"Quick Twenty" lists: a fast, fun, easy way to introduce instructors and administrators to STEM songs for teaching

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Part of the VOICES “Digital Library” project

Goals of the Digital Library:

• Support instructors, administrators, professional songwriters, students, and scholars in creating, finding, and using materials relating to songs for STEM education

• Develop and encourage best practices for use of songs in STEM classes
Proposed content for the digital library:
• Enhanced, curated database
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- Flashcard summaries of the best scholarly articles about STEM songs
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- Enhanced, curated database
- Flashcard summaries of the best scholarly articles about STEM songs
- Templates for learning guides
Needed for full implementation:
• substantial investment of time and money
• grant support
A start: The Quick Twenty Project

• 20 pretty good songs from each STEM field, showing the power of STEM songs for teaching, and the range of approaches to using them
• Relatively easy to assemble
• Approachable: quick, fun
Expectations for each song:
• **Usefulness for teaching**
• **Lyrics & recording freely available online**
• **Ideas for use in a course, specific to the song**

Example from a semi-professional STEM songs person:
I’m a Virus, by Glenn Wolkenfeld
Mr. W’s Virus Rap

https://youtu.be/kYf_Sl8W3qY
I’m a Virus (Lyrics)

Virus Interactive Lyrics

Mode: Learn

Q #1/8; Correctly labeled 0 out of 4 items

Move each item to its correct place:

- cell    infectious    metabolism    reproduce

I’m a virus, an [ ] particle,
a nano-thug, a pirate, the genuine article
Ebola, chickenpox, west Nile, influenza,
Yellow fever, AIDS, herpes, SARS, I’m comin’ right at ya

I’m not a [ ], not an independent organism,
I don’t even have my own [ ]
I only [ ] myself by taking over cells,
Then I bust ‘em apart, no wonder you don’t feel well!
I’m a Virus (Lyrics)

Virus Interactive Lyrics

Mode: Learn

Move each item to its correct place:

- cell
- infectious
- metabolism
- reproduce

I’m a virus, an infectious particle,
a nano-thug, a pirate, the genuine article
Ebola, chickenpox, west Nile, influenza,
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I’m not a cell, not an independent organism,
I don’t even have my own metabolism
I only reproduce myself by taking over cells,
Then I bust ‘em apart, no wonder you don’t feel well!

Good!
You placed all of the items correctly on the first try!
Example from a professor: Poiseuille’s Law, by Greg Crowther
Blood flow (\( \dot{Q} \)) =

\[
\frac{r^4 \cdot \Delta P}{\frac{8}{\pi} \cdot L \cdot \eta}
\]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r )</td>
<td>radius of vessel</td>
</tr>
<tr>
<td>( \Delta P )</td>
<td>pressure gradient along vessel</td>
</tr>
<tr>
<td>( L )</td>
<td>length of vessel</td>
</tr>
<tr>
<td>( \eta )</td>
<td>viscosity of fluid</td>
</tr>
</tbody>
</table>

[https://youtu.be/9lnznkgQ-NQ](https://youtu.be/9lnznkgQ-NQ)
Lesson Plan

Songs like this one can be used during class meetings and/or in homework assignments. Either way, the song will be most impactful if students DO something with it, as opposed to just listening.

An initial, simple follow-up activity could be to answer the study questions below. A more extensive interaction with the song might entail (A) learning to sing it, using an audio file and/or sheet music as a guide, and/or (B) designing kinesthetic movements ("dance moves") to embody it. The latter activity could begin with students identifying the most important or most challenging content of the song, and deciding how to illustrate that particular content.
Study Questions

(1) What is Poiseuille's Law used for? That is, what does it calculate? In what units should be answer be reported?

(2) What does the "r" in the song stand for?

(3) The song states, "The blood flows around and around and around." Is this true?

(4) How does vessel radius relate to resistance to blood flow?

(5) What is delta P here? Is this the same delta P that is in Fick's Law of Diffusion?

(6) Of all the terms included in the equation, which one has the strongest influence on blood flow?

(7) Your classmate claims that blood flow is dependent on vessel DIAMETER raised to the fourth power. Is this true?
Poiseuille’s Law of Laminar Flow

(1) Poiseuille’s Law calculates the rate of blood flow through a single blood vessel of the circulatory system. Units should be volume of blood per unit time, e.g., milliliters per second.

(2) “r” stands for radius -- the radius of the blood vessel.

(3) Blood does flow in a circuit: from the left heart to the various tissues of the body, back to the right heart, to the lungs, to the left heart, out to the various tissues again, and so on.

(4) Resistance to flow (often abbreviated with a capital R) is inversely proportional to radius to the 4th power (r^4). As radius increases, resistance decreases.

(5) Here delta P refers to a difference in hydrostatic pressure over the length of the vessel. It is not the same as the delta P in Fick’s Law of Diffusion. That delta P refers to a concentration difference of dissolved gases (whose concentrations are reported as partial pressures).
Expectations for the list:

• Examples from each educational level
• Reasonable gender balance of song authors and performers
• Each song labelled with its general area (e.g. “electricity”) and topic (e.g. “Ohm’s Law”)
• The list should include at least 3 general areas.
High priorities for the list:

- Some songs set to well-known tunes written in the last 10 years.
- Some songs set to original tunes.
- Variety of song genres (e.g. folk, rap, rock, country).
- Songs by professional songwriters and by non-professionals.
- Some songs with polished recordings/videos, and some with rather unpolished recordings. (Setting the bar too high may discourage some.)
• Have subject coordinators for physics, biology, and statistics.
• You to develop a Quick Twenty list for another STEM field?
• astronomy, chemistry, computer science, engineering, geology, math, psychology, ...

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