Name: _____ Group: _____

THE PROBLEM

MEMO

TO: R&D personnel

ON: March 20, 2009

SUBJECT: Research contract

This memo is to remind you of the mandate entrusted to us. Prolonged exposure to sounds louder than 100 dB can cause long-term hearing damage. Your job is to imagine a device capable of measuring the amplitude of sound vibrations produced by a loudspeaker. This will entail performing a technological analysis of a speaker. We will supply you with a speaker so that you can draw the necessary design plan and technical diagram. The attached procedure will take you through the steps for observing how a speaker operates. You are to provide your boss with a design plan for your measuring device and a description of how it works. We will call on an outside firm to produce the technical diagram once we have approved your design plan.

Louise Latreille
Louise Latreille
Personnel director

In this learning and evaluation situation, you will play the role of one of the personnel in the R&D department.

Name: _____ Group: _____

THE PROBLEM *(continued)*

How to observe the operation of a speaker

Materials

- 60-mm speaker
- variable voltage alternating current (AC) source
- 4 electrical wires with crocodile clips
- multimeter *or* AC voltmeter

Procedure

1) Connect a wire to a terminal of the AC source.
2) Connect that wire to the positive terminal of the speaker.
3) Connect a wire to the other terminal of the AC source.
4) Connect that wire to the negative terminal of the speaker.
5) Connect the multimeter or AC voltmeter to the speaker terminals.
6) Energize the AC source.
7) Calibrate the AC source to 1 V.
8) Observe and record how this affects the speaker cone.
9) Observe and record how this affects the sound produced.
10) Increase the voltage of the current source to 2 V.
11) Observe and record how this affects the sound produced.

Name: _____ Group: _____

CREATING THE CONTEXT

I ask myself questions

1. What is a speaker?

2. What is sound?

3. What is a vibration?

4. What is amplitude?

5. How is the intensity of a sound from a speaker amplified?

6. What questions could guide your technological analysis of the speaker?

Name: _____ Group: _____

CREATING THE CONTEXT *(continued)*

I must

7. Reformulate the goal of the problem in your own words.

_____

_____

_____

I think

8. How do you think a speaker varies the intensity of a sound? Justify your answer.

_____

_____

_____

What I know and what I must find out

9. Record the information you have and the information you have to find.

What I know . . .	What I must find out . . .

Name: _____ Group: _____

CREATING THE CONTEXT *(continued)*

I prepare my work

10. How will you find the information you need to design a device for measuring vibrations?

11. Give the main steps of your work in chronological order.

Reflection

Do I clearly understand what I have to do?

Yes ☐ No ☐

Name: _____ Group: _____

GATHERING INFORMATION

I do research

1. What is a wave?

_____

_____

_____

2. Name four characteristics of a wave.

_____

_____

_____

3. In what ways do waves propagate?

_____

_____

_____

4. What distinguishes between these ways of propagating?

_____

_____

_____

_____

5. How does sound propagate through the air?

_____

_____

6. To what does the amplitude of a sound correspond?

_____

_____

7. How will you measure the amplitude of a transverse wave?

_____

_____

_____

Name: _____ Group: _____

GATHERING INFORMATION *(continued)*

I do research

8. What is a wavelength?

9. What is frequency?

I analyze my results

10. What is the overall function of a speaker?

11. Name a few material, human or esthetic constraints involved in designing a speaker.

12. Observe the operation of a speaker according to the procedure provided. Record your observations in the following table.

Voltage	Effects on the cone	Effects on sound
1 V		
2 V		

Name: _____ Group: _____

GATHERING INFORMATION *(continued)*

I analyze my results *(continued)*

13. Draw the design plan of the speaker as a cross-sectional view. Mark the following information on your plan:
- symbols for the forces involved
- symbols for the types of motion produced
- names of the following components: frame, permanent magnet, enclosure, plastic cylinder cone, copper wire coil, fabric diaphragm

Name: _____ Group: _____

GATHERING INFORMATION *(continued)*

I analyze my results *(continued)*

14. Draw the technical diagram of the speaker as a cross-sectional view. You do not have to include a legend of materials. However, make sure you mark the following information on your diagram:
- names of the components
- symbols for the guiding controls
- symbols for the linking components

15. How does the speaker increase the amplitude of the sound wave produced?

_____

_____

_____

Reflection

Have I clearly understood the following:	Yes	No
• amplitude?	☐	☐
• wavelength?	☐	☐
• frequency?	☐	☐

Name: _____ Group: _____

COMPLETING THE PROBLEM SOLVING

I make suggestions

1. Explain briefly how your device could measure the amplitude of a sound.

_____

_____

_____

_____

_____

2. Draw the technical diagram for your device. If necessary, represent the movements produced.

Reflection

	Yes	No
Have I considered various design solutions?	☐	☐

Name: _____ Group: _____

VALIDATING THE PROBLEM SOLVING

I justify my approach

1. Justify how your device measures the amplitude of the sound vibrations produced by the speaker.

2. How would your device enable you to identify sounds harmful to the ear?

3. What are the advantages of your device?

4. What are the disadvantages of your device?

5. How would you improve your device?

Name: _____ Group: _____

MY EVALUATION

Use the evaluation grid on the next page for your self-evaluation. Write A, B, C, D or E in the appropriate spaces in this table.

SSC 2 Makes the most of his/her knowledge of science and technology				
Criteria*	**Observable indicators**	**Me**	**Teacher**	**Comments**
1	**Creating the context** Definition of the goal and formulation of questions for technological analysis of the speaker		☐ With help	
2	**Gathering information** Development of a design plan and a technical diagram for the speaker		☐ With help	
3	**Completing the problem solving** Design plan for a measuring device and description of its operation		☐ With help	
4	**Validating the problem solving** Justifications of the solution		☐ With help	

*** Evaluation criteria**

1. Formulation of appropriate questions
2. Appropriate use of scientific and technological concepts, laws, models and theories
3. Relevant explanations, solutions or actions
4. Suitable justification of explanations, solutions or actions

Name: _____ Group: _____

EVALUATION GRID

SSC2 Makes the most of his/her knowledge of science and technology

Criteria*	Observable indicators	A	B	C	D	E
1	**CREATING THE CONTEXT** Definition of the goal and formulation of questions for technological analysis of the speaker	The questions for technological analysis are relevant AND the problem solving goal is very clear.	The questions for technological analysis are relevant AND the problem solving goal is clear.	The questions for technological analysis are more or less relevant OR the problem solving goal is more or less clear.	The questions for technological analysis are more or less relevant AND the problem solving goal is more or less clear.	The work needs to be redone.
2	**GATHERING INFORMATION** Development of a design plan and a technical diagram for the speaker	The design plan and the technical diagram are accurate and complete.	The design plan and the technical diagram are complete, but contain a few errors.	The design plan and the technical diagram are incomplete or contain many errors.	The design plan and the technical diagram are incomplete and contain many errors.	The work needs to be redone.
3	**COMPLETING THE PROBLEM SOLVING** Design plan for a measuring device and description of its operation	The design plan and the description portray the operation of the device.	The design plan and the description portray the operation of the device, but contain a few errors.	The design plan and the description portray the operation of the device more or less accurately or contain many errors.	The design plan and the description portray the operation of the device more or less accurately and contain many errors.	The work needs to be redone.
4	**VALIDATING THE PROBLEM SOLVING** Justifications of the solution	The justifications are very clearly stated and are all relevant. At least one advantage and one disadvantage are named and are relevant.	The justifications are clearly stated and are all relevant. At least one advantage and one disadvantage are named.	The justifications are more or less relevant OR the advantage and the disadvantage are more or less relevant.	The justifications are more or less relevant AND the advantage and the disadvantage are more or less relevant.	The work needs to be redone.

*** Evaluation criteria**

1 Formulation of appropriate questions
2 Appropriate use of scientific and technological concepts, laws, models and theories
3 Relevant explanations, solutions or actions
4 Suitable justification of explanations, solutions or actions