Sounds of Music - 2003 Coaches Clinic

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General Suggestions:

1. Students should start building their instruments as soon as possible. This doesn't mean to short-change the research process. They don't want to have to "cram" the building phase. Start with an idea, then research, then building as soon as it's wise.
2. The physics/acoustics element of this event can be taught as *part* of the building and "learning to play" phases. The best way to make this THIRD of the event a success is to make it holistic.
3. The building process should start with theory and design. Have the student draw a blueprint and explain the theory behind the instrument (*tuning* and playing). It's best to have a strategy for tuning.
4. Make sure that the students practice often, because it's well known that "as you practice, so shall you perform." That goes for more than just music, of course.
5. Have your team practice the quiz portion often. Particularly, have them practice *explaining* their answers aloud to other teammates. They should feel comfortable *explaining* their answers.

Essential Information

- Sound Physics and Acoustics. Nodes, antinodes, modes, calculating fundamental frequencies for open and closed pipes, for strings etc. Resonances, amplification, sympathetic vibration, decibel scale, beats, harmonics etc.

- Basic Music Theory. Helpful, but NOT essential. Transposition, modes (minor/major), intervals, rhythm, notation, etc. Except for the rhythm. That very well could be essential.

Some other useful information (although it's a *bit* technical for most competitions):

Tempered semitone: 1.05946 or 100 cents

$f=1/T$ $\lambda=v/f$

$f_1=v/2L$ (open pipe) $f_1=v/4L$ (closed pipe)

speed of sound in air (room temp) = 340 m/s = 1130 ft/s
increase in speed for 1^0C = 0.6 m/s; for 1°F = 1.1 ft/s
standard A(concert tuning pitch): A_4 = 440 Hz
C_5 = 523.25 Hz (C above middle C, or C_4)
Accepted average range of Human Hearing: 20Hz – 20kHz

Possible/Practice questions:

1. The musical interval from 200 Hz to 300 Hz is the same as the interval from 500Hz to _____ Hz.
2. Two violins out of ten make only a just perceptible change in loudness. However, we all know that adding 2 celli to 10 violins is much more noticeable. What is the explanation in terms of the functioning of the ear?
3. How do harmonics and resonance effect the perceived sound of your instrument?
4. How does the material of your instrument effect its perceived sound? What if were made of X other material?
5. How does your instrument MAKE sound? How do you change the pitch? What physically happens with the instrument? How did you tune it? How do the materials affect the sound?
6. The tones one can play on a bugle are limited to the so-called "natural scale." If the lowest bugle frequency is 100 Hz, what will be the next four higher frequencies the bugle can produce? 100, ______, ______, ______, ______ Hz

Sounds of Music: Select Bibliography (rev. 07-01)

Hopkin, Bart. Musical Instrument Design: Practical Information for Instrument Making. Tucson; See Sharp Press, 1996. ISBN: 1-884365-08-6

THIS IS THE BOOK TO HAVE!!! It has a great deal of in-depth information about the physics behind musical instruments and musical instrument making. This book will provide all the tools a motivated student will need to design a unique musical instrument. The book is full of charts and diagrams explaining the physics of sound and relating them to the musical instrument designs.

Backus, John. The Acoustical Foundations of Music. New York: W.W. Norton and Co., 1977. ISBN 0-393-09096-5

This book is a fairly advanced, college-level text on the physics side of music and musical instruments. The mathematics are discussed in some detail as well as the physics. There are different chapters/sections for the different types of instruments. The book is fairly dense and is in a college-text format. This is an ideal book for the student looking for in-depth background as well as excellence in this event.

Banek, Reinhold and Jon Scoville. Sound Design: A Handbook of Musical Instrument Building. Berkeley; Ten Speed Press, 1995. ISBN: 0-89815-775-7

This book is very similar to the Hopkin book above, but on a bit more simple a level. The physics is addressed primarily through examples of musical instruments specifically to be built. There are a lot of good ideas in this book for instrument building as well as a lot of non-traditional, non-Western instruments.

Hall, Donald E. Musical Acoustics. Brooks/Cole Pub.; Pacific Grove, CA, 1991. ISBN 0-534-13248-0

Another acoustics textbook, similar but quite different from the Backus. This book is set up more like a traditional textbook, but goes into as much depth as the Backus text. Another ideal resource for a student looking to "go the extra mile" with this event.

Havighurst, Jay. Making Musical Instruments by Hand. Gloucester, MA; Quarry Books, 1998. ISBN: 1-56496-352-7

This is a fairly simple book with a lot of pictures, however to build the instruments he illustrates well, one would need a great deal of independent background in the design of instrument building. A great deal of time and tools are necessary to make specific use of this book, but a student could get a lot of ideas from seeing how a professional instrument builder would go about making some of these instruments.

Hopkin, Bart. Making Simple Musical Instruments. Asheville, NC; Altamont Press, 1995. ISBN: 0-937274-80-1

This is Hopkin's picture book. He illustrates the design and construction of several instruments. This book would make a very good companion to Hopkin's other book. (see below) In this book, he also covers playing technique.