, 2002.

# QUALITIES OF INDIVIDUAL LEADERS

The environment in which we do and teach science continues to evolve rapidly. (Let me use “science” to stand for all fields associated with STEM.) The practice of science continues to change, moving farther and farther away from the old stereotype of a loner isolated in a lab (a stereotype that was probably never true) to a new model where the scientist is a member of a global network integrating information and data from a variety of sources in the pursuit of discoveries and applications in science and technology.

Our student population continues to change at an equally rapid rate. A review of demographics of today’s entering students suggests a greater diversity, in terms of gender, ethnic background, and preparation. More students are entering college than ever before, bringing a broader variety of pre-college preparations. This, and their wide-ranging interests and career aspirations, challenge us to rethink our undergraduate STEM programs designed to serve those interests and career aspirations.

– Robert C. Hilborn, Amherst College.

*From A Report from the Undergraduate Physics Community.*

In the broadest sense, we see the purposes of leadership as encompassing the following values:

- ♦ To create a supportive environment where people can grow, thrive, and live in peace with one another.
- ♦ To promote harmony with nature and thereby provide sustainability for future generations.
- ♦ To create communities of reciprocal care and shared responsibility where every person matters and each person’s welfare and dignity is respected and supported.

Leadership values are reflected, first and foremost, in the ends toward which any leadership effort is directed: What are we trying to change and why? What is the nature and scope of the intended change, and who will benefit? We believe that the value ends of leadership should be to enhance equity, social justice, and the quality of life; to expand access and opportunity; to encourage respect for difference and diversity; to strengthen democracy, civic life, and civic responsibility; and to promote cultural enrichment, creative expression, intellectual honesty, the advancement of knowledge, and personal freedom coupled with social responsibility.

Values also underlie the leadership process. Given our view that leadership is a group process whereby individuals work together in order to foster change and transformation, effective leadership necessarily requires: (a) that the group function according to certain principles and values, and (b) that individual members of the group exemplify certain qualities and values that contribute to the effective functioning of the group. These individual qualities are summarized below:

## Individual Qualities

- ♦ Self-knowledge. This quality means being aware of the beliefs, values, attitudes, and emotions that motivate one to seek change and transformation. It also implies an awareness of the particular talents and strengths, together with the personal limitations, that one brings to the leadership effort.
- ♦ Authenticity/integrity. This quality requires that one’s actions be consistent with one’s most deeply felt values and beliefs. It is perhaps the most critical factor in building trust within the leadership group.
- ♦ Commitment. This quality implies passion, intensity, and persistence. It supplies the psychic and physical energy that motivates the individual to serve, that drives the collective effort, and that sustains that effort during difficult times.
- ♦ Empathy/understanding of others. The capacity to “put yourself in the other person’s place” is critical to effective collaboration, building trust and resolving differences in viewpoint. It also requires the cultivation and use of what is probably our most neglected communication skill: listening.
- ♦ Competence. In the context of any group leadership activity, competence refers to the knowledge, skill, and technical expertise required for successful completion of the transformation effort.

– Alexander W. Astin, Helen S. Astin, University of California, Los Angeles.

*From Leadership Reconsidered: Engaging Higher Education in Social Change.*

# THE IMPORTANCE OF GIFTED INDIVIDUALS

If our universities [and colleges] are to adapt to the rapidly evolving world, they need bold and progressive leadership to fight the forces that typically resist change. I have developed a series of personal insights concerning the university system. They are:

- ♦ That irrational inertia, though inherent to large systems, can be overcome with creative effort.
- ♦ The importance of gifted individuals, and of keeping their groups small. If you want to accomplish something, gather a few people who really care to do it. In general, I find that larger committees accomplish less because of the conservative nature of the committee process.
- ♦ Provide enough rope. One means of overcoming inertia is through a delegation of responsibility— providing motivation for change by providing "rope." In other words, give small groups of faculty the flexibility to make changes and revisions in their domain of responsibility.
- ♦ That "naive" young intellectuals are critical in pushing the system into the future.
- ♦ The use of successful models, proving that the reforms successfully established at one place can be reestablished at other sites.
- ♦ The need for bribes, or "incentive funding," to create change. Leadership must use limited resources creatively to induce people to depart from their natural path of conservatism— basically, use a carrot rather than a stick to motivate change.

– Bruce Alberts, National Academy of Sciences.

From *PKAL Occasional Paper: What I Learned in Thirty Years at the University About Catalyzing Change*.

When we asked why students were not succeeding, several reasons surfaced: the need to work to afford college which took students away from studies; the lack of understanding of how to study; how faculty were presenting material in their classrooms. The fact that this was a young campus where people had been experimenting for years was important as we proceeded to tackle these problems. Our faculty (many of them, at least) were willing to try new things and to break down barriers to success.

Our faculty take the success of our students personally; their greater interactions with students in research laboratories and in study groups connected to introductory courses mean no students fall between the cracks, as previously. What a visitor to our campus will see now, as on any major research university, is all types of students from many different countries, working closely with faculty day in and day out. As part of this institution-wide effort, we have expanded and strengthened faculty development activities, particularly in regard to the uses of technology and web-based instruction.

– Freeman A. Hrabowski, University of Maryland, Baltimore County.

From *An Interview with a Leader: Freeman Hrabowski III, President, University of Maryland - Baltimore County*.

# TRANSFORMATIONAL CHANGE

By definition, experts have developed particular ways to think and reason effectively. Understanding expertise is important because it provides insights into the nature of thinking and problem-solving. It is not simply general abilities, such as memory or intelligence, nor the use of general strategies that differentiate experts from novices. Instead, experts have acquired extensive knowledge that affects what they notice and how they organize, represent, and interpret information in their environments. This, in turn, affects their abilities to remember, reasons and solve problems.

## Key conclusions:

- ◆ Experts notice features and meaningful patterns of information that are not noticed by novices.
- ◆ Experts have acquired a great deal of content knowledge that is organized, and their organization of information reflects a deep understanding of the subject matter.
- ◆ Experts' knowledge cannot be reduced to sets of isolated facts or propositions but, instead, reflects contexts of applicability, i.e., it is "conditionalized."
- ◆ Experts are able to retrieve important aspects of their knowledge with little intentional effort.
- ◆ Though experts know their disciplines thoroughly, this does not guarantee that they are able to instruct others about the topic.
- ◆ Experts have varying levels of flexibility in their approaches to new situations.

– John D. Bransford, Ann L. Brown,  
Rodney R. Cocking,  
National Research Council.

From *How People Learn: Brain, Mind, Experience, and School*.

Transformational leaders set out to empower followers and nurture them in change. They attempt to raise the consciousness in individuals and to get them to transcend their own self-interests for the sake of others.

To create change, transformational leaders become strong role models for their followers. They have a highly developed set of moral values and a self-determined sense of identity. They are confident, competent, and articulate, and they express strong ideals. They listen to followers and are not intolerant of opposing viewpoints. A spirit of cooperation often develops between these leaders and their followers. Followers want to emulate transformational leaders because they learn to trust them and believe in the ideas for which they stand.

It is common for transformational leaders to create a vision. The vision emerges from the collective interests of various individuals and units within an organization. The vision is a focal point for transformational leadership. It gives the leader and the organization a conceptual map for where the organization is headed; it gives meaning and clarifies the organization's identity. Furthermore, the vision gives followers a sense of identity within the organization and also a sense of self-efficacy.

Transformational leaders also act as change agents who initiate and implement new directions within organizations. They listen to opposing viewpoints within the organization as well as threats to the organization that may arise from outside the organization. Sometimes leaders generate instability themselves through nurturing the expression of discordant viewpoints or issues. Out of the uncertainty, transformational leaders create change.

The transformational approach also requires that leaders become social architects. This means they make clear the emerging values and norms of the organization. They involve themselves in the culture of the organization and help shape its meaning. People need to know their roles and understand how they are contributors to the greater purposes of the organization. Transformational leaders are out front in interpreting and shaping for organizations the shared meanings that exist within them.

– Peter G. Northouse, Western Michigan University.

From *Leadership: Theory and Practice (2nd ed.)*.

# LEADERSHIP LESSONS LEARNED

There are both pitfalls and benefits to being a change agent. The pitfalls include notoriety; you are under a microscope if you are different in looks and in approach (A belief in the value of diversity is another reason that I took the risk of being a change agent!). Another pitfall is that there is lots of negative feedback, and many people expect you to fail. The challenge, the external challenge, is to educate senior colleagues; the internal challenge is to be able to endure cynical and critical comments and attitudes.

But the benefits of being an agent of change are very real also, including notoriety, believe it or not. There is a self-satisfaction in knowing that you are doing something you love, and that you might be beginning to change the system. With each success your confidence builds.

Early in my career I learned to choose my battles; I learned to go beyond departmental colleagues and the college. I also learned to stay centered, to keep focusing on what was important to me; finally, I learned to ignore lots of negative feedback, but to be reasonable enough to be able to sift the positive from the negative. The keys were my ability to identify allies- wherever they might be, to be politically aware, and to learn how to work collaboratively. Perhaps most important, I learned to connect my work as a change agent to my work as a scholar; I did not forget my disciplinary home.

There were also other important lessons I learned: the importance of keying into national efforts in regard to educational transformation; that there is life beyond tenure and departmental politics. So, I leave you with some final words of advice:

- ♦ Do not over-prepare.
- ♦ Do not burn any bridges.
- ♦ Know the rules of the system, but also know that rules must sometimes be broken.
- ♦ Do not believe everything you hear.
- ♦ Do not say 'yes' to everyone and everything- be selective.
- ♦ Do not worry about upsetting some people some of the time.

## What you should do is:

- ♦ Learn how to delegate, empower, and relinquish control.
- ♦ Have a backup plan- and plan ahead.
- ♦ Leave all options open.
- ♦ Develop and sustain a support network.

## Choose your battles:

- ♦ Cultivate allies, mentors and colleagues in and beyond your campus.
- ♦ Understand the formal organizational chart of your community.
- ♦ Get the lay of the land- understand the folk wisdom of your community.

– Denice D. Denton, University of Washington.

From *On Being a Change Agent in SME&T Education*.

Many leaders search for years, even decades, to find the purpose for their leadership. It is relatively easy to state your purpose early in life, but much harder to develop passion for it. Passion for your purpose comes when you are highly motivated by your work because you believe in its intrinsic worth, and you can use your abilities to maximum effect.



*Come, come my friends.  
'Tis not too late to seek a newer world...  
That which we are, we are-  
One equal temper of heroic hearts,  
Made weak by time and fate, but strong in will  
To strive, to seek, to find, and not to yield.  
– Alfred, Lord Tennyson, "Ulysses."*

– Bill George.

From *Authentic Leadership: Rediscovering the Secrets to Creating Lasting Value*.

# THE INDIVIDUAL AS A CHANGE AGENT

- ♦ It is important to understand what role you would like to play, and could best play, in the process of change. Becoming a leader does not necessarily mean one has to be out in front banging the drum. Further, realizing the value of listening gives one the opportunity to step back and understand what is going on before proposing personal solutions to the task at hand.
- ♦ Change is not sustainable unless and until it is seen as advancing the work and goals of the vast majority of stakeholders. (Doing no harm is not sufficient.) Further, the future benefits of the new initiative must manifestly justify the reallocation of existing and future resources. Basically, the change has to be, or become, what everyone wanted to do anyway, even if they didn't know it at first.
- ♦ Revitalizing undergraduate STEM is a complex problem. To paraphrase H.L. Mencken: for every complex problem, there is a simple solution, and it is wrong. While institutions, both local and national, play a role, changes that "stick" are carried out in reality by academic departments, energized by faculty leadership and collegiality, in a complex interplay that recognizes and understands local missions and local constraints while keeping an eye on high standards set by the national STEM community.

– PKAL National Steering Committee.

From *A PKAL Essay: Leaders: Lessons Learned*.

There are two basic reasons why every person working in an enterprise committed to making continuous improvements must be change agents with moral purpose. First, since no one person can possibly understand the complexities of change in dynamically complex systems, it follows that we cannot leave the responsibility to others. Second, and more fundamental, the conditions for the new paradigm of change cannot be established by formal leaders working by themselves. Put differently, [everyone] has the responsibility to help create an organization capable of individual and collective inquiry and continuous renewal, or it will not happen.

Formal leaders in today's society are generated by a system that is operating under the old paradigm. Therefore, they are unlikely to have the conceptions and instincts necessary to bring about radical changes consistent with the new mindset...

It is only by individuals taking action to alter their own environment that there is any chance for deep change. The 'system' will not, indeed cannot, do us any favours. If anything, the educational system is killing itself because it is more designed for the status quo while facing societal expectations of major reform. If teachers and other educators want to make a difference, and this is what drives the best of them, moral purpose by itself is not good enough. Moral purpose needs an engine, and that engine is individual, skilled change agents pushing for changes around them, intersecting with other like minded individuals and groups to form the critical mass necessary to bring about continuous improvements.

– Michael Fullan, University of Toronto.

From *Change Forces: Probing the Depths of Educational Reform*.

# SUCCESSFUL STEM EDUCATIONAL INNOVATORS

Certain general personality features stand out as common to the successful STEM education faculty innovators. They are risk takers and very hard workers. They make commitments and stick with them to the end. Many are inspired by a sense of mission. And they are savvy and persistent about obtaining resources, including moral and material support from proactive administrators and external funding agencies. They take pride in doing a good job for their students and often for their departments, disciplines and/or institution as well.

## Attitudes & habits of interpersonal interaction

Many people can, however, be described by the general characteristics listed above. Thus, while perhaps necessary, these general features certainly are not exclusive to successful STEM education innovators. That is, they are not defining characteristics. By contrast, I believe that unless a person has the characteristic attitudes and habits discussed below, they will not be in this group of successful STEM innovators.

- ♦ Their identity as a scholar does not depend on placing themselves above other faculty members, academic staff, graduate students or undergraduates (Wilshire, 1990). Accordingly, they listen respectfully to students ("there are no dumb questions"), [they] strive to build on students' questions and ideas, and quickly recognize and are delighted by the occasional startling insight that a student presents.
- ♦ These faculty not only are comfortable admitting to students when they don't know something or made a mistake, but also value these situations as opportunities to engage their students in the kind of problem solving that is central to the scientific process. These educators are at least as interested in teaching the process by which discoveries are made as the outcomes of those discoveries.
- ♦ They view students not as "outsiders" but as less experienced potential peers. That is, they trust students. Accordingly, they design their courses and interact with students with a "we're in this together" attitude. Viewing students as novice potential members of their communities, they include them in the real talk and real work of these "communities of practice" (Lave & Wenger). They therefore do not view maintaining constant control of the classroom as a virtue, but rather seek out ways to give students at least some decision-making power.
- ♦ In contrast to faculty who consider teaching a burden ("teaching load") to be accomplished in the least amount of time possible, these individuals feel genuinely excited about students and teaching. They enjoy seeing their students learn, and take a certain pride in their students' accomplishments.

– Susan B. Millar, University of Wisconsin, Madison.

From *Characteristics of Successful STEM Education Innovators*.

I am a hard-core experimental physicist, and so I always believe that it is absolutely essential to have an unbiased evaluation of what the data is telling you. I have learned that it is very important to see what is really there when you do an experiment and not simply see what you are looking for. It became increasingly clear to me that when evaluating the effectiveness of most physics teaching, if one stripped away the triple biases of ancient tradition, how we were taught as students, and what we wanted to see, the results looked pretty dismal.

I looked at teaching as part of my job, and I wanted to do that job well. I came to realize that I was not doing it well, nor were most of the physics profession. Over time I have also become increasingly aware of the importance of science and technology to our modern society and the resulting dangers of doing such a poor job of teaching it to our citizens. Finally, I was also struck by the contrast between the meager understanding of physics most students got from taking years of physics courses compared with the almost routine caterpillar-to-butterfly like transformation into skilled physicists that I could observe in graduate students working with me on research.

The combination of these factors drove me to tackle the challenges of improving physics education. Perhaps the closest contact with my actual research was that it allowed me to look carefully at how and why students in the research lab learned so successfully, and so I could use this information to attempt to get something of those same factors into the completely different environment of the classroom.

– Carl E. Wieman,  
University of Colorado, Boulder.

From *Interview: NSF 2001 Distinguished Teaching Scholars- Dr. Carl E. Wieman*

# INFORMED PARTICIPATION AND EMPOWERMENT

Reform will require concerted action by faculty, administrators, professional societies and other educational organizations, foundations, industry, and government. The process begins with faculty and administrators. [We urge] each academic institution to critically review how it educates its future biologists. Departmental retreats are a good setting for an initial examination of current educational objectives, practices, and outcomes. The circle should eventually be broadened by inviting faculty from different departments to come together with administrators and discuss aspirations and goals for the coming decade. The resources needed to effect these changes must be clearly defined and a realistic path must be charted to complete the planning stage. University administrators will need to actively support faculty development and remove barriers to interdisciplinary teaching, a key aspect of enhancing undergraduate education. Departments and colleges must find new ways to help individual faculty and academic departments innovate and reward their efforts in creating, assessing, and sustaining new educational programs. For example, faculty interested in adapting teaching approaches for their own use or in creating new teaching materials should have lighter than normal requirements for teaching, research, or service while actively engaged in such projects.

– National Research Council.

From *Bio 2010: Transforming Undergraduate Education for Future Research Biologists*.

A challenge for supporting informed participation is in providing a mechanism allowing various participants to integrate their perspectives in a meaningful way. To do so, it is important to support the process of reflection-in-action. As participants act upon a problem, breakdowns occur due to incomplete understanding of the underlying problem, conflicts among perspectives, or the absence of shared understanding. By supporting the process of reflection within this shared context, opportunities arise for building upon these breakdowns in ways that integrate the various perspectives and expertise, while enhancing shared understanding. Supporting informed participation requires processes that integrate the individual and the group knowledge through collaborative constructions. Information spaces need to be constructed collaboratively and integrated into the work and social practices of the community. These collaborative constructions result in work products that are enriched by the multiple perspectives emerging through community discourse.

## **Requirements for systems supporting informed participation and empowerment**

Effectively supporting informed participation and empowerment is a socio-technical problem in which the social support and the technical infrastructure for [solving] open-ended problems go hand in hand.

By providing the opportunity for people to change systems, we encourage users to become owners of problems. Of course, not all users want to be intimately involved in all phases of a problem-solving activity. Fostering communities where individuals can spontaneously find appropriate roles and responsibilities is extremely important. However, people are not going to accept responsibility without an understanding of what costs, benefits, and other motivating factors they will encounter. People are motivated to participate if a problem affects them and if they see a benefit to participating. Supporting authentic problems in which people have a personal stake is an essential part of motivating a community. There must also be a reward for investing time and effort to becoming knowledgeable enough to act as designers. The nature of these rewards may range from a feeling of control over the problems, to being able to solve or contribute to the solution, a passion to master tools in greater depth, an ego-satisfying contribution to a group, or a sense of good citizenship in a community.

– Ernesto Arias, Hal Eden, Gerhard Fischer, Andrew Gorman and Eric Scharff, University of Colorado, Boulder.

From *Beyond Access: Informed Participation and Empowerment*.

# CHARACTERISTICS OF THE IDEAL LEADER

## Instructions:

The *Characteristics of the Ideal Leader* inventory, designed by PKAL, will provide insight about your strengths and your potential as a leader.

For each of the characteristics described below, rate your current leadership style on a scale of 1-5: 1 signifying that this is not a characteristic of your current style; 5 signifying that this is very much a characteristic of your current style.

After completing the Inventory, you should identify a handful of key leaderships traits that are both critical and lacking at this time. With these growth areas identified, we suggest keeping a journal of your efforts to incorporate the targeted traits into your professional life. You may want identify someone you know who truly exhibits the chosen leadership characteristics and interview them. Reassess your targeted characteristics six months after the initial assessment.

In addition, PKAL is currently compiling essays from leaders in STEM fields on how these characteristics have made them effective leaders. These essays are available at <http://www.pkal.org/>, and can be illustrative for others. We also invite you to send PKAL a synopsis of some of your more thought-provoking journal entries to share with others on the PKAL website.

We encourage faculty members also to use this template as a catalyst for change with their campus administrators. Both you and your chair, for example, might complete this inventory on yourselves and each other and then have a conversation about the results.

This Inventory will be expanded and used as a major tool for campus teams collaborating in the PKAL Initiative, 2004-2006.

"Qualities of Individual Leaders" Leaders:	How do I rate myself on these characteristics of the ideal leader?
are aware of their particular talents & strengths	1 2 3 4 5
require that their actions be consistent with their most deeply felt values & beliefs	1 2 3 4 5
have the capacity to "put themselves in another person's place"	1 2 3 4 5
have the knowledge, skill, & expertise required to complete the transformation	1 2 3 4 5

"The Importance of Gifted Individuals" Leaders must:	How do I rate myself on these characteristics of the ideal leader?
overcome inertia by identifying and supporting gifted individuals	1 2 3 4 5
provide enough flexibility to make changes	1 2 3 4 5
capture the lessons learned from successful models emerging elsewhere	1 2 3 4 5
use limited resources creatively to affect change (a carrot rather than a stick)	1 2 3 4 5

# CHARACTERISTICS OF THE IDEAL LEADER

“Transformational Change” Transformational leaders:	How do I rate myself on these characteristics of the ideal leader?
are strong role models	1 2 3 4 5
create vision	1 2 3 4 5
listen, but also initiate	1 2 3 4 5
understand organizational culture	1 2 3 4 5

“Leadership Lessons Learned” Change agents:	How do I rate myself on these characteristics of the ideal leader?
do not over-prepare	1 2 3 4 5
do not burn any bridges	1 2 3 4 5
learn how to delegate, empower, relinquish control	1 2 3 4 5
leave all options open and choose their battles	1 2 3 4 5

“The Individual as a Change Agent” A change agent:	How do I rate myself on these characteristics of the ideal leader?
belongs to an organization capable of individual and collective inquiry	1 2 3 4 5
is a change agent with a moral purpose	1 2 3 4 5
intersects with like-minded colleagues to bring about continuous improvements	1 2 3 4 5
understands the system	1 2 3 4 5

“Successful STEM Educational Innovators” An education innovator:	How do I rate myself on these characteristics of the ideal leader?
is able to take risks, inspired by a sense of mission	1 2 3 4 5
is savvy and persistent about obtaining resources, can maneuver around constraints	1 2 3 4 5
is a proactive and pragmatic problem-solver	1 2 3 4 5
is a member of cross-institutional networks	1 2 3 4 5

# CHARACTERISTICS OF THE IDEAL LEADER

“Informed Participation and Empowerment” Informed participation and empowerment requires:	How do I rate myself on these characteristics of the ideal leader?
providing a mechanism allowing integration of various perspectives in a meaningful way	1 2 3 4 5
supporting the process of “reflection in action”	1 2 3 4 5
encouraging users to become owners of problems	1 2 3 4 5
informing participants about the cost, benefit, and other factors affecting change	1 2 3 4 5

“Leadership in Undergraduate STEM” Leaders can successfully:	How do I rate myself on these characteristics of the ideal leader?
leverage and capitalize on the work of innovators	1 2 3 4 5
translate an idea into action	1 2 3 4 5
focus on the learner and have clear insights about how people learn	1 2 3 4 5
learn from failures, understanding the limitations of their work	1 2 3 4 5

“A Willingness to Trust” Leaders are ready to:	How do I rate myself on these characteristics of the ideal leader?
admit mistakes	1 2 3 4 5
listen attentively to what others have to say	1 2 3 4 5
show they are willing to change their mind	1 2 3 4 5
trust others, trust is contagious	1 2 3 4 5

“Community and Communication” Leaders:	How do I rate myself on these characteristics of the ideal leader?
are inclusive	1 2 3 4 5
don't hesitate to ask for advice	1 2 3 4 5
make sure a communication plan is complete	1 2 3 4 5
communicate with more rather than fewer	1 2 3 4 5

# CHARACTERISTICS OF THE IDEAL LEADER

“Open to Surprise” Leaders:	How do I rate myself on these characteristics of the ideal leader?
are receptive to what comes over the transom	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
are wired to perceive the unexpected	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
can scan the environment and identify emerging trends	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
work consciously to develop diversity of thought	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

“Successful Inventors” Innovators:	How do I rate myself on these characteristics of the ideal leader?
are resourceful and resilient	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
show a commitment to practical action	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
have a high tolerance for complexity and ambiguity	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
are comfortable working on the margins of established knowledge	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

“No Room for Mavericks?” Mavericks:	How do I rate myself on these characteristics of the ideal leader?
are willing to bring fresh blood into the equation	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
recognize those earning the right to be heard	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
give other mavericks opportunity and time to blossom	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
do not control all important decisions at the top	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

“Understanding the Outstanding” To achieve well beyond expectations:	How do I rate myself on these characteristics of the ideal leader?
exceptional people and practices should be leveraged	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
understand that change can be brought about from within	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
identify ways to improve performance and working conditions	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
identify and build from positive outliers	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5

# LEADERSHIP IN UNDERGRADUATE STEM

The lessons for leaders is that at the same time as projects continue to evolve, the internal and external environments also change. Everything is volatile; leaders have to monitor and respond to such changing environments to ensure that innovative solutions do not have short lives. It is the responsibility of leadership to be able to capitalize and leverage reforms, to support the work of innovators on their campus by signaling that the results of working together can be sustained. Visionary leaders generate such a community.

Other changes occur because of successful reforms. Those who have taken the lead in the reform effort learn something about the process of change, about how to translate an idea into action. They have better insights about how students learn, about how to help students internalize an affection for science and mathematics. Success breeds success; those who have wrestled creatively and productively with one problem, arriving at a successful solution, are more confident in moving ahead.

But, more than from success, reformers learn from their failures; this is part of what being researchers mean— we learn from the limitations of our work. And in examining our failures, we find larger impediments to access and reform that cannot be fixed with our particular solution. When you analyze failures further, you find courses that effectively do not work, and no one had ever known they did not work; you find internal contradictions and limitations in the curricular structure, subtle problems in the way math and science is taught. For example, the curriculum is structured with a kind of verticality that is not found in the discipline, that does not reflect what the discipline is like. In reality (for example), mathematics is a bushy field. Mathematicians run around and make connections; they dig deep holes. The curriculum as presented is more vertical than the discipline is in reality, and this is one of the impediments that restricts access. We are not introducing students to the real world of science and mathematics, which should be our goal.

– P. Uri Treisman, University of Texas, Austin.

From *On Leadership in STEM*.

...it is a characteristic of science that it is a cooperative effort. It is not simply the speculation of some sage or scholar in the privacy of his study. Science of any kind is a matter of teamwork between specialists who have soaked themselves in their subject, who live together, who criticize one another's ideas, each of whom makes an individual, although quite often imperceptible, contribution to the totality of knowledge and understanding. Very occasionally an outstanding thinker may emerge who has insights which will short-circuit the patient studies of the professionals. But such outstanding thinkers are unusual. So failing the great mind, science has to be developed by the interplay of average minds, one hopes, rather above average. It progresses by dialogue and teamwork.

– Sir Michael Howard.

From *Military Science in an Age of Peace*.

# A WILLINGNESS TO TRUST

The most gifted leaders understand that the needs of people cannot be fully plumbed by asking them what they want or why they want it. One of the deepest truths about the cry of the human heart is that it is so often a cry that is never uttered. There are needs and feelings we express quite openly; lying deeper are emotions we share only with loved ones, and deeper still the things we tell no one. We die with much unsaid. It is strange that members of a species renowned for communicative gifts should leave unexpressed some of their deepest yearnings, their smoldering resentments, their worries and secret hopes, their longing to serve a higher purpose.

As a consequence, beneath the surface of most constituencies are dormant volcanoes of emotion and motivation.

The greatest poets, novelists and playwrights have always tapped those underground sources. They have always given expression to the unexpressed, have always had transactions with the hidden element in the souls of their audiences. The ablest leaders share that gift of understanding and carry on similar transactions. So do the most inspired religious teachers.

Some of the dormant emotions can be extremely destructive. But leaders should know what is there.

– John W. Gardner.

From *On Leadership*.

Building trust is a process that begins when one party is willing to risk being the first to open up, being the first to show vulnerability, and being the first to let go of control. Going first requires considerable self-confidence. If you, as the leader, show a willingness to trust others with information (both personal and professional), constituents will be more inclined to overcome any doubts they might have about sharing information. Trust is contagious. And distrust is equally contagious. If you exhibit distrust, others will hesitate to place their trust in you and in their colleagues. It's up to you to set the example. To promote trust throughout the organization, be the first to:

- ◆ Disclose information about who you are and what you believe.
- ◆ Admit mistakes.
- ◆ Acknowledge the need for personal improvement.
- ◆ Listen attentively to what others are saying.
- ◆ Invite interested parties to important meetings.
- ◆ Share information that's useful to others.
- ◆ Openly acknowledge the contributions of others.
- ◆ Show that you're willing to change your mind when someone else comes up with a good idea.
- ◆ Avoid talking negatively about others.
- ◆ Say, "We can trust them," and mean it!

– James M. Kouzes, Barry Z. Posner, Santa Clara University.

From *The Leadership Challenge*.

*The Leadership Challenge*.

Kouzes, James M., Posner, Barry Z. San Francisco, CA: Jossey-Bass, 2002.

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# COMMUNITY AND COMMUNICATION

A communications plan must reflect the particular campus culture and traditions, because these will influence how people "hear" the messages sent out about the proposed ideas and the credibility given to them.

Key to a successful communications plan is anticipating questions or criticisms. You should have ready access to data or other information to answer anticipated questions. Although it may not be possible at the beginning to be very specific about applicability to your campus and situation, information about the experiences of peers (both processes and outcomes) can be informative. Gather available research evidence, assemble information about student patterns of enrollment, persistence, achievement, and interest, pull together data about faculty workloads, perceptions, expertise, and open positions, if appropriate. There should be careful projections of financial needs and implications as well as realistic expectations about outcomes.

Anticipate questions and objections from each of the potential constituencies, and have the information at hand to respond; be sure there are no potentially embarrassing gaps.

Decide who should communicate with whom, based on the audience and the topic. In general, as long as the messages are consistent, it is better to have more rather than fewer people involved in the process of communicating.

## Test your plan:

- ♦ Look at the organizational chart or telephone directory of offices for your campus. Be sure no important unit or person has been forgotten; when in doubt, include them.
- ♦ Review the plan with the initial project team and identify any gaps in the process or people.
- ♦ Contact a trusted colleague at another institution, preferably someone with experience with a similar effort, and ask for his or her advice and critique.
- ♦ If an unexpected obstacle to effective communication arises - as it will - try not to be defensive.
- ♦ Admit mistakes; apologize when necessary and keep a sense of humor, especially about yourself and within your group.

– Melvin D. George, University of Missouri System Administration.

From *Leaders Need to Communicate*.

As you plan, you will be building community by clarifying institutional goals, thinking toward an enhanced image for the sciences and mathematics on your campus. You will be arriving at a community in which there is a predisposition to share ideas, challenge precepts, and revel in exploring unfamiliar territory with colleagues—activities that are standard ways of operating for communities of research scientists. Think about how a true community exhibits the willingness, even the drive, to discuss matters of the moment informally with colleagues in the lounge, or to explore issues in formal, regular sessions with peers.

Community is the spirited enactment of the conviction that ideas are important, and that they gain life when people bring different perspective to their consideration. Communities embrace a common vision, yet allow— even promote— difficult dialogues. This is the challenge to leaders, within the faculty and administration, as your planning proceeds. Planning takes a long time. All involved must make a personal commitment to take the time to wrestle, individually and collectively, with questions about educational goals, about the nature of community, and be ready and willing to bring particular experiences and expertise to the large campus-wide discussions on these issues.

– Jeanne L. Narum, Project Kaleidoscope.

From *A PKAL Essay: Planning, Leadership & Community*.

# OPEN TO SURPRISE

The role of the chief academic officer is to keep focused on the central mission of the institution and at the same time to be aware of new opportunities and challenges at the edges. Harkening back to my roots in biology, and at some inspired or maniacal moment, I likened the college to an amoeba, an organism with an essential integrity, but one whose shape regularly changes, especially at the edges. And I likened my role as that of overseer of the feeding and caring for the amoeba. I was trying to reconcile what can be thought of as antithetical notions: stability and integrity of purpose versus vitality and embracing change. A college or university, and its academic program, must do both: have a core purpose, maintain its identity and be flexible, sense changes in the environment and be able to respond effectively. So in my mind's eye through the microscope, there is the amoeba, ruffling its membrane, streaming its cytoplasm, advancing pseudopod here and there, re-centering itself behind its advancing edge. Through all that, it is still recognizably an amoeba doing its thing. The role of leaders is to expect that the shape will – actually must – change, to anticipate that there will be environmental perturbations (periods of starvation and periods of nutrient surplus) and be ready to move toward new opportunities.

– Elizabeth S. Boylan, Barnard College.

From *Interview: A Kaleidoscope of Perspectives*.

Every organization needs to have a systematic approach to examining the future. At the same time its leaders must look for today's unexpected success. That is usually the best way to spot new opportunities.

These are what [Peter] Drucker calls the right hand of disciplined thinking and the left hand of openness to surprise. He uses the phrase "being receptive to what comes in over the transom." This receptivity must start at the top. Yet few organizations are full of senior executives who enjoy the unexpected. This is not surprising. After all, who generally gets promoted in organizations? The good problem solvers, people who value predictability and control.

This poses a practical issue about how we identify and develop people for leadership positions. The fact is, most organizations and most people, are not wired to readily perceive the unexpected. Most of us would agree that it is important for senior executives to continually scan the environment, talk to customers, get a sense of the market and the times, identify emerging trends. However, it's extraordinarily hard for us to do this.

Our perceptions of the world are based on past experience and the mechanics of cognition. Most successful organizations don't adapt to waves of change simply because they cannot see those waves coming.

That is why diversity is a core leadership issue. Ultimately this goes beyond racial, ethnic, or gender diversity, although it includes them. It has everything to do with how we see the world. I believe successful organizations of the future will work consciously to develop diversity of thought. But this will be different for Machine Age organizations, dominated by the tendency toward homogeneity, a norm instilled by the assembly line. Machine Age organizations tend to fall back on their established ways of seeing the world, largely because they are so homogenous in their outlook. Organizations and communities need many eyes. Only by working with people who see things differently can we be truly open to surprise.

– Frances Hesselbein and Rob Johnston, The Drucker Foundation.

From *On Leading Change: A Leader to Leader Guide*.

# SUCCESSFUL INVENTORS

Effective inventors tend to display personality characteristics including resourcefulness, resilience, a commitment to practical action, nonconformity, passion for the work, unquenchable optimism, high persistence, high tolerance for complexity and ambiguity, willingness to delay gratification, and a critical stance toward their own work. They are able to embrace failure as a learning experience. Successful inventors are self-critical of their own work. They learn to abandon knowledge that may be too constraining, and they embrace failure as a learning experience. They show an alertness to practical problems and opportunities and an ability to match their talents with the problem using a tool kit of effective ways to conceptualize and break down the problems.

Characteristically, inventors are deeply knowledgeable about their areas of endeavor, on both a theoretical and “hands-on” basis, while they are also comfortable working on the margins of established knowledge.

Many of these traits are characteristic of high performance of almost any sort, and several mark most creative endeavors. A few, such as alertness to practical problems and opportunities as well as a mix of scientific and hands-on knowledge, are fairly specific to technological invention. It is important to emphasize the dispositional side of the inventive mind—the alertness to problems and opportunities, the curiosity, the enthusiasm, the commitment. While many accounts of inventors and inventive thinking place in the foreground knowledge and abilities of various sorts that swing into operation as a problem is solved, it is especially notable that inventiveness is not just a matter of knowledge and ability. The dispositional side of invention is crucial.

– The Lemelson-MIT Program, Massachusetts Institute of Technology.

From *Invention: Enhancing Inventiveness for Quality of Life, Competitiveness, and Sustainability*.

Reconnecting thinking and acting and developing reflective practitioners represents a profound design challenge for postindustrial colleges and universities. It will require a willingness to rethink and reinvent the basic institution of higher education. To what extent should students spend their time at the university versus in the “real world”? How much of the educational process should be project based? How much should students work in teams, learning with and from one another, versus individually? How can we come to value practical knowledge on an equal footing with theoretical knowledge, and what types of research and educational processes are needed to enable the two to enrich one another? What types of relationships will have to develop between the university and the larger community of profit and nonprofit institutions to make this happen? What does all of this mean for the nature of a teacher’s work in the future?

– Peter M. Senge,  
Massachusetts Institute of Technology.

From *The Academy as a Learning Community: Contradiction in Terms or Realizable Future?*

# NO ROOM FOR MAVERICKS?

This is not to pretend that the universities have either wholesale solutions to humanity's ills or a monopoly on skills to address them. Universities are human creations, full of human imperfections, with as much sloth, envy, malice, and neglect as any other community and rather more than their share of pettiness, arrogance, and pride. But it is to assert that the universities, with all their imperfections, represent the crucible within which our future will be formed. Boiling, steaming, frothing at times, a new amalgam must somehow be created within them if we are to surmount our social problems and rediscover the civic virtues on which our society depends. And as leaders in every field of endeavor are educated within their walls, as knowledge is increased within their laboratories, new works created within their studios, and professional practice developed and refined within their facilities, so the universities provide each new generation of leaders, educated, influenced, and shaped within the culture of the campus. It is this emerging community—analytical and affirming, critical and creative, inclusive and inquiring, engaged and enabling—that will be the new university. And it is this new university that must be challenged and enabled to play an increasingly influential role in the creation of the future.

— Frank H.T. Rhodes, Cornell University.

From *The New University*.

Let me make a plea with all of you who are in older institutions, to aim for flexible response amid policies and procedures. If you're on the board and in control, take some risk and bring some fresh young blood into the equation. You will be amazed what a few new faces can bring to a stagnant group of people. But give them room to succeed.

## **How to recognize legitimize mavericks who can bring you into the future:**

- ◆ They care not just for their own ideas but for the goals of the organization.
- ◆ They are making a difference in their present position.
- ◆ They are willing to earn the right to be heard.
- ◆ Others are following their leadership— influence is taking place and it is producing good results.

## **How to encourage the true mavericks who can help you:**

- ◆ Give them a long tether— they need space to soar.
- ◆ Put them in charge of something they can really own.
- ◆ Listen to their ideas and give them time to grow.
- ◆ Let them work on their own if they wish.
- ◆ Leave them alone and give them time to blossom.

## **How to discourage the true mavericks who can help you:**

- ◆ Have as many layers of management as possible for decisions to have to travel through.
- ◆ Keep looking over their shoulders.
- ◆ Make your policy manual as thick as possible.
- ◆ Control all important decisions at the top.
- ◆ Send everything possible to committees for deliberation.
- ◆ Always make them wait months for decisions that affect them. Put them on a team full of small-thinking bureaucrats.

— Hans Finzel.

From *The Top Ten Mistakes Leaders Make*.

# UNDERSTANDING THE OUTSTANDING

Beyond assessment looms the challenge, beset by familiar obstacles, of accomplishing significant and lasting change in institutions grown accustomed to modest or miserable performance. A strategy for such reform focuses on "positive deviants." This involves identifying exceptional people or practices that are already successful within an organization or community and devising means to amplify their impact. Inducing in this way change "from within rather than from without" has proven remarkably effective in reducing malnutrition of children in Vietnam and other poor countries. The same approach is now being increasingly applied to contend with other daunting societal problems as well as to enhance the performance of manufacturing or marketing firms.

[Jerry] Sternin points out that "Most corporate change efforts resemble traditional development efforts: they focus on defining the organization's needs, and then they try to fulfill those needs by introducing resources and "best practices" from the outside. Often, though, the members of the organization resist the external solutions, and the desired performance gains prove either unattainable or fleeting." Now, however, companies and management-consulting groups are beginning to identify ways to improve performance and working conditions. Sternin<sup>1</sup> cites the case of a pharmaceutical company: "[It had believed] that the more reps you had and the more calls you made on customers, the more you would sell. However, the positive deviants within the company, the most successful units, had fewer salespeople [and] made only one-third the usual number of visits to customers per day... These reps were spending far more time with individual doctors, educating them on the benefits and uses of the products...and they were outselling the others by a big margin."

The strategy of amplifying positive deviants is itself in accord with the pragmatic and "hands-on" precepts of scientific research. It emphasizes the key role of "outliers," whose example can empower a community or institution to achieve performance well beyond presumed limits.

– Dudley R. Herschbach, Harvard University.

From *Understanding the Outstanding: Zipf's Law and Positive Deviants*.

<sup>1</sup> David Dorsey, "Positive Deviant," *Fast Company* 41 (December 2000): 284; on web at <http://www.fastcompany.com/online/41/sternin.html>

Scientists do not discover in order to know, they know in order to discover. The inversion of purpose is more than just a trait; it is the essence of the matter. Humanists are the shamans of the intellectual tribe, wise men who interpret knowledge and transmit the folklore, rituals, and sacred texts. Scientists are the scouts and hunters. No one rewards a scientist for what he knows. Nobel prizes and other trophies are bestowed for new facts and theories he brings home to the tribe. One great discovery and the scientist himself is great forever, no matter how foolish the rest of his deeds and pronouncements. No discovery, and he will probably be forgotten, even if he is learned and wise in matters scientific.

Scientists therefore spend their productive lives struggling to reach the edge of knowledge in order to make discoveries. David Hilbert, the most successful mathematician of the early 1900's, stated the rules very well: "So long as a branch of science offers an abundance of problems, it will stay alive; a lack of problems foreshadows extinction or the cessation of independent development."

– E.O. Wilson, Harvard University.

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# ABOUT THE NEW PKAL INITIATIVE

Project Kaleidoscope announces a new initiative- a three-year, coordinated series of activities focusing on developing on-campus leaders for the work of building and sustaining strong undergraduate STEM learning communities.

PKAL's experiences in disseminating best practices for improving individual courses, developing new programs, identifying and nurturing individual faculty leaders, and shaping new spaces for science are the foundation for this new initiative. PKAL's portfolio of activities— workshops, leadership institutes, web and print publications, consultancies, etc.— has been reshaped to serve this initiative.

The premise for this PKAL leadership initiative is that if the current momentum to transform the undergraduate STEM learning environment is to be sustained there must be:

- ◆ An informed cadre of leaders taking advantage of new opportunities facing their campus community, now and into the future.
- ◆ Buy-in at the institutional level to support the work of these leaders.
- ◆ Persistent opportunities to learn from and adapt lessons learned by those having documented success in changing the culture, arriving at policies, practices and programs that succeed— over the long-term— in supporting strong undergraduate STEM programs.

We are convinced that the best way to nurture 21<sup>st</sup> century leaders is to link theory and practice, to integrate discussions about the roles and responsibilities of institutional leaders into the work of tackling a specific opportunity facing their community, and to provide time for reflection and action. We believe taking the kaleidoscopic perspective on reform is the right approach.

We have identified four "umbrella" opportunities around which to shape this new PKAL initiative.

## **OPPORTUNITIES FOR 21ST CENTURY STEM LEADERS**

### **RESEARCH-RICH**

That all students have access to a research-rich learning environment that socializes them into the community of science.

### **INTERDISCIPLINARY**

That the increasingly interdisciplinary manner in which science is practiced is reflected in the environment in which science is learned.

### **TECHNOLOGICALLY-INTENSIVE**

That emerging technologies are used most creatively and effectively in the service of learning.

### **SCIENCE FOR ALL**

That STEM learning is an integral part of the undergraduate experience for all students, preparing them for responsible citizenship in a world increasingly influenced by science and technology.

# ABOUT PKAL

## HISTORY

Project Kaleidoscope (PKAL) began in 1989 with support from the National Science Foundation to outline an agenda for the reform of undergraduate programs in science and mathematics. From the beginning, PKAL has taken a kaleidoscopic perspective, giving attention to all facets of the undergraduate learning environment. Nearly 5,000 individuals from over 900 colleges, universities, and professional organizations have participated in one or more PKAL activity.

With support from the ExxonMobil Foundation, PKAL is identifying and supporting faculty taking responsibility for leadership on their home campus and at the national level. There are over 1,200 PKAL Faculty for the 21<sup>st</sup> Century members, representing 500 campuses across the country.

Support for local reform efforts also comes through a consultant program supported by the W.M. Keck Foundation, which provides advice to campuses implementing an agenda for action developed at a PKAL event.

With support from FIPSE, U.S. Department of Education, PKAL is building local, regional, and virtual networks to advance efforts at the institutional and national levels.

Increasingly, the PKAL website is a significant vehicle for disseminating the work of PKAL and others dedicated to building and sustaining a strong undergraduate STEM community.

In 2004, PKAL began publishing a resource for STEM leaders. This publication is available on our website: <http://www.pkal.org/>.

Our world is one in which science and technology have a profound impact on every aspect of life. PKAL is part of the growing national effort, using the energies and expertise of leaders within the undergraduate STEM community, to prepare coming generations for that world, for lives that are self-fulfilled, productive, and of service to society.

What we learn from the experiences of those involved with PKAL is that strong programs, innovative approaches, and risk-taking ideas emerge when a community:

- ◆ Understands who their students are.
- ◆ Energizes gifted and respected faculty leaders at all career stages, giving them the flexibility, responsibility, and resources to effect change.
- ◆ Identifies critical questions to be asked at each stage of reform, ensuring they are asked in the context of mutual respect and shared commitments.
- ◆ Is willing to take risks, to seek collaborators within the campus and develops partnerships with the external community of stakeholders.

Our goal in this new NSF-funded initiative is to support and enhance the work of leaders building such communities.

Communities do not happen spontaneously. They are built intentionally and nurtured by leaders who understand how to give power and authority to the members of the community. The challenge ever present is to balance the diversity within the community with the vision that brings together people of good faith to create something new.

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