Lesson 2.6

Socratic Seminar Preparation

Invasive Species Control: Bounty Hunters!

To the Teacher

An effective method for preparing students for the civil discourse inherent to the resolution of socioscientific issues (SSI) is to stage Socratic Seminars. Students learn how to use effective discursive practice, explain their ideas, and support them with evidence. A Socratic Seminar is an academic discussion about a question in which students’ shared opinions are affirmed or refuted and refined through dialogue with other students.[1]

Advantages of Socratic Seminars include

- providing opportunities for critical readings of texts,
- teaching respect for diverse ideas, people, and practices,
- enhancing students’ knowledge and research base,
- creating a community of inquiry,
- developing critical thinking, problem solving, speaking, and listening skills,
- clarifying one's ideas, ethics and values,
- maximizing student participation, and
- encouraging divergent thinking.[1]

There are many ways of staging Socratic Seminars. A variation of the fishbowl method that is used for larger groups is utilized in this lesson.

Reference

Objectives

1. Recognize the strength and usefulness of a scientific claim is evaluated through scientific argumentation.
2. Recognize that a number of shared values and perspectives characterize a scientific approach.
3. Refine their positions on the issue of the eradication of invasive species.

Time Needed

Two 50-minute class period
Materials

- Materials per class
  - Class sets of the article, “Invasive Species Control: Bounty Hunters”
  - Class set of Dialogue vs. Debate sheet
  - Class set of Socratic Seminar Rules and Tips sheet
  - Class set of Seminar Questioning Cheat Sheet
  - Class set of Socratic Seminar Observation Form
  - Class set of Socratic Seminar Rubric
  - Class set of Lesson 2.6 Science Notebook Template – Socratic Seminar Preparation

- Materials per student
  - Science notebook

Procedure

Socratic Seminar Preparation
The steps below are typical of Socratic Seminar preparation.

Disperse copies of Socratic Seminar documents for reference. Do not rush the introduction to Socratic Seminars, as some students will be nervous, have multiple questions, and require more clarification. The model utilized in this unit is adapted from the Advancement via Individual Determination (AVID) model.

1. Introduce the purpose, process, and structure of the Socratic Seminar.
   - The purpose is to refine claims through dialogue.
     - Refer to the Dialogue vs. Debate sheet for clarification as to the meaning of “dialogue.”
     - Refer to the Seminary Questions Cheat Sheet, the Socratic Seminar Observation Form, and the Socratic Seminar Rubric for clarifications regarding the process. The Cheat Sheet may be used by students and teachers.
   - The classroom chairs (with or without desks) will be arranged into two circles, an inner circle and an outer circle with everyone facing the center of the circle.
     - One half of the class is in the inner circle discussing the text, while the remaining half is in the outer circle observing and listening.
     - Members of the outer circle will be taking notes and using an evaluation form to track the overall conversation and to focus on specific participants. Refer students to the Socratic Seminar Observation Form.
     - At the end of the conversation, the outer circle can share their observations. The groups then switch to allow the outside group a chance to discuss.

2. Review the inner circle discussion norms.
   - During discussion there is no need to not raise hand to enter into discussion.
   - Listen carefully.
3. Select appropriate text.

4. Provide opportunities for all students to read the text prior to the discussion.
   - Instruct students to refer to the Lesson 2.6 Science Notebook Template for first and second read instructions.

5. Develop the opening question for the discussion. An effective opening question has no right or wrong answer and is framed to generate dialogue leading to greater understanding.
   - The suggested opening question is the unit question, “Should we eradicate invasive species?”

6. Provide adequate time for all students to record the essential question, develop their answer, and identify support for the answer.
   - Instruct students to refer to the direction provided within the Lesson 2.6 Science Notebook Template.
   - Tell students that they may also refer to previous unit work.

**Closure**

Exit Ticket: Before students leave, ask what questions they still have about Socratic Seminars. Students can respond on a half sheet of paper or sticky note.

**Assessment**

Ultimately, the Socratic Seminar Observation Form and Rubric are used in the assessment of participation in the seminar.

Students are monitored and assessed based on their participation in small group and class discussions. Formative assessment is ongoing in order to continually reveal misconceptions and to appropriately redirect instruction and questioning, so that the misconceptions are confronted in a constructive manner.

Student accountability is additionally maintained through notebook checks.

*Note that intentional probing questions throughout the lesson are key not only to formative assessment, but to student’s confrontation of misconceptions.*
Invasive-species Control: Bounty Hunters

Destructive lionfish are invading coral reefs in the Americas, but fishing competitions can help to keep the problem species in check.

Hannah Hoag
Nature, 12 September 2014

Stephanie Green plunged her hands, sheathed in thick black gloves, into a cooler full of lionfish. Skilfully avoiding its 18 venomous spines, she plucked one out and laid it on a table to record its length. Nearby, volunteers were chopping up the brown, red and white striped fish to make ceviche and passing the dish into the crowd.

As they nibbled on the food, teams of scuba divers milled around the scoring area. They checked out each other’s catches and argued over who would be taking home the more than US$3,500 worth of prizes from the 2013 lionfish hunting derby in Key Largo, Florida.

“At the check-in time it’s a mad rush, with teams coming in with coolers of fish, trying to beat the clock,” says Green, the chief scientist of the contest and a marine ecologist at Oregon State University in...
Corvallis. By the end of that day last September, Green and the other scorekeepers had counted 707 lionfish, from one smaller than a golf ball to one that stretched nearly two soccer balls long.

4 The hunting competition is part of an effort to tackle an invasive species that has been identified as one of the world’s greatest conservation issues. Since lionfish (Pterois volitans) first appeared on the eastern seaboard of the United States in the 1980s, the voracious predators have gobbled up coral-reef fish from North Carolina to Venezuela. Officials responsible for protecting reefs have struggled to find ways to control populations, and managers are embracing these fishing contests in a handful of coastal communities.

5 The strategy is a bit of a gamble, given that competitions to catch other invasive species — such as pythons in Florida — have had limited success. But the data collected by Green show that even one-day contests can effectively knock down local populations. Her findings and those from other hunting efforts offer lessons on how a little bit of reward money — coupled with science and outreach — can help to keep invasive species in check. “We can’t control lionfish in the entire ocean, but derbies can have high impacts locally,” says James Morris, an ecologist with the US National Oceanic and Atmospheric Administration in Beaufort, North Carolina.

6 Like many invasions, the lionfish conquest started small. The fish are normally found in the western Pacific Ocean, Indian Ocean and Red Sea, where predators and competitors keep the populations under control. Genetic analysis suggests that roughly a dozen fish were first introduced off the Florida coast, either accidentally or intentionally released from aquariums. From there, the population exploded. Lionfish spawn almost continuously, releasing 2 million eggs a year, and they have few predators or competitors in their new home.

7 “At first people thought they were funny, beautiful,” says Mark Vermeij, a conservation biologist at the Caribbean Marine Biological Institute on the island of Curaçao. But opinions changed as the lionfish took over, he says. “Quite quickly they were everywhere. They were like cockroaches.”

8 Since they were first spotted near Fort Lauderdale, Florida, in 1985, lionfish have colonized more than 4 million square kilometers — throughout the Caribbean Sea, the Gulf of Mexico and all along the Atlantic coastline of the southern United States — and show no signs of relenting. Marine ecologists worry that the invasion will eventually extend to Uruguay, stopped only by winter water temperatures. It could become one of the most ecologically harmful fish introductions in the western Atlantic, says Mark Hixon, a marine ecologist now at the University of Hawaii at Manoa, and Green’s supervisor at Oregon State. At some sites off the coast of North Carolina and in the Bahamas, the populations are 5–15 times denser than in the fish’s natural range, sometimes even reaching 400 fish per hectare.

9 The conquest could have profound effects on the biodiversity of coral-reef ecosystems. Lionfish consume whatever fits in their maws — and a lot of it. A DNA analysis of the stomach contents of 157 lionfish caught in the Mexican Caribbean identified 43 crustacean and 34 fish species, including parrotfish, French grunt and graysby — important sources of food for local people. Without natural predators, a lionfish can gobble up 79% of the juvenile fish on a reef in as little as five weeks.
The feeding frenzy could also lead to larger problems. Some of the fish they prey on clean algae off coral reefs and are already overfished in the Caribbean. Without these essential species, algae could outcompete the corals. Simulations by Jesús Ernesto Arias-González at the Center for Research and Advanced Studies of the National Polytechnic Institute, in Mérida, Mexico, have shown that a lionfish invasion would decrease the biomass of corals in a Caribbean reef by about 10% within ten years.
Out of control

11 Green did not set out to study lionfish. She had just started a doctorate in conservation biology when she travelled to the Bahamas in 2008 with her adviser Isabelle Côté, a biologist at Simon Fraser University in Burnaby, Canada. A student they visited was seeing lionfish all over her study sites. “Nobody knew anything about them, the basics of where they were, or what they ate,” says Green.

12 Green and Côté wondered whether the native fish would return if they removed the lionfish. In December 2009, they staked out 24 patches of reef and arranged for scuba divers to prune the population of lionfish at the sites every month for 18 months. They predicted that the culling effort would need to remove 25–92% of the predators, depending on the site, to keep them from consuming too much of the prey species. By the end of the experiment, the native fish had rebounded by 50–70% in the reefs that reached the targeted level of protection.

13 Green and Côté were not the only ones to hunt down lionfish. Earlier that year, the Reef Environmental Education Foundation (REEF) in Key Largo, Florida, had started running derbies in the Bahamas to increase local awareness of the invasion. Green, who had been collaborating with the foundation during her PhD, got involved in planning the first hunts.

14 She later decided to use the competitions to test whether limited hunts could have an impact. With the help of volunteers outfitted in scuba and snorkels, Green counted lionfish at 60 sites before and after the derbies in Key Largo and the Bahamas in 2012 and 2013. On the basis of a preliminary analysis of the derbies, she says, “there were dramatic drops in the densities of lionfish in the sites where people fish.” After the competitions, lionfish densities were slashed by more than 60% over a 100–150 km² area compared with pre-derby levels. “It’s like pulling weeds from your garden,” she says. “You’re not going to completely get rid of them, but below a certain level, they won’t cause problems.”

15 Lionfish recolonized the sites within six months, but the animals were significantly smaller, which helped to reduce pressure on the reef. Smaller lionfish eat less, prey on smaller fish and produce fewer young.

16 Ted Grosholz, a marine ecologist at the University of California, Davis, says that the data collected by Green and REEF support the idea that derbies can effectively control lionfish populations in selected areas. They also dovetail with results from other lionfish control efforts. When the fish invaded the Dutch Caribbean in 2009, volunteers immediately began to use spear guns to remove lionfish from the...
island of Bonaire, but did nothing in neighbouring Curaçao. After two years of spearfishing, Vermeij and his colleagues found that the lionfish biomass in the treated areas of Bonaire was just one-third of that in the unfished areas, and about one-quarter of what was seen in Curaçao.

**On Target**

17 The lionfish contests have been much more successful than some other efforts that have used hunters to control invasive species. In 2013, for example, the Florida Fish and Wildlife Conservation Commission organized the first Python Challenge, a month-long event with cash prizes that enlisted professional and amateur hunters to remove Burmese pythons (*Python bivittatus*). But the pythons proved tough to catch because they are hard to spot in the Florida brush; the hunters caught just 68 snakes from a population that is estimated at 30,000–100,000.

18 Jason Goldberg, a biologist at the US Fish and Wildlife Service in Arlington, Virginia, says that derbies could be improved by incorporating the results of research. Organizers need to calculate how many individuals to remove, whether it is better to cull older or larger individuals and how their density affects the health of the population. That information can then be used to set hunting targets — and prevent the kinds of problems that arose when Australia culled red foxes (*Vulpes vulpes*). The 2002–03 Victorian Fox Bounty Trial removed one-fifth of the state’s red foxes but ended up boosting the population because the survivors thrived when they had less competition for food.

19 Cash incentives can help by drawing amateurs into efforts to control invasives. In the Pacific northwest, for example, anglers are offered $4–8 for every northern pike minnow (*Ptychocheilus oregonensis*) they capture to deter the fish from preying on young salmon. The programme has removed more than 3.9 million fish and slashed predation by 40%.

20 Goldberg says that research on lionfish derbies should offer insight into how often — and when — they should take place at each location. He adds that new steps might be needed, such as encouraging commercial fishing of lionfish to make the species more common in restaurants.

21 The lionfish invasion and the success of the derbies has led to policy changes in Florida. In August, wildlife regulators relaxed hunting restrictions in the state to allow divers wearing rebreathers — devices that allow them to remain in the water for longer — to harvest lionfish. It will also now allow derby participants to spear lionfish in areas where spearfishing is otherwise prohibited. “For marine protected areas to function as conservation areas, it’s important that the biology and ecology be conserved to the highest level possible, and that now requires lionfish control,” says Morris.
With her results pointing in a positive direction, Green intends to continue analysing data from lionfish derbies, including an event in Key Largo on 13 September. When she shares her research findings with the divers, it tends to fire them up, she says. “There’s this good community feeling at the derbies that this is a tool that can have a positive effect and help to suppress the invasion.”

Nature 513, 294–295 (18 September 2014) doi:10.1038/513294a

References

## Dialogue vs. Debate

**AVID Socratic Seminar**

<table>
<thead>
<tr>
<th>Dialogue</th>
<th>Debate</th>
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<tbody>
<tr>
<td>Dialogue is collaborative; multiple sides work toward a shared understanding.</td>
<td>Debate is competitive and/or oppositional; two opposing sides try to prove each other wrong.</td>
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<tr>
<td>In dialogue, one listens to understand, to make meaning, and to find common ground.</td>
<td>In debate, one listens to find flaws, to spot differences, and to counter arguments.</td>
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<tr>
<td>Dialogue enlarges and possibly changes a participant’s point of view</td>
<td>Debate affirms a participant’s point of view.</td>
</tr>
<tr>
<td>Dialogue creates an open-minded attitude; an openness to being wrong and an openness to change</td>
<td>Debate defends assumptions as truths.</td>
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<tr>
<td>In dialogue, one submits one's best thinking, expecting that other people's reflections will help improve it rather than threaten it.</td>
<td>In debate, one submits one's best thinking and defends it against challenge to show that it is right.</td>
</tr>
<tr>
<td>Dialogue calls for temporarily suspending of one's beliefs.</td>
<td>Debate, calls for investing wholeheartedly in one's beliefs.</td>
</tr>
<tr>
<td>In dialogue, one searches for strengths in all positions.</td>
<td>In debate, one searches for weaknesses in the other positions.</td>
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<tr>
<td>Dialogue respects all the other participants and seeks not to alienate or offend.</td>
<td>Debate rebuts contrary positions and may belittle or deprecate other participants.</td>
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<tr>
<td>Dialogue assumes that many people have pieces off answers and that cooperation can lead to workable solutions.</td>
<td>Debate assumes a single right answer that somebody already has</td>
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<tr>
<td>Dialogue remains open-ended.</td>
<td>Debate demands a conclusion.</td>
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<tr>
<td>Dialogue is mutual inquiry; collective knowledge.</td>
<td>Discussion is individual opinions; individual knowledge.</td>
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Seminar Questioning Cheat Sheet

AVID Socratic Seminar

Clarification Questions:
- What do you mean by _____?
- What is your main point?
- How does _____ relate to _____?
- Could you put that another way?
- What do you think is the main issue here?
- Let me see if I understand you. Do you mean _____ or _____?
- Jane, would you summarize in your own words what Juan has said? . . . Juan, is that what you meant?
- Could you give me an example?
- Would _____ be an example?
- Could you explain that further?
- Could you expand upon that?

Questions about the Initial Question or Issue:
- How can we find out?
- What does this question assume?
- Would _____ put the question differently?
- How could someone settle this question?
- Can we break this question down at all?
- Is the question clear? Do we understand it?
- Is this question easy or hard to answer? Why?
- Does this question ask us to evaluate something?
- Do we all agree that this is the question?
- To answer this question, what question would we have to answer first?
- I am not sure I understand how you are interpreting the main question at issue.
- Is this the same issue as?
- How would _____ put this issue?
- Why is this question important?
- Does this question lead to other questions or issues?

Assumption Probes:
- What are you assuming?
- What is Erika assuming?
- What could we assume instead?
- You seem to be assuming _____ . Do I understand you correctly?
- All of your reasoning depends on the idea that _____ . Why have you based your reasoning on _____ rather than _____?
- You seem to be assuming _____ . How would you justify taking this for granted?
- Why would someone make this assumption?

Reason and Evidence Probes:
- What would be an example?
- How do you know?
- Why do you think that is true?
- Do you have any evidence for that?
Reason and Evidence Probes (continued):
• What difference does that make?
• What are your reasons for saying that?
• What other information do we need?
• Could you explain your reason to use?
• Are these reasons adequate?
• Can you explain how you logically got from _____ to _____?
• Do you see any difficulties with their reasoning here?
• Why did you say that?
• What led you to that belief?
• How does that apply to this case?
• What would change your mind?
• But is that good evidence to believe that?
• Is there a reason to doubt that evidence?
• Who is in a position to know if that is so?
• What would you say to someone who said _____?
• Can someone else give evidence to support that response?
• By what reasoning did you come to that conclusion?
• How could we find out whether that is true?

Origin or Source Questions:
• Where did you get this idea?
• Do your friends or family feel the same way?
• Has the media influenced you?
• Have you always felt this way?
• What caused you to feel this way?
• Did you originate this idea or get it from someone else?

Implication and Consequence Probes:
• What are you implying by that?
• When you say _____, are you implying _____?
• But if that happened, what else would happen as a result? Why?
• What effect would that have?
• Would that necessarily happen or only probably happen?
• What is the probability of this result?
• What is an alternative?
• If this and this are the case, then what else must also be true?
• If we say that this is unethical, how about that?

Viewpoint Questions:
• You seem to be approaching this issue from _____ perspective. Why have you chosen this rather than that perspective?
• How would other groups/types of people respond? Why? What would influence them?
• How could you answer the objection that _____ would make?
• What might someone who believed _____ think?
• Can/did anyone see this another way?
• What would someone who disagrees say?
• What is an alternative?
• How are _____ and _____’s ideas alike? Different?
Socratic Seminar Rules and Tips

AVID Socratic Seminar

Socratic Seminar Rules

- Discuss, do not debate.
- Be courteous, NO PUTDOWNS.
- Goal is the pursuit of deeper understanding.
- Respect different thoughts and ideas.

Socratic Seminar Tips

Your Goal is to Understand...

- the ideas,
- and values reflected in the text.

Protocol:

- Refer to the text when needed during the discussion. This is not a test of memory.
- Do not stay confused; ask for clarification of both ideas and definitions.
- Discuss ideas, rather than other’s opinions.
- It’s OK to pass when your turn comes; participate at another time instead.
- Do not participate if you are not prepared.
- Stick to the point currently under discussion; write down inspirational ideas so you can bring them up at a more appropriate time in the conversation.
- Listen carefully, especially when you are waiting to speak, as they may be moving on to another point.
- Speak up so that all participants can hear you; don’t speak while others are.
- Remember that this is a conversation between students, not between student and teacher.

Basic steps to forming opinions:

1. What is it that I think I know? Or that the author thinks he/she knows? Can I restate his/her ideas in my own words? What needs clarification? Definition?
2. Is it true? Why do I think so? What else do I need to know or understand before deciding?
3. What inferences can be drawn from this? What are the implications of this? So what? How does this change things?
4. What are the underlying assumptions with this claim?
5. What are the reasons I believe this? How do I know what I think I know? Is the evidence credible?
6. How does this happen in other situations? In the world? How does this connect to other stuff?
7. Can I think of a counter example? When this doesn’t happen? Why doesn’t it happen? Are there internal contradictions?
# Socratic Seminar Observation Form

Your Name: | Partner:
---|---

**Directions:** Each time your partner does one of the following, put a check in the box.

- **SPEAKS IN DISCUSSION**
- **LOOKS AT THE PERSON WHO IS SPEAKING**
- **REFERS TO THE TEXT**
- **ASKS A QUESTION**
- **RESPONDS TO ANOTHER SPEAKER**
- **INTERRUPTS ANOTHER SPEAKER**
- **ENGAGES IN SIDE CONVERSATION**

**AFTER DISCUSSION:** What is the most interesting thing our partner said?

**AFTER DISCUSSION:** What would you like to have said in the discussion.
# Socratic Seminar Rubric

<table>
<thead>
<tr>
<th></th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANALYSIS</strong></td>
<td>Provides deep analysis, without prompting, to move the conversation forward.</td>
<td>Provides solid analysis, without prompting, to move the conversation forward.</td>
<td>Offers some analysis, but needs prompting from others.</td>
<td>Offers little/no analysis.</td>
</tr>
<tr>
<td><strong>UNDERSTANDING</strong></td>
<td>Demonstrates a deep knowledge of the text and the questions.</td>
<td>Demonstrates a solid knowledge of the text and the questions.</td>
<td>Demonstrates a general knowledge of the text and the questions.</td>
<td>Demonstrates a weak knowledge of the text and questions.</td>
</tr>
<tr>
<td><strong>PREPARATION</strong></td>
<td>Has come to the seminar prepared, with notes and a marked text.</td>
<td>Has come to the seminar prepared, with notes and a marked text.</td>
<td>Has come to the seminar inadequately prepared, with few notes and a little/no marked text.</td>
<td>Has come to the seminar ill-prepared, lacking notes or a marked up text.</td>
</tr>
<tr>
<td><strong>ACTIVE LISTENING &amp; EXTENSION</strong></td>
<td>Shows he/she is actively listening through body language, comments, and questions. Offers clarification and/or follow-up that extends the conversation by building on others’ comments.</td>
<td>Shows he/she is actively listening through body language, comments, and questions. Offers some clarification and/or follow-up.</td>
<td>Rarely shows he/she is actively listening through body language. Does not offer clarification and/or follow up to others’ comments.</td>
<td>Does not show active listening. Body language/posture is unprofessional/inappropriate. Does not offer clarification and/or follow up to others’ comments.</td>
</tr>
<tr>
<td><strong>EVIDENCE</strong></td>
<td>Almost always refers to specific examples in the text.</td>
<td>Often refers to specific examples in the text.</td>
<td>Relies more upon his/her opinion, and less on the text to drive his/her comments.</td>
<td>Relies almost totally on his/her opinion, and less on the text to drive his/her comments.</td>
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Lesson 2.6 Science Notebook Template
Socratic Seminar Preparation

Directions: Record all written responses in your Science Notebook.

Before Socratic Seminar – First Read
1. Read through the entire section without stopping to think about any particular section. Pay attention to your first impression as to what the reading is about. Look for the main points and then go back and reread it.
2. The second time you read it, talk to the text.
   a. Underline major points or forceful statement.
   b. Put vertical lines at the margins to emphasize a statement already underlined or a passage too long to be underlined.
   c. Put an (*) to emphasize major points.
   d. Put numbers in the margin to indicate sequence of points.
   e. Put numbers of other pagers where point is also mentioned.
   f. Circle key words or phrases.
   g. Write in the margin questions that come to mind.

Socratic Seminar Preparation – Second Read
Name of Article: __________________________________________________________
Author(s): ______________________________________________________________

1. Read the article individually.
2. Highlight or underline at least one main idea per paragraph. Summarize main points for paragraphs 1 – 22.
3. Circle unfamiliar words or phrases. Write them down with their definitions.
4. Summarize the main points of the reading.
5. Write down minimum of six questions about what you have read. (Use two level 1, 2, and 3 questions)

<table>
<thead>
<tr>
<th>Opening Questions</th>
<th>Core Questions</th>
<th>Closing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
<tr>
<td>• Relate to text</td>
<td>• Develop theme</td>
<td>• Relate to self</td>
</tr>
<tr>
<td>• Use concrete examples</td>
<td>• Lead into abstract</td>
<td>• Relate to reality</td>
</tr>
<tr>
<td>• Not yes or know questions</td>
<td>• Lead to further questions</td>
<td></td>
</tr>
</tbody>
</table>

EXAMPLE

What does the author mean when she states that “the conquest could have profound effects on the biodiversity of coral-reef ecosystems.”

EXAMPLE

Is this type of invasive species eradication appropriate for other animal invasive species such as the feral cat?

EXAMPLE

What in your thinking has changed about the way we should tackle the invasive species dilemma?