

## Lesson Plan for ‘Development of Regional Resources’: Focusing on Metal Resources

### 「地域資源と利用（地域資源管理論）」の授業計画 －金属資源に焦点を当てて－

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#### 概要

本学の国際教養学科において、地域に存在する資源とかかわりの深い授業の一つとして、2013年に「地域資源管理論」が開講された。その後、2018年に行われた改組により、「地域資源と利用」として生活デザイン学科に提供されることになった。オムニバス形式による本授業では、著者は金属資源に焦点を当てて授業を展開しているが、生活デザイン学科という中で、学生たちが興味をもち、満足をする授業が必要であると考え。そこで、本論文では、実習や実験を伴わない学生中心の授業展開と、それによる学生の反応をもとに、今後の授業への改善案を提案するための考察を行った。

Key words: 学生中心の学習, Student-Centered Learning, 授業計画 Lesson Plan, 地域資源 Regional Resources, 金属 Metals, 金属の特徴 Properties of Metals, 科学読み物 Science Readings

#### 1. Introduction

The Development of Regional Resources (DRR) course was launched biennially at the Faculty of Liberal Arts for junior class students of Hiroshima Jogakuin University in 2013. With the reorganization of our university in 2018, it was decided that the DRR course would be provided annually to first-year students of the Department of Human Life and Environment at the Faculty of Human Life Studies mainly with the aim of deepening the interest of participating students in regional resource issues and cultivating within them the desire to contribute to the effective use of those resources.

The 15-lesson DRR lecture series is given by three instructors in an omnibus format under guidance that is provided by the coordinator during the first lesson. The author instructs the second to sixth lessons, which deal with metal resources. Studies on metal education for university students are aimed primarily at providing education course students with lessons that include practice sessions, e.g., metalworking<sup>1), 2)</sup>. Moreover, Kitamura<sup>3)</sup>, referring to lectures on metal properties and experiments and demonstration involving metal, noted the need for metal education in Technology and Home Economics curriculums for junior high school students.

Recently, the instructors in our university have been required to design lessons aimed at student-centered learning. Accordingly, a plan has been formulated to allow female students majoring in Human Life and Environment studies to actively acquire metal knowledge without requiring experiments and practice sessions. In this paper, we describe the first such lesson, which was the second class of the 15-lesson series, and provide suggestions for future lesson improvements.

## 2. Lesson plan

### 2-1. Lesson plan outline

Since female students only study metal in the DRR course, they were unable to answer most questions related to the kinds of metals that are used in our daily lives and what items covered were made of metallic materials in their previous lesson. Accordingly, we formulated an attractive lesson plan for first-year female students who normally study fashion, interior décor, housing architecture, lifestyle, and local culture. The topics of classes two to six in the series conducted by the author in 2018 were as follows:

2. Metal fundamentals
3. Metal for tools
4. Metals as decor
5. Metals as nourishment and treatment
6. Summary and examination

The details of the second lesson are covered in the following section.

### 2-2. Second lesson details

A detailed description of the second lesson plan in the 15-lesson DRR series is provided in Table 1.

**Table 1 Lesson plan for the second lecture in the DRR series**

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Topic:

Metal fundamentals (What are metals?)

Learning objective:

Students will learn to identify the properties of metals.

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Introduction: (15 min)

List three kinds of skills and techniques in your mind, as shown on the whiteboard.

Instruct students to write down three skills that relate, in any way, to metallic products.

Write the following examples on the whiteboard:

Ice Skating: Skate blades

Bonsai: Trimmers

Cooking: (leave blank)

Instruct each student to write their answers on the whiteboard and show them to the rest of the class.

Supplement the information on what kinds of metals are used for the products in their answers.

Explain how metals are incorporated into the goods and tools we use in our daily lives.

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Development: Part one: History of tools (20 min)

Query students regarding the time periods when people started using metallic tools. Ask, "Was iron the first metallic material used?"

Write the following on the whiteboard:

History of tools

1. Stone age
2. (        ) age
3. (        ) age

Explain to students how metals were incorporated into mythology. For example, Greek mythology, Kojiki (A Record of Ancient Matters), and Nihon Shoki (Chronicles of Japan)<sup>4)</sup>.

Write the five age categories of Greek mythology<sup>5)</sup> on the whiteboard as follows:

Timeline of the ages of man in Greek mythology

1.        Golden age
2.        Silver age
3.        Bronze age
4.        Age of Heroes
5.        Iron age

If there is sufficient time, replace Golden with '(        )' and ask a student volunteer to fill the brackets with the correct metal.

Provide a brief overview of the five ages.

Note that the iron age is ongoing.

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Development: Part two: Grouping of metals (20 min)

Query students on what kinds of metallic beverage cans can be purchased from vending machines.

Show the students the two most common metallic beverage cans and write the following on the whiteboard:

Steel

Aluminum

(Steel, which consists primarily of iron, a slight amount of carbon, and other trace metals, will be discussed in detail during the third lesson.)

Query students on the differences between steel and aluminum.

Note, students will usually say that hardness is the primary difference.

Steel            Hard

Aluminum      Soft

Inform students that recent technology can make steel cans as thin as aluminum cans<sup>6)</sup>.

Encourage students to touch steel and aluminum cans.

Inform students about metal groupings.

Write four types of metal groupings on the whiteboard as followings:

keywords	groupings	
Abundance	Base metals	Rare metals
Usage	Iron	Non-ferrous metals
Corrosion resistance	Precious metals	Base metals
Specific gravity	Heavy metals	Light metals

Supplementary: There is no sharp line between the precious and base metal groupings.

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Development: Part three: Metal properties (20 min)

Ask students to explain the differences between metals and other materials such as stones and paper.

Write the following hints for metal properties on the whiteboard:

Hints:

1. Aluminum foil
2. Wire hangers
3. Electronic circuits
4. Heaters
5. Mirrors

If possible, show students the products mentioned above.

Hints regarding the properties of metals discussed above.

1. Malleable
2. Ductile
3. Electrically conductive
4. Thermally conductive
5. Reflective

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Assessment phase: (3 min)

Quiz:

First option

Ask students to write down the properties of metals that they learned in today's lesson.

Second option

Connect A and B with a line to a closely suitable property. Items in A can be connected to plural properties shown in B.

A (Metallic products)	B (Metal properties)
A-1 Printer cable	B-1. Malleable
A-2 Oil-blotting paper made of gold leaf	B-2. Ductile
A-3 Silver ring	B-3. Electrically conductive
A-4. Steam iron	B-4. Thermally conductive
A-5. Piano wire	B-5. Reflective

Expected student answers:

A-1 (B-2, B-3)

A-2 (B-1)

A-3 (B-1, B-2, B-5)

A-4 (B-4)

A-5 (B-2)

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Review and closing: (9 min)

Inform students that people have used metallic products since ancient times due to their useful properties.

Instruct students to answer the above assessment quiz.

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Assignment: (3 min)

Instruct students to bring a printed online periodic table to the next lesson or to bring a book that contains a periodic table, such as a high school chemistry textbook.

An example chart can be found at: [http://stw.mext.go.jp/common/pdf/series/element/element\\_b10.pdf](http://stw.mext.go.jp/common/pdf/series/element/element_b10.pdf)

### 3. Discussion

When, in the previous lesson, we asked the students about metallic products and the names the types of metals they used (e.g., aluminum and iron), they were unable to answer those questions confidently. In the second lesson plan, we begin by asking students to think about three kinds of skills that relate in any way to metallic products and to give examples. Then, after allowing a few minutes for thought, the students are directed to write down their answers in their notebooks. The purpose of this introduction is to make students aware that skills and metals are often linked.

In Part 1 of the new development, we covered the history of tools. Bronze and iron artifacts are currently considered to have arrived in ancient Japan simultaneously, which means Japan did not have a bronze age. However, a hint regarding dotaku (ritual bells made from copper) dating to the Yayoi Period helps students to solve the provided quiz.

In their study, Shiba, Yamasaki, Nakata, and Ogawa<sup>7)</sup> evaluated and affirmed the effectiveness of promoting an understanding of metal-related concepts via original science readings during lessons for elementary school children. In the DRR lessons, we instruct students using a history book on Greek mythology in which periodization is described by using the names of different metals. One student said that the stories she learned had caused her to take an increased interest in metals. Recently, Wakino and Sumiya<sup>8)</sup> reported that, for junior high school students, science readings correlate with their interests in science and effect their motivation to learn. Although Greek mythology may not be considered a normal topic for a science lesson, they found that the unexpected combination of mythology and metals had the potential to stimulate student curiosity when included in a lesson on metals.

In our assessment phase, we prepared the two quizzes shown in Table 1. In the first quiz, students were initially only requested to write down five words they had learned. However, it was later thought it would be better to ask students to provide specific examples and briefly explain the properties of metals.

To be ready for a strict on-time policy, as well as for supplementary lesson tools, we intend to design science-reading-like worksheets for future DRR lessons.

#### 4. Summary

In this study, we described the lesson plan of the second lecture in the DRR lecture series in order to stimulate more active learning interest than students would normally achieve simply by listening to a lecture. We also provided suggestions for future lesson improvements. The lesson plan in the present study focusses on the following four key points:

1. Combination of mythology and metals
2. Ingenuity during questioning (metallic products and skills)
3. Suggestions for improved assessment activities
4. Suggestions for the use of science-reading-like worksheets in DRR classes

The second option quiz has not yet been implemented in the assessment phase. Accordingly, we intend to ask students to complete this quiz during the next lesson.

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