Shifting from Activitymania

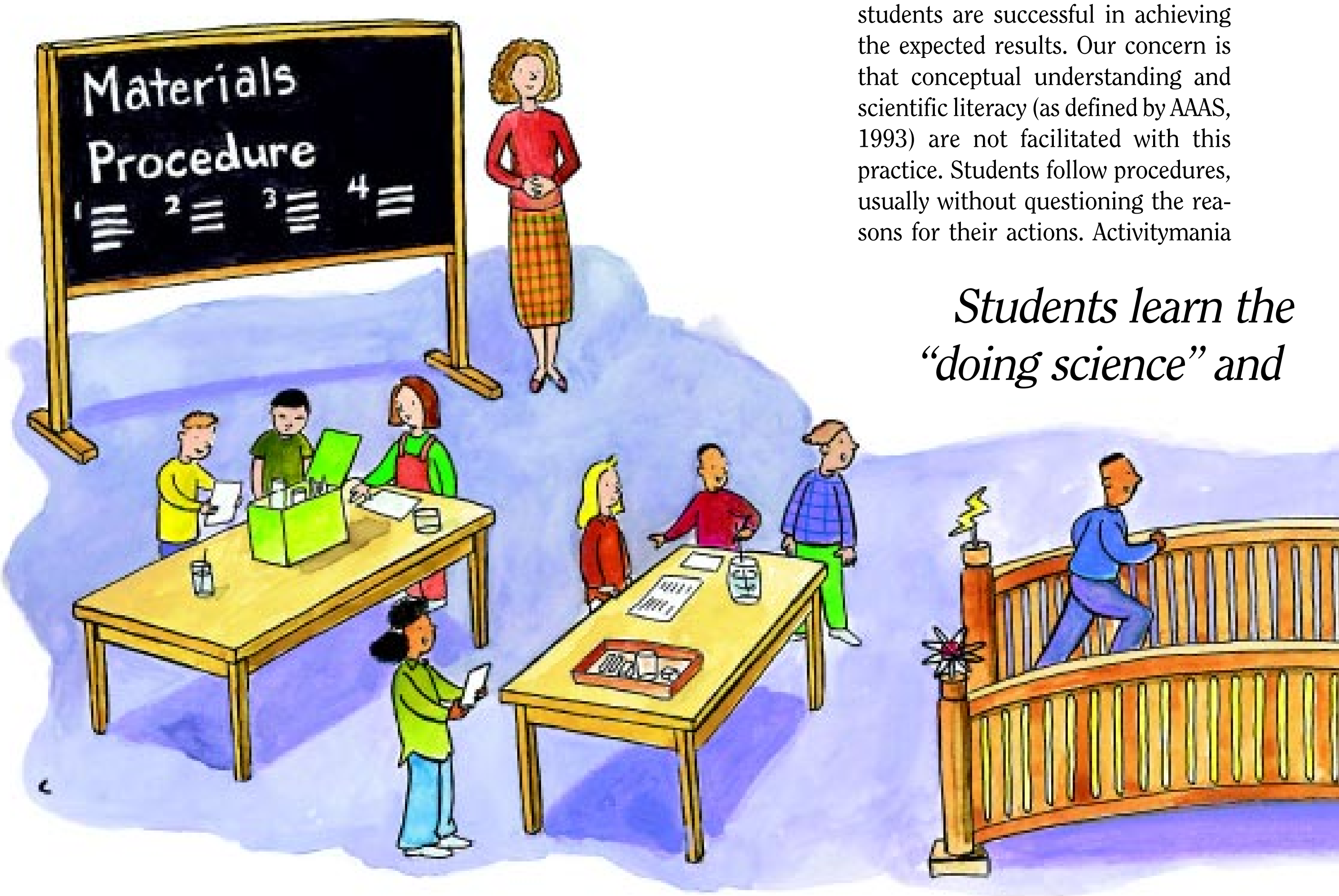
Often, when science instruction occurs in some elementary classrooms, it is in the form of a barrage of activities—what we call "activitymania." Using surveys and interviews of practicing and prospective teachers, we explored classroom practices in different districts at the K–12 level. We found that some factors need to be recognized and addressed prior to making a shift from activitymania to inquiry science teaching and learning (National Research Council, 1996).

Activitymania—What Does It Mean?

Activitymania is an approach to teaching elementary science that involves a collection of prepackaged, hour-long (or less), hands-on activities that are often disconnected from each other. Each activity has a definite beginning, middle, and end. In contrast, inquiry is the process of searching for patterns and relationships in the world around us. Inquiry cannot be prepackaged as it takes different directions according to students' interests and questions related to the concept being studied. (See Table 1 on page 17 for essential differences between activitymania and inquiry.)

Activities can be engaging for students and easy for the teacher. The outcome is usually defined and most students are successful in achieving the expected results. Our concern is that conceptual understanding and scientific literacy (as defined by AAAS, 1993) are not facilitated with this practice. Students follow procedures, usually without questioning the reasons for their actions. Activitymania

Students learn the "doing science" and



to Inquiry

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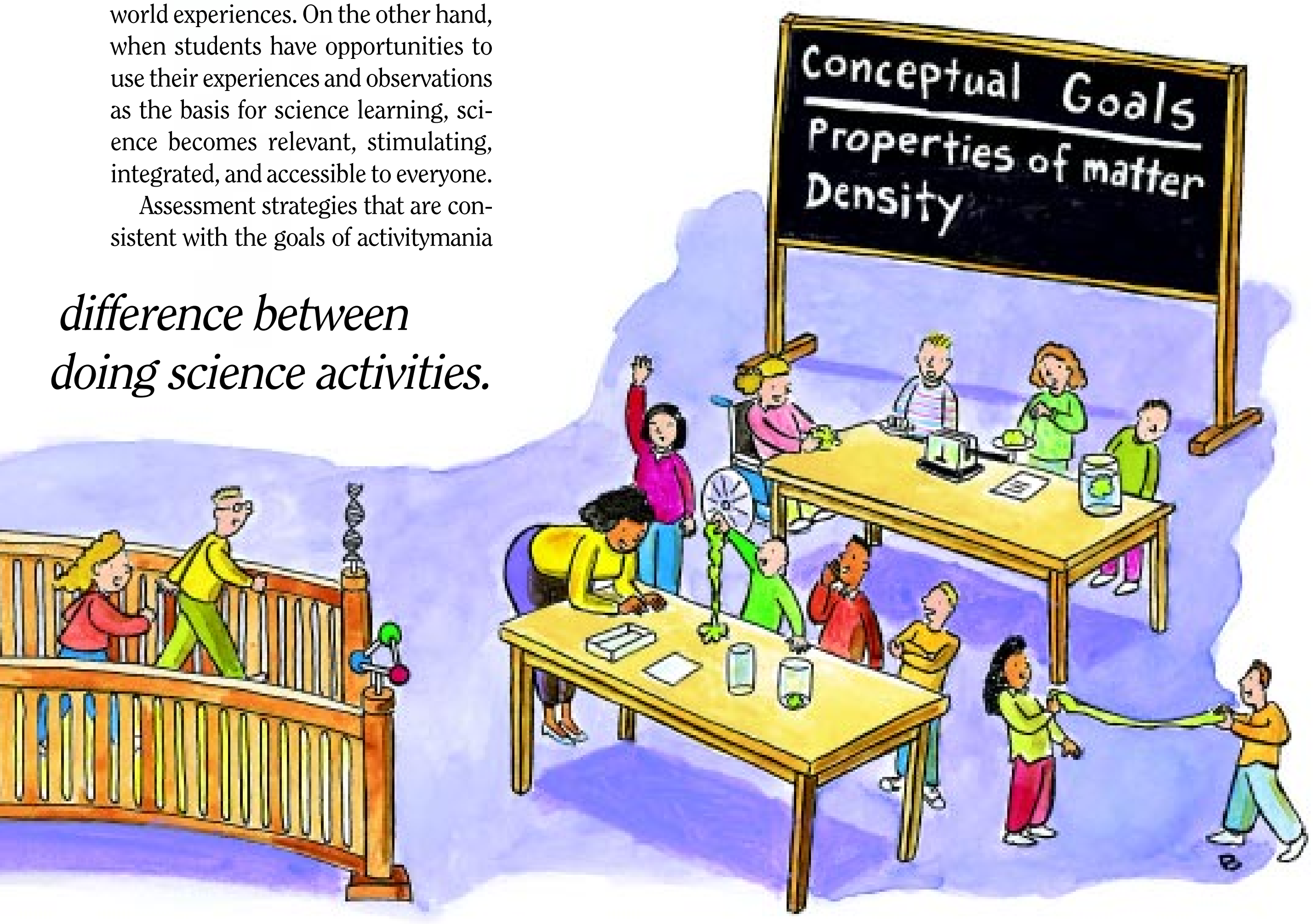
is not consistent with constructivist learning theory (Tobin and Tippins, 1993).

In activitymania, the working hypothesis is clearly defined by the teacher prior to experimentation, while in inquiry, it arises from students' questions and is based on their experiences. During activitymania, the students learn to disregard results that do not match teachers' expectations rather than question and analyze their data; science is perceived as disconnected from students' real-world experiences. On the other hand, when students have opportunities to use their experiences and observations as the basis for science learning, science becomes relevant, stimulating, integrated, and accessible to everyone.

Assessment strategies that are consistent with the goals of activitymania are inconsistent with the goals of inquiry. Activitymania calls for immediate, product-oriented, right-answer assessments, whereas inquiry supports long-term, process-oriented evaluations. Inquiry calls for the development of rubrics that authentically assess students' learning throughout the scientific investigation.

For example, one rubric might be related to the development of research questions, while another addresses experimentation. The individual teacher develops various rubrics and allocates points according to the goals and processes explored in his or her classroom (Moscovici and Gilmer, 1996). There are numerous reports in the literature of students developing assessment rubrics. For example, Lundberg (1997) reported how students in her class defined quality work and developed rubrics that helped her grade open-ended, problem-solving

difference between doing science activities.



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laboratory experiments. Inquiry assessment goes beyond the final exam to include components such as exhibitions, debates, community problem-solving projects, and Internet communications.

Contributing Factors

In our study, we explored perceptions expressed by practicing teachers with regard to their use of activities in science teaching. We also looked at the elements of teacher preparation programs contributing to the implementation of activitymania.

A large number of teachers reported to us that they want science to be enjoyable for students. Hands-on activities provide for small group interaction and accommodate different learning styles.

Some activities that are easy to set up can be repeated. The step-by-step approach usually ensures control and a somewhat smooth progression toward an expected outcome. The prepackaged aspect makes the information easy to transfer. Teachers perceive that such practice supplies students with a basic knowledge of the science topic in a neatly laid out procedure.

The National Research Council (1996) recommends that science be taught in every classroom at every grade. The activitymania approach ensures science concepts will be addressed in the classroom. Activities also provide a large measure of satisfaction for those teachers who are unhappy with the textbook and lecture format.

Teacher preparation programs tend to reinforce using a barrage of activities for teaching science concepts. Often, activities are used by science education instructors to model pedagogical methods, such as how to distribute materials, take a field trip, or manipulate equipment. Unfortunately, many preservice teachers misunderstand that the purpose of the activity is to model a certain teaching strategy. Instead, they adopt and transfer this activity approach to their own classrooms.

The same result is achieved when activities are used to develop a science concept. Preservice teachers are motivated by the excitement and pleasure of the manipulation of the materials but may not have opportunities to question, explore, and develop conceptual science.

In order to promote inquiry, teachers should clearly define conceptual goals and the relationships to students' lives and interests prior to selecting classroom activities.

There is a definite difference between "doing science" and doing science activities. Often, preservice teachers have few opportunities to work with real scientists to develop an understanding of the nature of scientific inquiry. They attend undergraduate science lecture courses that are heavy in factual information and recall. The laboratory sections in these courses consist of a series of disconnected activities that don't build toward a conceptual understanding of science. When, in a science methods course, preservice teachers encounter enjoyable activities in which they feel successful, it is understandable that they choose to emulate the activity approach.

What Next?

We propose a shift from activitymania to inquiry in order to better develop students' higher order cognitive skills (Zoller, 1993). This shift *doesn't* mean throwing out the kits and manuals. Instead, we ask teachers to clearly define conceptual goals and the relationships to students' lives and interests prior to selecting classroom activities.

Teachers should ask questions such as "Why are magnets important to my students?" "How do my students relate to plants?" or "What are my students' experiences and questions related to weather?" Once these overall goals are established, supporting activities that link and build understanding can be identified.

These supporting activities can be used in a variety of ways:

- *To engage the students.* A relevant activity will provide students with a fundamental background and stimulate questions that lead to further investigation. For example, a hands-on experience with oobleck, mud, shaving cream, and similar combinations can lead to investigations about properties of matter.
- *In skill development.* For example, students can measure volume and mass in order to explore density and buoyancy.
- *As an idea for modification and extension.* Clough and Clark (1994) adapted a cookbook-type laboratory activity to engage students in inquiry. Rather than supplying the students with the expected result, they facilitated students' inquiry through the use of guiding questions.
- *To provide students with common experiences to address their questions during their inquiry.* For example, evaporation and condensation can be illustrated in the context of the water cycle and weather.
- *As a method by which students demonstrate their understanding of the concept and related scientific ideas.* This may be a final as-

Table 1. A Summary of Essential Differences Between Activitymania and Inquiry.

	Activity	Inquiry
Time	• short (approximately 50 minutes)	• long (more than 5×50 minutes)
Planning	• definite, allows preplanning	• flexible, general preplanning
Materials	• ready to go (e.g., kit) • teacher's responsibility	• upon students' request • students' and teachers' responsibility
Results	• known by the teacher, published by text, and most times known by students • one expected and accepted result	• unknown by teacher, students, or text • multiple results will be negotiated and discussed
Working Hypothesis	• well defined by teacher prior to experimentation	• arising from students' questions and based on their experiences
Teacher's Feelings	• in control (high power) • unchallenged intellectually (assimilation mood) • relaxed—low energy level • expert (students asking him or her for reinforcements) • having fun	• sharing control (lower power) • intellectually challenged (accommodation mood) • learning a lot—perturbed • experienced co-learner (students discussing findings with teacher and students alike) • enjoying the intellectual challenge • perturbed by the intellectual challenge
Students' Feelings	• following prescribed procedures • matching personal findings with expected findings (teacher's) • working on teacher's question • the teacher knows the right answer • one right answer • passive	• developing procedures and a list of materials and equipment • interpreting results as there are no prescribed findings • working on personal or group question(s) • as students developed the question, the teacher does not know the answer • multiple answers accepted • motivated—using "I want (or we want) to find out" • perturbed • challenged intellectually and looking for equilibration (Piaget)
Assessment	• immediate • product-oriented (right/wrong answer) • technical	• long-term • process-oriented • developing rubrics
Students' Learning	• technical skill (follow procedures) and develop low order cognitive skills • disregard results that do not match teacher's expectations • science is done and understood by special people (intellectually gifted) • perpetuate the idea of science as magic • science as discontinuous, one-time shots that are difficult to explain and usually do not "work" anyway • one needs a lot of knowledge in order to do and understand science	• observation and develop higher order cognitive skills • disregard data for reasonable and scientific reasons • use discrepancies as entry points for inquiry • everybody can get involved in doing and understanding science • science as patterning the world • science as integrated, continuous, and even predictable • one builds knowledge while doing and learning science

sessment in which student groups design and present an activity that models their scientific understanding.

Moving Toward Inquiry

Activitymania is one way science has entered elementary classrooms. It is a step away from teacher-directed, textbook-centered elementary science. It is now time to go a step further and make the shift toward inquiry. Modifications can be made to existing science programs (e.g., kits, texts) to meet criteria for inquiry science as suggested in Table 1. This movement will better ensure the development of scientifically literate citizens who will use science when making decisions to solve tomorrow's problems.

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