Challenge: Without modifying your bit-sending device develop a protocol for sending a response to a question which has four possible responses.

Guidelines:

- **Do not change your device.** Your device should currently have two states, State A and State B. You may not add new states to your device. In other words, your device should still only send bits.
- **Agree on a protocol.** Agree upon a protocol for representing four possible responses to a question using some combination of bits sent by your device.
- **Be efficient.** Your protocol should be as efficient as possible.

Protocol: List the two states of your device below, then fill in the question your protocol will respond to and how the responses will be represented.

State A: ______________________________________________________________

State B: ______________________________________________________________

The Question: _________________________________________________________

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<th>Possible Responses</th>
<th>How to send with your device</th>
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Challenge Extensions:

- Redesign your device by including ideas from your classmates’ devices.
- Try to send your message with another team’s device. Were you successful? Why or why not?

Conclusion: Follow your teacher’s instructions for presenting your work to the class. The presentation should include:

- A description of how the system is used to encode messages
- Details on how the recipient can properly interpret/decode the message being sent
- A demonstration of your device in use
- Use the rubric to assess your learning
Reflection:
There are two major connections that should be made in this lesson. The first connection to make is that even though everyone’s binary message-sending devices are different, since they all are designed to send a binary message, all the devices can achieve two states, which we call state A and state B for the time being. It also means that any one of them can be used to send any kind of message, as long as the messages are binary. The second major connection to make is that in order to send messages a communication protocol must be established. That means there must be an agreement between the sender and receiver about how messages will be formed, communicated, and interpreted.

Answer the following questions:

1. Why would we decide to send a message in only bits rather than modifying our devices to represent more states (State C, State D, State E, …)?

2. Multiple Choice: When sending a response to a question with four possible answers, the most efficient method will require no more than what number of bits?
   
   A. 5 bits
   B. 4 bits
   C. 3 bits
   D. 2 bits
   E. 1 bit

3. How did collaboration impact the development of your protocol? What challenges did working in a group present and in what ways did it positively impact your final product?