HOKKAIDO UNIVERSITY

# Role of Integrated Science Approach in Higher Education in Japan: An attempt at Hokkaido University

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# Science Education in Japanese High School

- K10-K11 Students must learn three subject (fundamental level) out of four subjects; Physics, Chemistry, Biology, Earth Science
- High school students must choose STEM or non-STEM in K11.
- STEM-oriented students choose two (higher level) subjects our of four.
- Entrance exam requires up to two subjects, so most of the students have forgotten other subjects.

**It is difficult for High school students to understand the whole scope of science.**

# Social problem related to science

**Problem of Nuclear Waste**

Cost
(Economy)

Politics

**Relation to Science**

**Nuclear decay (Physics)**

**Reaction of radioactive materials (Chemistry)**

**Effects on Lifes (Biology)**

**Location of disposals (Earth Science)**

Science literacy is the knowledge which should be used in our lives.

# Integrated Approach

**The Sciences: An Integrated Approach, 5th Edition**

**James Trefil, George Mason Univ.**

**Robert M. Hazen, George Mason Univ.**

# In Hokkaido University

**We started Integrated Science Course (2 units, one year) 2009～**

1. **Lecture 60 minutes with clickers**
2. **Discussion 30 minutes**

**T. Hosokawa, M. Ogasawara, and H. S.**

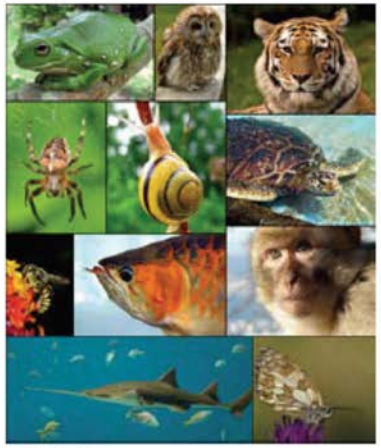
# Textbook

Integrated science from the beginning

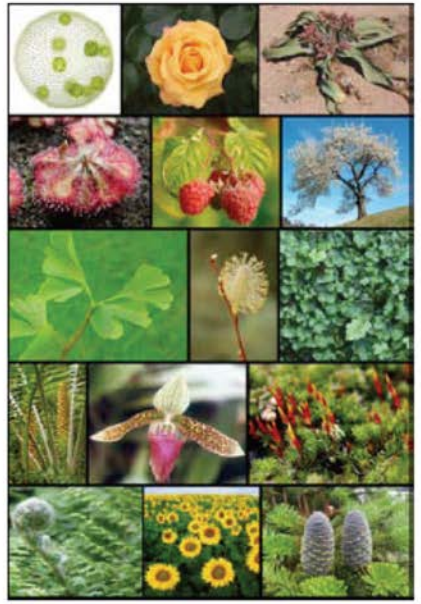
530 pages

Students can download them freely through course management system.

菌界



動物界



植物界

# Homework Quiz and reports (Moodle)

直近イベント

第１回目テスト(５月９日締め切り) (公開日時)
今日, 02:30
第２回テスト（５月９日締め切り）(公開日時)
平成28年 04月 25日, 02:36

カレンダーへ移動する ...
新しいイベント ...

最近の活動

平成28年 04月 16日(土曜日) 21:15 以来の活動
最近の活動詳細 ...
新しい活動はありません。

ニュースフォーラム

## 第１回（４月１８日）

科学とは何かと科学的方法について学びます。**２回目からの出席者もテキストを読んで、第１章テストを受講してください。２回目からの出席者は１回目レポートは提出しなくてもかまいません。**

- 第１章テキスト
- 第１回目テスト(５月９日締め切り)
- 第１回目または２回目レポート(５月９日締め切り)

## 第２回（４月２５日）

宇宙の秩序と天空、地上の力学について勉強しましょう。小テストとレポートを提出してください。 **１回目または２回目のレポートの点数の高い方を成績に反映させます。**

- 第２章テキスト
- 第２回テスト（５月９日締め切り）

## 第３回（５月９日）

ニュートンによる天空と地上の力学の統一について学びます。今回授業課題に関してのレポートはありませんが、授業で良い発表をしたグループにはグループ全員に点数が与えられます。

- 第３章テキスト
- 第３章テスト（５月１６日締め切り）

## 第４回（５月１６日）

エネルギーと熱について勉強します。


UNIVERSITY

# Discussion

**We use Open-ended Problems, which do not have unique answer.**

**Most of the problems in STEM subject in undergraduate are algorithmic problems.**

# Problem type classification (Jonassen 2000)

**Problems in STEM subjects are limited!**

**We are trying to make problems with wider classes.**

**Trouble shooting**

**Dilemmas**

**Decision Making**

| Type | Class | Examples | Familiarity in Undergraduate STEM Education |
|---|---|---|---|
| 1 | Logical Problems | Rubik's cube, proofs of mathematical theorem | Familiar in mathematics, Physics |
| 2 | Algorithmic Problems | Textbook problems, Solved by software | Quite Familiar in STEM subjects (Students tend to solve problem without understanding the underlying concepts→ConcepTests, Ranking Tasks) |
| 3 | Story Problems | Real world mathematics, physics | Familiar Context-rich problems |
| 4 | Rule using Problems | Formula using problem | Familiar |
| 5 | Decision Making Problems | Decision in Stock trading, Decision in situation change | Unfamiliar |
| 6 | Trouble-shooting | debugs | Familiar in programming and engineering but rare in other science |
| 7 | Diagnosis-Solution Problems | Evaluating treatment options | Unfamiliar |
| 8 | Strategic Performance problems | Applying tactics in real time negotiation | Unfamiliar |
| 9 | Case Analysis Problems | Low school problems | Unfamiliar |
| 10 | Design Problems | Planning problems | Unfamiliar |
| 11 | Dilemmas | Dilemma in real world, very familiar in real world | Unfamiliar |

# Dilemmas

We can get information about genetic cancer or Down syndrome before birth.

Discuss the advantage and disadvantage and find your answer for whether you will have the tests. Consider ethics and the lives of your descendant after your death.

# Dilemmas

Some scientist claims that the Vitamin C cures cancers. How do you prove or disprove his claim? Consider ethics.

# Findings

They lack the knowledge of social factors( Economy, ethics, etc.)

This is not the course for knowledge( we do not have enough time)  but to realize the importance of viewing problems in many aspects.

# Future directions

We have integrated Natural science and Social science( in part).

Our needs for STEM are changing so rapidly.

We feel that we should integrate engineering and computer science. AI and robotics.

Math education seems to be a harder task! (not only for non STEM students but also to medical or biology-oriented students)