Assessment Criteria

Education Value

A premium will be placed on home-made versus purchased solutions. The intent is learn how instruments are constructed and how measurements are made, so an “out-of-the-box” solution is less valuable than one constructed from components. That isn't to say that some items can't be purchased. Indeed, there will be interesting technology that would provide invaluable knowledge, and the intent is not to try and construct a scientific instrument out of mud and sticks, but the more science that is demonstrated the better.

Cost

The cost of a solution is a very large factor in the evaluation of competing designs. There will be a hard upper limit set on the price of an instrument, mimicking the real world constraints that are usually imposed on projects. Materials cost is the only factor that will be considered, since the labour of the students cannot be fairly included in the cost estimate. Of two competing designs, the less expensive one is better. The intent is not to gauge the depth of student (or parent) pocketbooks, but rather discover that technology is accessible with even mundane materials. Also included in this cost evaluation is the amount of time needed to acquire the materials, since time is money.

Simplicity

The ease with which an instrument can be constructed will be considered a crucial factor in the evaluation. If the construction of a device requires special machining operations, special materials or low yield processes it will be downgraded with respect to a simpler device that does not require extraordinary construction efforts. A good rule of thumb is to reconsider any supplies and materials that are not available in any hardware store. In many cases, raw data measured in the sensor can be analysed at the base station, saving considerable complexity.

Mechanical

Designs that are immune to, or can tolerate, mechanical deformation, such as caused by ice buildup, vandalism, wind, impact (dropping), vibration, crushing (sitting on), insects and other maltreatment (i.e. assembled or installed incorrectly) are superior.

Service Interval & Mean Time Before Failure

Because the station must run unattended most of the time, a design needing frequent service intervals is not as good as a design that can be installed and forgotten. Designs that don't use consumables are better than those that do, but for instruments requiring consumables, the greater the service interval the better. For example, moving parts require bearing surfaces, and bearing surfaces usually require some sort of lubrication at intervals, so a design without any moving parts is inherently better.

Temperature

Since the instrument must operate outside in temperatures ranging from -25ºC to 50ºC, an instrument capable of tolerating these extremes is better than one that needs to be shielded from the environment. Operation below freezing temperatures will be especially important as much of Ottawa's winter nights and even days are spent in the negative part of the temperature range.

Moisture

In the exterior environment, the level of water on, in or around the instrument cannot be controlled. Instruments that have no water soluble parts and don't rust in the rain are better than those that do. Wood, cloth and other materials that absorb water should be avoided in favour of materials like rubber, plastic and brass that do not, since freezing temperatures often accompany the moisture which leads to damage from ice expansion.

Power Consumption

A limit on the available power is set by the power subsystem (solar panel and battery). A design that uses less power is better than one that consumes more. A device that consumes power intermittently (i.e. it can be “turned on” only when being measured) is better than one that needs to be on all the time. Completely passive designs are, of course, the best.

Accuracy & Precision

Designs that are inherently more accurate are better. Often many parameters can be adjusted to play off accuracy for other criteria, and accuracy is only of secondary concern for this exercise since data can be linearized and calibrated in the base station. Precision is fairly critical, since a resolution limit imposed by the design cannot be overcome.

Size & Weight

Since this is a stationary device and doesn't need to fly or to be enclosed, there is less concern about size and weight. But, all things being equal, the less massive and volumous the design the better.

Aging

The lifespan for the project is only a couple of months. It would be nice if it lasted a couple of years. The projects that can tolerate effects like thermal cycling, ultra-violet radiation and pollution are better than those susceptible to aging. Designs cognizant of lightning and suitably grounded are better.

Esthetics & Elegance

A design that looks nice is great to have, but this is a low priority compared to one that works beautifully.

Evaluation Criteria	Marks	A	B
Education Value - which demonstrates scientific principles more directly? - which one would McGyver build?	10		
Cost - which one is estimated to cost less? - which one can you put together quicker?	9		
Simplicity - which one has less parts? less moving parts? - which one could your grandfather have made?	8		
Mechanical - which one could travel in your backpack?	7		
Service Interval & MTBF - which one runs unattended longer? - which one will last longer?	7		
Temperature Immunity - which one works better in February?	6		
Moisture Immunity - which one works better in the rain or snow?	6		
Power Consumption - which one would you prefer to buy batteries for?	4		
Accuracy & Precision - which one is predicted to have the most precision? - which one needs the least adjustment or calibration?	3		
Size & Weight - which one would you rather take camping?	2		
Aging - which one will last longer? - which one would you be willing to buy?	1		
Esthetics - which one would you be proud to show other students? - which one would grace the school with it's presence?	1		
Total			