Supplement 2: Sample grading rubric for the turtle question from supplement 1 (application of SA/V ratio principle). This example was not used in class.

Q: A small and a large turtle both have a body temperature of 12^{o} C. They glide into the water of a pond, which has a temperature of 20^{o} C. Which turtle will reach the water temperature faster? Explain why.

The correct answer has 4 components:
Different versions are accepted as long as the key components are present somewhere in the answer (for example components 2 and 3 are often combined: see below):

1. Model (recognition of principle):
e.g. As organisms increase in size, their volume (V) increases faster than their surface area (SA) (or: their SA/V decreases).

2. Relate model components (SA, V) to structure and function in the question context:
e.g. SA: the SA of the turtle is used for heat exchange; V: the turtle volume/body is warmed up.

3. Combine principle with question context:
e.g. The large turtle has <u>relatively less SA</u> (scaled by volume) [to take up heat = component 2] or: relatively more volume (scaled by surface area) [to be warmed up = component 2].

4. Conclusion (reasoned out answer to question):
e.g. As a result, the smaller turtle reaches 20^{o} C faster than the larger turtle.

<u>Partial credit for partial answers:</u>
Ignored SA:
Larger turtle needs to heat up more volume (or: smaller turtle needs to heat up less volume).

Ignored Volume:
Larger turtle has more SA to take up heat (or: smaller turtle has less SA to take up heat).

<u>No credit (unspecific, ambiguous, or wrong examples):</u>
Smaller turtles need less heat to warm up. Smaller turtles are more effective. The larger turtle has a larger SA/V.