This article will report on and describe the work carried out by:

The above paper documents how reflective writing can be used to facilitate the students’ curiosity and engagement in class and laboratory work. It is suggested that reflective journal writing may become an instrumental tool and a student-created learning resource that could also be used as a means of continuous assessment in the classroom.

What is inquiry?
Inquiry based learning, has gained acceptance as a method for creating interest among students and for promoting the benefits of science and mathematics knowledge and skills (Chang & Mao, 1999; Gibson & Chase, 2002; St. Omer, 2002; Abd-El-Khalick, et al., 2004; Grandy & Duschl, 2005). A focus on inquiry changes the school curriculum from the memorisation and recall of facts to the development of critical thinking skills. Inquiry is a term used in science teaching that refers to a way of questioning, seeking knowledge and finding out about phenomena.

There are many different forms of inquiry that can be incorporated into a science lesson:

● Guided inquiry: a form of inductive inquiry where the teacher is the centre of instruction.
● Unguided inductive inquiry: the student is the centre of inquiry.
● In both forms of inductive inquiry, students are engaged in learning about concepts and phenomena by using observations, measurements and data to develop conclusions and ask questions about what has been learned.

● In deductive inquiry the student starts with the big idea, conclusion, or general concept and moves to specific cases.

One of the most successful methods by which a student will learn, is by standing back from the activity they are doing, processing their experiences, reflectively thinking about what they are doing, recalling from experiences and reasoning how the activity being carried out will link to current and future learning situations. Inquiry based activities must involve those where the students answer their own questions through analysing data that they collect independently.

Learning how to solve problems is another form of inquiry teaching. Challenging problems, such as; ‘What will the consequences be of global warming?’, ‘What solid waste products are the most environmentally hazardous?’, ‘What resources are most critically in short supply?’, can be investigated by the students. Posing problems such as these brings real world situations into the science classroom and furthers students' appreciation for the process of inquiry. Teachers that use problem solving are providing a perspective for students in which they will propose solutions to problems and make recommendations towards what should be done to change, improve, correct or prevent the situation. Involving students in solving problems that are important to society and themselves should be an important goal of science teaching in our curriculum.
Inquiry in the classroom
All teachers understand and have an idea of what ‘Inquiry’ actually means, however confusion often arises over, whether a class is actually inquiry-based or not. It is often obvious when a class is not inquiry-based, it is not always as obvious whether an active lesson is truly inquiry-based or not. Scientific inquiry, in theory, should be very easily introduced into classrooms, as methods of inquiry are very similar to scientific investigations. It is documented that the process of inquiry should include the following; observation, measurement, experimentation, communication, thinking processes such as inductive and deductive reasoning, formulating hypotheses and theories, proposing alternative ideas in order to solve problems, find meaning, as well as analogy, extrapolation, synthesis and evaluation.

Laboratory investigations and laboratory write ups
Kyle (1980) argued that the ability to scientifically inquire was the personal, internalised ability to synthesise knowledge which had been learned through basic process skills, enabling the person to rationally inquire and to solve problems by means of inductive thinking. Therefore observation, measurement and experimentation in the laboratory taken together, do not make up the whole process of inquiry. Reflecting on findings, asking questions on what was carried out and why and formulating hypotheses is true learning by inquiry. The power of inquiry based learning is dependent on the opportunity it provides for students to confront their prior ideas and misconceptions as well as to investigate (Timmerman et al., 2008).

Many educators believe they are incorporating inquiry into their lessons by getting the students to carry out experiments and fill in experiment sheets and answer questions after the experiment is carried out. However textbooks and accompanying laboratory notebooks do not provide the student with the opportunity to pose a question to be investigated, formulate a hypothesis to be tested, design observation, measurement and experimental procedures, predict experimental results and work according to their own design. Inquiring learners, learn best through questioning, reflecting on their actions. Unfortunately many textbooks and workbooks do not promote inquiry and problem solving in this sense (Germann et al., 1996).

Reflective writing
We often assume that by doing inquiry based activities in the classroom that the students have gained scientific understanding. It has been found however that experiences derived from hands-on science inquiry need to be strengthened by teacher support and other cognitive tasks to ensure student understanding. Writing is one example of such cognitive tasks that will support science learning in an inquiry based learning environment. The act of writing requires thinking, offers opportunities for reflection on content, promotes attainment of personal meaning, and furthers the development of processing skills, organising ideas and reasoning (Fellows, 1994; Rowell, 1997; Keys, 1999; Mason, 1998). Science Reflective Journals (SRJ) develop the students’ skills in identifying and asking questions, leading to a greater understanding of the topics being covered and the elimination of previously held misconceptions. Fellow (1994) found that learning among middle school students in America involved memorisation of facts without changing their thinking. This study found when instructional activities including discussions and reflective writing were introduced into their chemistry lessons, there was a dramatic increase in the students’ conceptual understanding. Students added new concepts and theories to their writing and improved the logical organisation of arguments in their explanations.
More recently the research carried out by Hohenshell & Hand (2006) and Towndrow et al., (2008), found that the practice of student reflection plays a key role in promoting inquiry. They emphasised that identifying and asking questions through SRJ writing is the key to developing scientific skills among students. It was found that engagement in reflective activities brings about positive changes in laboratory investigations, changing from the idea that scientific facts are unquestionable.

There have been many papers written on the benefits of scientific inquiry, however sometimes it can be difficult to introduce inquiry successfully into science lessons. Traditionally science concepts and facts are taken as a given and very little student questioning occurs in the classroom. This paper outlines research findings on how to enhance students’ questioning and hence their understanding which can be incorporated into lessons in any of the science areas.

Research Study
Science Reflective Journals
Towndrow, Ling & Venth (2008) tracked a teacher and his class over a period of five weeks and documented changes that occurred when reflective journal writing was used to supplement the teaching and learning of different topics on the syllabus. This study was based on a class of grade 7 (13-14 years old) girls in Singapore. The students were of average academic ability and were generally reluctant to ask questions openly in class. Small notebooks were distributed to every student in the class and labelled ‘Science Reflective Journal’. Over a five week period, at the end of every lesson or laboratory activity the students were allowed five minutes to write into their journals.

Broad headings were given to the students as they were new to such a practice and needed guidance. They wrote their reflections under the following headings:
1. Questions I have about today’s lesson
2. Something I have learned today
3. Some thought provoking incidences in the class today.

A summary of the process is given in Figure 1

Results
The reflective journal entries after week one were factual and superficial, however some questions did show an attempt by students to connect theory being learned to real life situations. By week four the students’ questions became more adventurous. This highlighted that the use of these reflective journals was encouraging the development of critical thinking. As the weeks progressed it was evident from the students’ questioning that the level of complex thinking had increased.

Discussion
The Science Reflective Journals, proved to be a very effective means of communication between the students and teachers. On evaluation of these methods, the students stated how beneficial such an activity was in their understanding of scientific content. They allowed the students to stop at regular intervals and think about what they were doing.
The student’s laboratory skills also improved as the SRJ encouraged them to keep records of their experiences and they practised the skill of analysing by thinking about the questions they wanted to ask in relation to their laboratory experiences.

Many research papers have suggested the advantages of reflective writing for teachers (Francis, 1995; Ward & Mc Cotter, 2004). This paper highlights the importance of different writing tasks in promoting and developing methods of inquiry in science subjects. Also, these different writing tasks were used together in a classroom, they would help in developing a greater conceptual understanding in science among students. The journals gave the students an opportunity to record their attitudes, thinking critically and creatively. It is important however to take into consideration that reflective writing will not suit all students, therefore teachers need to guide their students through the process.

Such activities could be incorporated into science classrooms in Ireland. Analysing students comments and questions may seem time consuming, however you could change this activity to suit your needs and the needs of the class. For example, give them exact definite headings to write on, encourage them to write brief to the point comments and questions or use one reflective journal and pass it around the class at the end of every lesson. Such an activity will encourage the students’ enthusiasm for the subject and also the development of true scientific skills which will be used in further education and in general life situations.

References
St. Omer, L. (2002). ‘Successfully scientific instruction involves more than just discovering concepts through inquiry-based activities.’, Education, 123 (2), 318-321.