How are inquiry-based labs different from more traditional labs?

Most would agree that introductory science courses should help students develop a literate understanding of how scientists reveal knowledge about the natural world. It is also clear that students are more engaged and seem to "learn better" when they are actively doing, rather than passively listening. This is in large part why "hands-on" labs have traditionally been an integral part of science classes. But, what does it mean for a student to be more engaged in their learning, and what are students learning about the nature of scientific discovery in our science labs?

Now, think back to your own experiences in introductory science labs. Were they engaging? What kinds of behaviors or attitudes did science labs foster in you? Did they foster an appreciation for the creativity involved in doing science? Did they help you to become more comfortable with the uncertain or tentative nature of scientific discoveries? Did they help you to understand why we should trust the knowledge revealed through science? Did they foster a deeper understanding of the connections between basic scientific knowledge and issues that will confront you in your personal or civic life? Did they foster an appreciation for the differences between basic and applied science, and help you to make decisions about how you would like to interact with science in your future civic and professional life? Did they increase your confidence that you are capable of doing real science?

Science education researchers have discovered that for many students immersed in more traditional labs the answer to most of these questions is a resounding no. So what are traditional science labs, and why is it that they often fail to meaningfully engage students in science and foster less than literate conceptions of the nature of scientific discovery?

Traditional Science Labs - The goal of most traditional science labs is to confirm or reinforce understanding of concepts or processes, and it is usually those very abstract concepts which serve as the context for the lab exploration. Although these labs use scientific methods, they often prompt students to follow an explicit set of instructions which should yield a preplanned outcome. Because the context of the lab is often quite abstract to the leaner, they often mindlessly follow these instructions. Then after the data is collected they are asked to try to interpret the findings by answering questions explicitly provided to them at the end of the lab. So for students, these lab experiences can be more akin to blindly following a cookbook recipe, and like a recipe, is often thought to have failed if the expected results don't materialize.

So, what are inquiry-based labs, and how are they different from more traditional lab experiences?

In inquiry-based labs it is instead observations and questions, which are sometimes centered on issues that are relevant to students' personal or civic lives that initiate and set the context for the lab exploration. This is because research in science education has revealed that students are more engaged in their own learning when there is an initial context which is centered on student interests and experiences. In inquiry-based labs, students also practice making critical decisions about hypotheses, predictions and the design/execution of the experiment. This "student-centered", rather than solely "concept-centered" focus fosters deeper interest and investment in the exploration, helps students to more fully appreciate the creative aspects of science and understand how design decisions can influence the validity of their findings.